1ST CAMBODIAN NATIONAL MEDICAL LABORATORY QUALITY CONFERENCE

QUALITY LABORATORY DIAGNOSTIC SERVICES FOR HEALTHCARE

June 11-12, 2019

Phnom Penh Hotel

Phnom Penh, Cambodia

PROGRAM BOOKLET

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OPENING REMARKS

Professor ENG HUOT

SECRETARY OF STATE FOR HEALTH

MINISTRY OF HEALTH

Professor Eng Huot was born in 1947 in the District of Bakan in the Province of Pursat. He was a Doctor in medicine, studied at the Faculty of Medicine, Phnom Penh. From 1980, he became lecturer on Gynecology and Obstetric at Faculty of Medicine, Phnom Penh. He was Director of the 17 April Hospital (presently, Kossamak Hospital) from 1983 to 1990, then Director of National Center for Maternal and Child Health from 1990 and after became Director General for Health of the Ministry of Health from 1997 to 2003. After about two decades as lecturer, he became Professor of Gynecology and Obstetric of the Faculty of Medicine of the University of Health Sciences, Phnom Penh from 1998.

He was nominated as Project Director of Reproductive Health Project supported by UNFPA from 1994, Project Director of Health Sector Reform from 1998 to 2003, as Project Director of the Health Sector Support Project funded by WB, ADB, UNFPA and DFID from 2003 to 2009, was nominated as Program Director of Second Health Sector Support Program 2009 to 2016, and recently he was nominated as a Project Director of Health Equity and Quality Improvement Project (H-EQIP) 2016-2021 and Health Security Project 2017-2022.

Professor Eng Huot was appointed as Secretary of State for Health from 2004 during the third mandate of Royal Government of Cambodia , and re-appointed as Secretary of State for Health for the fourth mandate (2008-2013), the fifth mandate (2013- 2018) and the six mandate (2018-2023) of the Royal Government of Cambodia.

H.E Dr. HOK KIM CHENG

DIRECTOR GENERAL FOR HEALTH

MINISTRY OF HEALTH

Dr Hok Kimcheng was born on January 29th, 1969 in Kandal Province. He worked almost 25 years for making a different of blood service in Cambodia by improving infrastructures; dedicated in introducing QMS into Blood Service in Cambodia.

He is Medical Doctor graduated from University of Health Science, Phnom Penh, Cambodian in 1994. From 1999 to 2011, He continued his postgraduate studies in Medical Biology at University of Health Science of Cambodia and at Teaching Hospital (CHU Bretenau) in France.

Dr. Kimcheng was promoted to be Director of National Blood Transfusion Center of Ministry in 2011. In January 2019, Dr Kimcheng was prompted to be Director General for Health, Ministry of Health. Dr. Kimcheng contributes actively in promotion and mobilization of people in community to donate blood. He used local blood donation perception as a principal tool for develops concept note and material for education of youth based on Behavior Change Communication.

In 2016, he cooperates closely with youth's network (UYFC) for developing the club of blood donor its Application (software) for promote voluntary blood donation.

Dr. Kimcheng is also a team leader of Blood Safety working Group and Vice chief of Sub-Technical Working Group for Blood Safety and Laboratory. He contributes to improve Blood Safety and Laboratories in Cambodia from his knowledge and good leadership.

WELCOME MESSAGE

Dr. SAU SOKUNNA

DEPUTY DIRECTOR OF HOSPITAL SERVICE, MINISTRY OF HEALTH

On behalf of the National Medical Microbiological Laboratory Network in Cambodia (NMMLNC). I would like to express my gratitude for the participation and presence of all national and international participants. This conference is part of the efforts by NMMLNC, Ministry of Health, and collaboration with laboratory partners namely WHO, I-TECH, DMDM, Foundation Mérieux in Cambodia, with participation from key delegation speakers from Lao PDR, Myanmar, Thailand and Singapore to work together in forging the strengthening of the laboratory network in human and animal sectors and explore opportunities for coordination and collaboration to identify priorities and implementation of the "Quality Diagnostic Services for Healthcare" research capabilities and platform for preparedness of emergent and re-emergent infectious diseases in the public health in Cambodia. These are crucial elements for laboratory technicians and practicing doctors in order to provide correct diagnosis and effective treatment as well as to contribute to minimize the risk of infections and contamination for improved human and animal health and safer environment. Strengthening laboratory safety and quality including proper packaging and transportation of clinical specimens, risk management both inside the laboratory and in the outside environment, are indispensable to ensure accurate, reliable and trustworthy test result has become a focus at the regional and global levels.

We are honored by the attendance of experts from multiple disciplines to exchange knowledge and experience in the prevention and control of infectious diseases, especially among Asian members to share research progress on major circulating pathogens and laboratory capacity surveillance support in the process to implement and infection prevention, identification of root causes and risk prevention with a focus on continued improvement, quality accreditation in the context of global health and what Cambodia needs to achieve in the future.

The aim of this conference is to build mutually valuable and lasting connections, not only among scientists of health laboratory networks, but also with experts in other fields who can facilitate our work. We gathered the foremost academicians, clinicians, public health professionals, health workers and other related professionals who have been doing substantial work in national health facilities, especially the key partners to provide and share on the current situation and challenges ahead.

Finally, on behalf of the NMMLNC. I would like to thank again to WHO, DMDP, I-TECH, FM, Professors, Researchers, National and International Distinguished Guests and all speakers from differences countries, and all development partners for your technical and financial support.

We hope this event will spark fruitful collaborations and connections that will benefit the Region for years to come.

With our best wishes,

SAU Sokunna, MD, MSc. Deputy Director of DHS/MoH Cambodia
Country Focal point for Blood Safety and Laboratory Service
Director of National Medical Microbiology Laboratory Network in Cambodia
Director of National Biosafety Committee

ACKNOWLEDGEMENT

1st Cambodian National Medical Laboratory Quality Conference

"*Quality Laboratory Diagnostic Services for Healthcare*"

June 11-12, 2019

Phnom Penh, Cambodia

The Organizing Committee gratefully acknowledges the generous financial sponsorship and technical support from the following organization and agencies, who have contributed towards the success of this conference.

1. Defense Threat Reduction Agency (DTRA)
2. World Health Organization (WHO)
3. International Training Education Center for Health (I-TECH)
4. Diagnostic Microbiology Development Program (DMDP)
5. Fondation Mérieux (FM)
6. Roche Diagnostics (Thailand) Ltd
7. SYSMEX Asia Pacific PTE LTD

TERM OF REFERENCE

1st Cambodian National Medical Laboratory Quality Conference
"*Quality Laboratory Diagnostic Services for Healthcare*"
June 11-12, 2019
Phnom Penh, Cambodia

Background: Laboratory conferences serve several important functions which include an educational and professional development mission as well as scientific exchange. This first Cambodian national conference on medical laboratory practice aims to increase the value and visibility of diagnostic services that laboratories deliver to the community, physicians, patients, laboratory professional sciences and national policy makers.

Purpose of the conference:

1. Provide a converging point for laboratory practitioners in Cambodia at all levels of service and healthcare delivery. This will provide an opportunity for interface on issues and concerns of common interest, both strategic and operational and as a forum for information exchange, consensus building and coordination of matters that affect the National laboratory landscape like biosafety, biosecurity, surveillance, sample transport, diagnostic efficiency, training and quality management.
2. Convene a forum for continuing education for lab staff to enhance competency in analyzing and communicating public health science.
3. Distribute information on tools and guidance for:
   - Meeting the requirements of the Ministry of Health, and other accrediting organizations
   - Enhancing quality in laboratory processes and procedures through efficiency of laboratory operations.
   - Clinical diagnostics to improve health for the people of Cambodia.

Vision:

Sustainable Quality of Laboratory result in country and Region

Mission:

To advance medical laboratory knowledge and sustainable practices in country and Asian Region.

Goal:

To provide a professional forum that represents the regional interests and needs of Laboratory practitioners and to provide a platform promoting constructive dialogue between the scientific community, governments, civil society, and the private sector.

Desired Outcomes:

- Increased visibility of laboratory services among community, physicians, patients, laboratory professional science and national policy makers.
- Convey the importance of biosafety and laboratory quality management systems to medical laboratories.
- Laboratory data analyzed and analysis skills of laboratory staff improved.

- Communication and presentation skills of laboratory staff is improved.
- Participants learn about quality and diagnostic capacity across Cambodia.
- Laboratory network strengthened.

Intended Audience

- Laboratory professionals working in Cambodia
- Donor organizations
- Technical assistants
- Private companies
- Universities and schools of medical technology.

CONFERENCE ORGANIZING COMMITTEE

BMLS/DHS

Dr. Sau Sokunna (Chairman)
Ph. Uch Monipheap (Secretariat)
Ph. Sam Sopheap
Ph. Ou Kimsan
Ph. Boy Chansopheap
Dr. Chhoeun Visalpagna
Ms. Chao Malin

I-TECH

Dr. Perrone Lucy
Ms. Ndefru Nayah
Dr. Ong Siew Kim
Mr. Song Sophanna
Ms. Leang Chhayheng

WHO

Dr. Milhano Natacha

DMDP

Ms. Letchford Joanne

Scientific Sub-Committee

Dr. Sau Sokunna
Dr. Ong Siew Kim
Dr. Milhano Natacha
Dr. Chou Monidarin
Dr. Hem Sopheak
Mr. Chroeng Sopheap
Ms. Letchford Joanne
Dr. Perrone Lucy
Ms. Ndefru Nayah
Dr. By Youlet
Dr. Sar Borann

Secretariat Office

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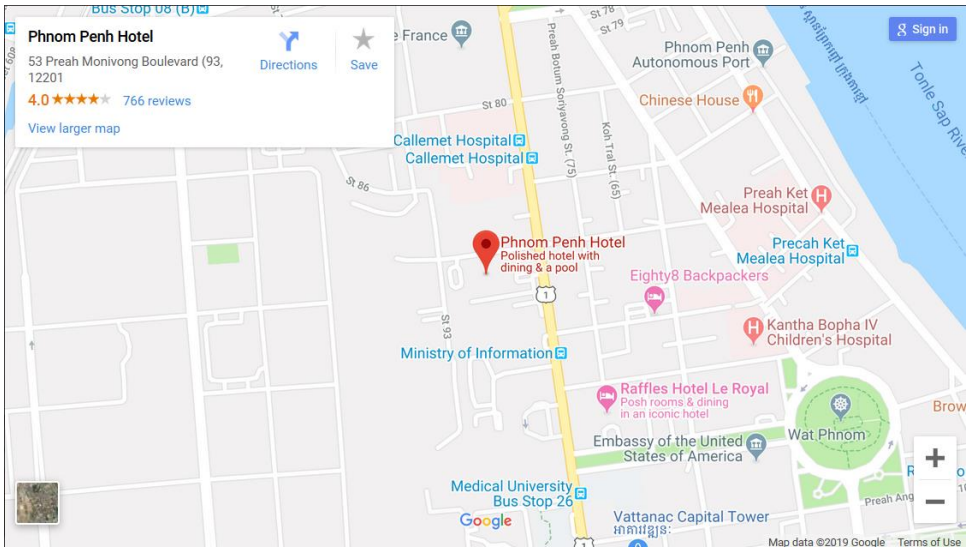
siewkimong@itech-cambodia.org

CONFERENCE INFORMATION

Venue: Phnom Penh Hotel, Phnom Penh Cambodia

Conference and workshop sessions will be held at Phnom Penh Hotel,
No. 53 Monivong boulevard, Sangkat Srah Chak, Phnom Penh, Cambodia
(about 60 minutes from Phnom Penh International Airport)
Website: phnompenhhotel.com
Tel: +855 23 991 868

Venue Map of Phnom Penh Hotel



Visa information

Please check whether you will need a visa to enter Kingdom of Cambodia. The organizer will not reimburse for Visa application or insurance fees to the sponsored participants.

Meals

Lunch and tea break will be available to registered participants during the meeting.

Registration:

Registration for conference starts at 1:00 PM on June 11, 2019 and at 8:00 AM on June 12, 2019.

Name Badge:

All committee members, participants and speakers are kindly requested to wear the name badges as identification during the meeting for admission to the lecture rooms and other scheduled activities including lunch.

Information and Assistance Desk:

For further assistance and additional information, you may proceed to the Secretariat Desk or you may approach any member of the conference organizing committee.

Speakers' Preview Desk:

Speakers may check their presentation slides at the registration table. Only presentations in Power Point format will be accepted. It is preferable that presentations be placed on a USB/flash disc and handed to the registration desk at least one day before presentation.

CONFERENCE WORKSHOP PROGRAM

1st Cambodian National Medical Laboratory Quality Conference
"Quality Laboratory Diagnostic Services for Healthcare"
June 11-12, 2019
Phnom Penh, Cambodia

Tuesday, June 11, 2019

Time	Activity
1300-1400	Conference Registration open Set up: Put-up posters.
1400-1445	Opening Ceremony -National Anthem- 1. Welcome remarks DHS 2. Welcome remarks WHO 3. Welcome remarks ITECH 4. Welcome remarks DMDP 5. Open remarks Ministry of Health, H. E Professor Eng Huot, Secretary of State
1445-1515	Group Picture and Networking (Break)
1515-1600	VIP Visit Poster Booth
1600-1700	Oral presentations – 10 min each OP1: CamLQMS Audit: Experience from Cambodia-China Friendship Preah Kossamak Hospital Laboratory OP2: Strengthening Diagnostic Testing Capacity to Identify Salmonella Isolated from Blood Culture at Takeo Provincial Hospital Laboratory OP3: Evaluating Quality Improvement in Kampong Cham Provincial Referral Hospital Laboratory, 2017-2019 OP4: Bloodstream Infections Detected from Patients Admitted to Battambang Provincial Hospital Between 2014 and 2017 OP5: The Secret of Quality: Diary of a Quality Assurance Officer

Wednesday, June 12, 2019

Time	Activity	Comment
0800-0830	Registration open	
0830-0945	**Theme 1: Laboratory System Governance, Policy, Guidelines** **Speaker 1:** Assessment of the Public Health Laboratory System in Cambodia and way forward **Speaker 2**: Laboratory framework align to IHR and APSED3 **Speaker 3**: Laboratory information management **Speaker 4**: What works for laboratory quality strengthening: An ITECH model	*Dr. SAU Sokunna (Chair)* *Dr. PERRONE Lucy (Co-Chair)* Dr. SAU Sokunna Dr. MILHANO, Natacha Mr. IENG Vanra Dr. PERRONE Lucy
0945-1015	Networking	

1015-1200	**Theme 2: Laboratory Quality & Diagnostics**	*Dr. HEM Sopheak (Chair)* *Ms. LETCHFORD Joanne (Co-Chair)*
	Speaker 1: Should I ask for this test? The implications of pre-test probability in requesting a diagnostic test.	Dr. KHIM Gaetan
	Speaker 2: Managing quality total testing processes	Dr. HORM Sreyviseth
	Speaker 3: Analytical systems: Cambodian scenario	Dr. ONG Siew Kim
	Speaker 4: Safety and Quality improvement in transfusion services	Dr. CHEA Sokhim
	Speaker 5: Pancreatic tuberculosis	Dr. BORY Sotharith
1200-1330	Networking	
1330-1500	**Theme 3: National initiatives on One-Healthcare**	*Dr. SAU Sokunna (Chair)* *Dr. MILHANO Natacha (Co-Chair)*
	Speaker 1: One-Healthcare approach in Cambodia	Dr. TUM Sothyra
	Speaker 2: Increased system capacity to protect against diseases and public health threats through BSCs certification in Cambodia	Dr. SAU Sokunna
	Speaker 3: Prospective on future diagnostic and research	Dr. BY Youlet
	Speaker 4: Laboratory Practices in Singapore	Professor AW Tar Choon
1500-1530	Networking	
1530-1700	**Theme 4: Pre-service development for laboratorian**	*Dr. CHOU Monidarin (Chair)* *Dr. ONG Siew Kim (Co-Chair)*
	Speaker 1: Implementing POCT in a developing country (video call)	Dr. Gerald J. KOST
	Speaker 2: Myanmar	Dr. Hnin Wityi MYINT
	Speaker 3: Thai education program for Medical Technology and Professional Licensing of Medical Technology	Ass. Prof. Yupa URWIJITAROON
	Speaker 4: Cambodia Medical Technology Program	Dr. CHOU Mondarin
1700-1730	Closing ceremony	
1730-1800	Poster take-down	

SPEAKERS

SAU Sokunna, MD, MSc
Deputy Director of DHS/MoH Cambodia
Country Focal point for Blood Safety and Laboratory Service
Director of National Medical Microbiology Laboratory Network in Cambodia
Director of National Biosafety Committee

Dr. Sokunna Sau is the Deputy Director of the Department of Hospital Services at the Ministry of Health in Phnom Penh, Cambodia, responsible for the management of the public health laboratory system in Cambodia. Dr. Sokunna lectures at the University of Health Sciences and is a member of the pharmacovigilance and technical committee within the Ministry of Health. He is also the Secretary of sub technical working group for blood safety and lab services, Director of National Laboratory Biosafety Committee, Director of National Medical Microbiology Laboratory Network in Cambodia. National Laboratory Contact Point in ASEAN Cluster 2, a member of the Asia Pacific Biosafety Association since 2016, and currently member of APBA EXCO team. From 2008 to 2012, Dr Sokunna was program coordinator for the Global Fund Round 6, at the Department of Drug and Food on Rational Use of MTP and Anti Malaria. He is responsible for expanding quality management system as well as biosafety and biosecurity network. He has established national policies on medical laboratory, and national medical laboratory quality standards. Dr Sokunna earned his medical degree from the Faculty of Medicine in Phnom Penh in 1994 and completed a master's degree of science in 2004. From 1995 to 1997, he worked at the referral hospital in Mondulkiri Province.

Assessment of the Public Health Laboratory System in Cambodia

Background: Laboratory services play an essential role in health systems, contributing towards disease surveillance and outbreak response, patient management, research and development, and informing policy. To strengthen laboratory capacity in Cambodia, in line with the Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies and the International Health regulations 2005, baseline assessments were conducted.

Methods: We conducted two baseline assessments of laboratory capacity in Cambodia, the first in 22 national and provincial laboratories in 2013, and the second in 27 provincial laboratories in 2018. An adapted version of the WHO laboratory assessment tool was used, divided into 15 modules: general information, buildings, sampling, biosafety, quality, public health functions, supplies & equipment, budget, data management, tests, staff, training supervision, IT, communication, and gap analysis. On-site visits and in-depth interviews with key laboratory staff were conducted during the assessments.

Results: In 2013, the average score for all 15 modules analyzed in the 22 laboratories assessed was 55%, with the highest score of 78% for diagnostic lab capacity, and the lowest 29% for Public Health Function module. In 2018 the total average score for the 27 laboratories assessed, for all 15 modules, was 45 %, the highest with 57 %, and the lowest for Public Health Function, scoring 12 %.

Conclusion: The results of the baseline assessments revealed limited knowledge of public health laboratory functions within the IHR framework amongst laboratory staff, as laboratory services are mainly perceived as a diagnostic service delivery unit for patient care. Factors contributing to this gap include limited understanding of roles and responsibilities in each laboratory, limited recognition of

priority diseases, and limited linkages between independent laboratory networks, hospitals and public health laboratories. To overcome these gaps, implementation of the national laboratory policy and strategic plan need to be enhanced.

Increased system capacity to protect against diseases and public health threats through BSCs certification in Cambodia

Background: In 2011, the Ministry of Health (MoH) in Cambodia implemented a national biosafety program contemplating, among other modules, biosafety cabinet (BSC) certification. BSCs serve as a means to protect laboratory personnel and the surrounding environment from pathogens. Given the increasing number of BSCs in the country, currently at 72 in number, and lack of human resources to certify these, MoH liaised with the National Biosafety Committee and international partners to develop in-country BSC certification capacity.

Methods: Two Cambodian technicians from the U.S. Naval Medical Research Unit 2 (U.S. NAMRU2) were selected to undergo training for repair, maintenance, and certification of BSCs at Eagleson Institute, Sanford, Maine, USA in 2013 and 2015, as part of the Strengthening Laboratory Capacity Program (SLCP) of the US Centers for Disease Control and Prevention—Thai Ministry of Public Health Collaboration (TUC). The initial training program was mentored by an accredited NSF 49 certifier, who accompanied the trainees on quarterly BSC certifications.

Results: By the end of 2016, both technicians had completed all requirements for NSF accredited class II Biosafety cabinet field certifiers. They followed NSF/ American National Standard Institute 49-2016 Biosafety Cabinetry including design, construction, performance and field certification modules, and one has since successfully passed the NSF Basic examination, in Singapore for Certification of Class II type A2 BSCs.

Conclusion: As a result of the in-country BSC certification capacity building effort, two in-country BSC certifiers are now qualified and responsible for the yearly certification of the 72 BSC distributed around the country. In order to overcome the gap in human resources for BSC certification, MoH is supporting the roll-out of further training of future BSC certifiers, with an additional four trainees currently undergoing training. They are estimated to complete their NSF examination by the end of September 2019.

MILHANO Natacha, PhD
Technical Officer for Laboratories
World Health Organization Health Emergencies Programme (WHE),
Cambodia WHO Country Office

Natacha Milhano has worked with WHE in Cambodia since 2017, supporting the Ministry of Health and partners in strengthening national public health laboratory capacity for emerging diseases in line with the Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies (APSEDIII) and International Health Regulations (2005). Her main focus has been strengthening capacity in terms of biosafety and biosecurity, laboratory quality management system, diagnostic capacity and partner coordination, among others. Natacha Milhano holds a PhD in Vector Borne Diseases from the University of Evora, Portugal, an MSc Forensic Science from King's College London, UK, and a BSc in Biochemistry from the University of Lisbon, Portugal.

Laboratory framework align to IHR and APSED3

The Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies (APSED III) provides a common framework for action in the Asia Pacific region for strengthening core capacities required under the International Health Regulations (2005). There are eight focus areas included in APSED III, each with projected outcomes and strategic actions, aiming for national and local capacity building, regional preparedness, surveillance, risk assessment and response systems, and integration of national, regional and global monitoring and evaluation systems. While focusing on essential public health functions, APSED III allows flexibility for implementation by Member States according to country context and national priorities.

In Cambodia, the Ministry of Health developed the Cambodian National Work Plan for Implementation of International Health Regulations (IHR) Minimum Core Capacities and Asia Pacific Strategy for Emerging Diseases (APSED) Priority Areas, 2012-2014, followed by the National Work Plan 2014-2016. Cambodia was the first country in the Western Pacific Region to voluntarily conduct a self-evaluation of IHR core capacities using the Joint External Evaluation JEE tool, the recommendations of which were included in the current National action plan, 2016-2020, reviewed on a yearly basis.

In the technical area of laboratories, divided into National laboratory system and biosafety and biosecurity, priority areas were identified during the JEE and have since driven the Ministry of Health's work towards achieving IHR core capacities. Major achievements include the development of national documents for laboratory, such as a policy and strategy, biosafety guidelines and a biosafety curriculum and roll-out to laboratory staff; a laboratory quality checklist tool for audits, a national laboratory information system, currently installed in 35 national and provincial laboratories, Improvement of facilities to ensure physical containment of dangerous pathogens and storage of pathogens, to mention a few.

IENG Vanra, MSc
Technical Officer (Information Systems)
Emerging Disease, Surveillance and Response (ESR)
Office of the WHO Representative in Cambodia

IENG Vanra, Information Systems and Surveillance Technical officer for WHO Health Emergencies Programme (WHE) unit at World Health Organization in Cambodia since 2006.

He has joined WHE team in Cambodia in early 2006 and has supported to Ministry of Health on strengthening surveillance system. Since then, he has developed several applications and databases for public health officer including Cambodia Early Warning and Response Network database (CamEWARN), data reporting tool by using SMS (Short Message Service) technology, Influenza Like Illness, Severe Acute Respiratory Illness web based, and other databases to support outbreak investigation team. Since 2012, he has developed a laboratory information system (CamLIS) and installed it to 35 laboratories in the country. He is also responsible for outbreak detection, investigation and response. He assists outbreak investigation team in data analysis and report writing.

CamLIS: A national web-based laboratory information system to enhance public health in Cambodia

Health information is used by policy-makers, planners, health care providers, development partners and the general public to track health system performance, support better health policies and make effective health-related decisions.

Laboratory information system is still a major issue in the Asia Pacific Region including Cambodia. In 2011, WHO supported Ministry of Health to develop the Cambodia Laboratory Information System (CamLIS) database in collaboration with partners and laboratory experts. This database allows all laboratory personnel to enter their laboratory data and perform analysis as required. Similarly, data from each laboratory is sent to a database center via internet connection, allowing other key personnel in the Ministry of Health to analyze and monitor data.

CamLIS was first piloted in the laboratory of National Pediatric Hospital in Phnom Penh in 2011 and rolled to 35 laboratories until now. Additionally, CamLIS has been linked to Patient Management and Registration System (PMRS) since 2015, with technical assistance from University Research in Cambodia (URC). This web-based application has several features and functions allowing users to timely analyze data as tables, graphs, and maps.

CamLIS is a great system which is bringing standardized patient results, history and laboratory data, quickly generated reports accessible on computer and physician's mobile phones, improvement of laboratory practices, supporting Antimicrobial Resistance Surveillance and detection of nosocomial outbreaks.

There are still challenges to work on such as limited internet connection and equipment, lack of specialized human resources and incomplete data collection, which the Ministry of Health is aware.

WHO and partners are committed to continue working with MoH to enhance the implementation of the system to further increase the efficiency of laboratory services as well as the management and reporting of data for surveillance purposes.

PERRONE Lucy, MSPH, PhD
Cambodia Laboratory QI Project Director
International Training & Education Center for Health (I-TECH)
Assistant Professor, Department of Global Health, School of Public Health
Adjunct Assistant Professor, Department of Laboratory Medicine, School of Medicine
University of Washington, Seattle, WA

Dr. Lucy Perrone is currently an Assistant Professor of Global Health and Laboratory Medicine and is the Director of Laboratory Systems Strengthening at the International Training and Education Center for Health (I-TECH) at the University of Washington in Seattle, Washington, USA. Dr. Perrone leads a diverse international team of 20 professional staff and leads a portfolio of grants and contracts totalling ~$3.5 million USD annually. Dr. Perrone has worked in over 20 countries globally and has diverse work experience from private industry (vaccines), to government (US CDC), to UN Agencies such as the WHO and most recently academia.

What works for laboratory quality strengthening: An I-TECH model

Training and mentoring programs to improve laboratory quality management systems (LQMS) in resource-limited countries have been shown to be one effective intervention to improve the capacity of medical laboratories to meet international standards of quality such as ISO 15189. The International Training and Education Center for Health's (I-TECH) Laboratory Systems Strengthening Program works with Ministries of Health in multiple countries to strengthen laboratory policies, strategic frameworks and plans, and build workforce capacity to meet the healthcare needs of the nation. I-TECH takes a multifaceted approach to capacity development, built on close partnerships with Ministries of Health and other relevant national agencies and partners. Workforce development efforts focus on both pre-service and in-service cadres and with a particular emphasis on laboratory managers to improve operational management and organizational leadership. This presentation will review some of I-TECH's global projects to date and present proven methods to improve laboratory quality and capacity.

KHIM Gaëtan, MD
Clinical Mentor
Diagnostic Microbiology Development Program (DMDP)

Dr. Khim Gaetan has graduated from the University of Health Sciences (UHS) with a Medical degree in Internal Medicine in 2013. Dr. Gaetan has worked for 3 years in the private sector working as a clinician in the OPD, IPD and ICU. He then joined Diagnostic Microbiology Development Program (DMDP) in 2016 and worked alongside Dr. Frances Daily in bridging the microbiology laboratory with the physicians and providing support in diagnosis and management of infectious diseases. The work extended to giving interactive lectures and simulation at the UHS to 4th-6th year student in the "International program" or IP. Dr. Gaetan currently works in Siem Reap and Battambang referral hospitals where DMDP is giving support to hospitals in doing point prevalence surveys (PPS) in antimicrobial consumptions to help guide quality improvement in prescribing.

Should I ask for this test? The implications of pre-test probability in requesting a diagnostic test.

Laboratory testing is an important tool and can remove some uncertainty for patient diagnosis and management. A laboratory test can be requested for two reasons: ruling in a clinically suspected disease or ruling out a disease which is unlikely to cause a problem. Whether a test is used one way, or another is guided by its sensitivity (ruling out a condition) and specificity (ruling in a condition). The clinical suspicion is raised after consideration of local epidemiology, a thorough history and physical examination, which guides what tests should be requested and is defined as the pre-test probability. This is particularly important for serology tests, which may be variably useful according to the disease prevalence. The systematic request of microbiology specimen on hospital admission and before provision of antibiotics can also help shape our understanding of local bacterial pathogens and resistance patterns. Quality of specimen collection is another important factor in ensuring the laboratory produces a valid result. The majority of laboratory errors occur during the pre-analytical phase, at the clinician and nursing level. Physicians should have a general understanding of microbiology principles and laboratory processes to ensure specimen requests are appropriate and ensure correct interpretation and action of the result. Unnecessary diagnostic testing or incorrect interpretation may also lead to over-diagnosis of conditions, which in turn could lead to patient not receiving appropriate therapy or unnecessary treatment and adverse effect for the patient.

ONG Siew Kim, MAACB, FAACB, MBA, PBT(ASCPi), EdD
Project Coordinator
International Training and Education Center for Health (I-TECH), University of Washington, Seattle
Cambodia Team

Siew Kim has worked with I-TECH and partners since 2017, supporting Ministry of Health, Cambodia to strengthen laboratory quality in national laboratories. Her work involves laboratory quality improvement and laboratory management via on-site workshops and telecommunications toward ISO15189 accreditation. Siew Kim has worked with College of American Pathologist accreditation and Singapore Accreditation Council on ISO15189. She is a certified clinical biochemist FAACB and phlebotomist PBT(ASCPi). She has taught at Curtin University, (Singapore) and Central Queensland University (Singapore). Her diagnostic laboratory career of 25 years focused her as Chair, Singapore Advisory Board, American Society of Clinical Pathology International to conduct continue medical education training. Ong Siew Kim graduated with a Doctor in Education from Durham University, United Kingdom, Master of Business Administration, LaTrobe University, Australia and Master of Science, University of Melbourne, Australia.

Analytical systems: Cambodian scenario

In the traditional laboratory process, analytical phase contributed to the least overall total error toward laboratory results. Yet, it seems to occupy most part of a medical technologist working hours. Analytical systems are many and varied. Choice of an analyzer would be based on needs of the clinical and laboratory specifications. Discussion would be based on supply chain and adherence to standards. Reference would be made to the 12 quality system essentials using the Cambodia laboratory management system (CamLQMS) checklist that is referenced to ISO 15189 standards for medical laboratories. Analytical processes include documentation of reagents lots changes, calibration frequency, internal quality control monitoring, external quality assessment, staff training, re-training and competency, instrumentation verification and traceability. These parameters are varied with different analytical systems. Correlation experiments between different analyzers for the same tests are required for medical decision. It could be problematic because of the use of reagents to conduct such experiments and time taken. Laboratory needs to minimize activities that are pertinent in laboratories using different analyzers for the same tests. This scenario of multi-platform systems drains the laboratory resources that is in addition to providing an avenue for analytical errors.

CHEA Sokhim, MD, MSc
Deputy Director of the National Blood Transfusion Centre, Ministry of Health, Cambodia

Dr. CHEA Sokhim is currently a Deputy Director of the National Blood Transfusion Centre, Ministry of Health and is a Deputy Director of Department of International Coordination, Ministry of Health from 1997 to 2014. He has worked with many institutions such as PATH International Organization (I-NGO) Partner with Ministry of Health, National Immunization Program, URC-CAP-Malaria, Partner with Ministry of Health, National Malaria Program, GAVI-HSS/HSSP2, Ministry of Health's Project, CNM/Malaria Program, Ministry of Health. He was graduated from University of Health Sciences, Phnom Penh, Cambodia, and continued his study to many countries such as Philippines, Singapore, JAPAN, USA and Australia. He is also as assistant authors and author of 16 significant developments and publications for using in blood transfusion service such as Policy of National Blood Transfusion Service 2018-2020, Strategies of National Blood Transfusion Service 2018-2020, Quality Manual of National Blood Transfusion Service 2019 and so on.

The safety and quality improvement in National Blood Transfusion Service

Objectives: To guide national blood transfusion services both public and private sector in implementation and maintenance of an effective quality management system (QMS) will greatly contribute to the achievement of this goal. To be fully effective, safety and quality improvement and QMS should incorporate risk-based thinking in all aspects of the vein-to-vein transfusion process and include quality monitoring, which is carefully planned, continuous and properly evaluated.

Methodology: This study focusing at three main blood transfusion centre (National Blood Transfusion Centre (NBTC)2 Provincial Blood Transfusion Centre (Kampong Cham, Siem Reap) and discusses several aspects of quality monitoring and risk management including their role, the importance thereof, objectives and implementation strategies. Quality monitoring is elaborated in detail with regard to quality indicators and quality control of blood components.

Results: National blood transfusion service (NBTS) has a strong desire to improve safety and quality in public health and has identified safe and quality of blood and its products for transfusion as an essential component of comprehensive health care system. The quality manual (2), facilities and safety(3), training procedure(4), other procedures(5) for blood transfusion service and national guideline for transfusion practice(6) were developed in response to the safety and quality in transfusion of blood and its products.

Conclusion: The National Blood Transfusion Service will meet the expectations of its customers and the community by consistently providing safe, quality and effective blood and its products and services. The safety both the blood donor and recipient are of utmost importance to the Ministry of Health and the National Blood Transfusion Centre. Secure government commitment to support and promote for the national blood safety programme(7).

Note:
(1) According to article 4 of national blood transfusion system policy (2014– 2018)
(2) Quality Manual for National Blood Transfusion Service 2019\
(3) Facility and Safety Manual for Blood Transfusion Centre 2019
(4) Training Procedure for Blood Transfusion Service 2019
(5) Standard of Procedures for Blood Transfusion Service 2019
(6)National Guideline for Transfusion Practice 2019
(7) Sustainability of safety and quality improvement in national blood transfusion service is required sufficiency of resources in order to maintain an effective quality management system.

BORY Sotharith, MD
Internist-Infectious Diseases Physician,
Head of Medicine A Department,
Head of Infectious Diseases Unit,
CALMETTE Hospital

Dr. Bory Sotharith graduated from University of Health Sciences of Cambodia in 2007 for the General Medicine then continue for the specialist of Internal Medicine and graduated in 2010 from the same University. He continued his study in France where he completed his courses and received a diploma of DFMS (Specialize Medical Formation Diploma) in Internal Medicine in 2012 from University of Limoges, France Republic. At the same time, he achieved his formation and received an certificate of clinical formation from Infectious Diseases and Tropical Medicine Department at the Hospital- University of Limoges, France in 2012. In 2013, He was appointed to be an Infectious Diseases Physician at Calmette Hospital and since that time, he involved in many research and surveillance with other international researchers to conduct many research in the hospital and also the country and the main topic of his research career is Melioidosis. In 2015, He was chosen to be Chief of Medicine A4 unit and also Head of Infectious Diseases Unit at Calmette Hospital. In 2016, He was promoted to be Chief of General Medicine A department and also stand the same for the Infectious Diseases as a Head of the Unit. In 2016, he was accepted to be a member of International Melioidosis Society and become a national trainer to give the courses related to this disease for the doctors around the country in the name of Ministry of Health. Beside working at the Hospital, Dr. BORY Sotharith is also one of the lecturer for the Internal Medicine and the Infectious Diseases at the Faculty of Medicine, University of Health Sciences.

Pancreatic Tuberculosis

A 47 year old man with no significant past medical history presented with abdominal discomfort, intermittent hemoptysis and unintentional10kg weight loss. Physical exam on admission revealed a palpable epigastric mass, with no appreciable lymphadenopathy. Initial labs were remarkable for a total bilirubin of 23 mg/dL, direct bilirubin 20 mg/dL, lipase 280 U/l and mild transaminitis. On CXR, patient had a right apical opacity with multiple pulmonary nodules (Panel A). Contrast- enhanced computed tomography (CT) of the abdomen showed 58 x 74 x 91mm heterogeneous mass with microcalcifications in the head of the pancreas (Panel B, C). Patient underwent laparotomy with lymph node sampling showing multiple caseating granulomas (Panel D). Sputum stain was positive for acid-fast bacilli and subsequent polymerase chain-reaction assay confirmed the presence of Mycobacterium tuberculosis. The patient was started on treatment with ethambutol, rifampin, pyrazinamide, and isoniazid. On follow up, the patient's symptoms have improved and the pancreatic mass has decreased significantly in size. Pancreatic tuberculosis is a rare manifestation, which can occur in isolation or with disseminated disease. Symptoms are often nonspecific and clinical presentation may mimic pancreatic malignancy.

TUM Sothyra, PhD
Director of National Animal Health and Production Research Institute,
General Directorate of Animal Health and Production

Dr. TUM graduated with Bachelor Degree in Veterinary Sciences, then undertook a M.Sc. program at James Cook University (JCU), Queensland, Australia on the application of geographic information systems (GIS) for the control of fasciolosis in the Kingdom of Cambodia; and a Ph.D. program at Murdoch University, Western Australia on epidemiology and economic studies to support the establishment of a progressive zoning approach for the control of foot and mouth disease in the Mekong Basin. He has involved in a number of national animal disease control programs including foot and mouth disease (FMD), highly pathogenic avian influenza (HPAI) and fasciolosis. He also involves in various studies such as risk (AMR) profile of E. coli, salmonella and staphylococcus aureus in beef, pork and poultry meat from slaughterhouses and markets, and investigating the risk of human disease from parasites of small mammals and bats. He is now Director of the National Animal Health and Production Research Institute (NAHPRI), General Directorate of Animal Health and Production (GDAHP), Phnom Penh, Cambodia.

One Health Approach in Cambodia

One Health approach in Cambodia has been recognised as the results of highly pathogenic avian influenza (HPAI) control and a strong multi-disciplinary coordination team called Zoonotic Technical Working Group (Z-TWG) (formerly Avian Influenza Technical Working Group) has been established to provide sound recommendations and advices to policy makers. Other working groups including Antimicrobial Resistance Technical Working Group (AMR-TWG) and Food Safety Technical Working Group (FS-TWG) have also been established to cope with the rising of foodborne hazards and AMR. A number of strategies, policies, guidelines and action plans which benefit the animal, environment and human health sectors have been initiated and guided by these groups.

BY Youlet, PharmD, MSc, PhD
Cambodia Manager, Fondation Mérieux

Dr. By is currently manager and country representative of Fondation Mérieux in Cambodia. He's also conducting researches and medical trainings for the University of Health Sciences in Phnom Penh. Dr. By has experiences in laboratory diagnostic and biomedical research for more than ten years. He had been working as laboratory medical practitioner over 7 years at a public hospital in France (Assistant Public Hôpitaux de Marseille, APHM) and as Research Assistant and Lecturer at the Faculty of Medicine of Aix-Marseille University in France, before appointed to work for Fondation Mérieux in Cambodia since 2013. At Fondation Mérieux, Dr. By manages and operates supporting projects including the strengthening of capacity building for public clinical laboratories and for laboratory professionals through Cambodian medical laboratory network in collaboration with the Ministry of Health of Cambodia. Dr. By graduated from the Aix-Marseille University in France by holding a Master and PhD degree in Human Genetic. He also graduated from the University of Health Sciences in Cambodia as Pharmacist Doctor Specialized in Medical Biology (DES). He was a fellow at London School of Hygiene and Tropical Medicine, UK for a Master program in Public Health.

Abstract title: Prospective on future diagnostic and research.

Over the last ten years, Cambodia has a great improvement in public laboratory diagnostic through Cambodian Laboratory Network action plan and commitment. It is amazing to see how medical diagnostic and research have progressed. However, many gaps still need to be filled. More programs for capacity building including infrastructure and human resources need to be implemented in order to allow population getting access to diagnostic and more over to insure the diagnostic quality and the efficacy of patients' care. We are going to present the current situation of diagnostic and research capacity in medical laboratory in the country and try to foresee the future need, progress and challenges.

AW Tar-Choon, MBBS, MMed (Int Medicine), MRCP, FRCPE, FRCPA, FAMS, MPP
Department of Laboratory Medicine, Changi General Hospital, Singapore

Dr. Aw completed medical studies at the University of Malaya in Malaysia. After a residency in internal medicine at Singapore General Hospital, he obtained specialist certifications in Internal Medicine from the National University of Singapore (NUS) and the Royal College of Physicians UK. In addition, he is certified in Chemical Pathology by the Royal College of Pathologists of Australasia. He was in the inaugural batch of the Masters in Public Policy program from the NUS Lee Kuan Yew School of Public Policy. Currently, he is Director (Chemical Pathology) at Changi General Hospital Singapore and Clinical Senior Lecturer (Medicine) at NUS. At NUS (1980-2006) he was Professor (Pathology) and Vice-Dean of the medical school. He was Chief (Laboratory Medicine) of the National University Hospital (NUH) and Medical Director of Alexandra Hospital (AH) Singapore. NUH and AH were the first two hospital labs in Asia-Pacific to be accredited by the College of American Pathologists in 1994 and 1998. He was Professor (Chemical Pathology) at Monash University Medical School (Malaysia campus) and Hon. Professor (Medicine) at its Australia campus (2006-2011). He was a member of the MOH Medical Laboratory Board and chaired the Singapore Accreditation Council Committee on Medical Laboratory Testing. He has published widely (166 original reports, 433 abstracts), delivered 345 lectures in 25 countries, and received distinguished awards. He is on the editorial boards of several journals including Nature Scientific Reports. His research interests are immunoassays, cardiac biomarkers (troponin, BNP, Galactin3), lab management (POCT, accreditation, LEAN), endocrine disorders (thyroid disease, diabetes), cancer biomarkers (HE4, circulating tumor cells), and laboratory management and healthcare management

LABORATORY PRACTICE IN SINGAPORE

Healthcare provision in Singapore

Through the Ministry of Health (MOH), the Government manages the public healthcare system to ensure that quality and affordable basic medical services are available to all Singaporeans. Financing schemes (subsidies, Medisave savings and insurance) ensure affordability of healthcare. Safety nets ensure that no Singaporean is denied access to healthcare because of financial difficulty. There is ongoing investment in healthcare facilities, manpower and information infrastructure to enhance accessibility across the continuum of care. MOH encourages individuals to adopt a healthy lifestyle and to take charge of their own health through the Health Promotion Board (HPB). HPB also promotes healthy ageing, integrated health screening, and chronic disease education and management. HPB's programs include nutrition, mental health, physical activity, tobacco control, and communicable disease education. The Health Sciences Authority (HSA) is a multidisciplinary scientific and regulatory agency for drugs, innovative therapeutics, medical devices and health-related products, ensuring they are well-regulated to high standards of safety, quality and efficacy. HSA also serves as the national blood service for public and private hospitals. It is also provides national expertise in forensic medicine, forensic science and analytical chemistry testing to serve the administration of justice and safeguard public health.

Singapore's public healthcare establishments provide a full range of services covering primary care at polyclinics to secondary and tertiary care at hospitals through nine acute hospitals, one psychiatric hospital, three community hospitals and twenty polyclinics. These are organized in 3 clusters each

associated with a medical school. The public sector provides 80% of inpatient care. In the private sector there are 8 acute hospitals, 4 community hospitals and 2102 GP clinics. The private sector provides 80% of outpatient care. MOH regulates the range and type of services provided by all healthcare organizations through its licensing and accreditation unit. Inspections are carried out every 2 years.

Laboratory Services in Singapore

All public acute hospitals have their own full service 24 hour laboratories in histopathology, microbiology, hematology and biochemistry. For low volume and more complex tests they are referred to the tertiary hospitals in each cluster. The organization of laboratory services at Changi Hospital is fairly representative of what happens in the public sector in Singapore. In our cluster Singapore General serves as the tertiary center. At Changi Hospital we perform 5 million tests annually; 80% of which is Biochemistry, 10% Hematology. 8% microbiology and 2% histopathology. Laboratory specialists complete a 5-year training program in their chosen specialty and are certified by the UK or Australian Pathology Colleges. Entry-level medical technologists are trained for 3 years in biomedical science at five local polytechnics after high school. Some biomedical science graduates from the University are also employed as medical technologists. We use the Cobas8000 total lab automation (TLA) system supplemented by the Abbott Architect i2000 for some immunoassays. All lab tests are ordered through the computerised physician order entry system. Phlebotomy is provided by nurses, medical students, doctors and lab staff. Samples are transported to the lab via pneumatic tubes. Samples are processed as soon as they are received and loaded onto the TLA. Most of the routine tests results are auto-verified and transmitted directly into the electronic medical records. For the commonly needed tests results are available within 60 mins in 90% of cases. We are accredited by the College of American Pathologists (CAP) since 2007 and we subscribe to the CAP external quality assurance program. Point of care testing (POCT) for glucose is done in the wards and clinics while POCT blood gases and electrolytes are carried out in the emergency department, operating theatre and intensive care units.

KOST GERALD, MD, PHD, MA, FAACC
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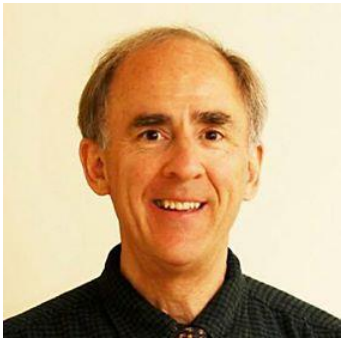
Emeritus Professor, Pathology and Laboratory Medicine
School of Medicine, University of California, Davis
Visiting Faculty, Siriraj Hospital, Mahidol University, Bangkok, Thailand
Fulbright Scholar, Chulalongkorn University, Bangkok, 2003-04



Dr. Kost studied Engineering at Stanford University and in Venezuela, then received the Master's degree in Engineering-Economic Systems (EEP) from Stanford prior to entering the Medical Scientist MD-PhD program at the University of California. He received his PhD in Bioengineering (NIH Traineeship) from UC San Diego and his MD from UC San Francisco in a Medical Scientist program. He was elected to Mu Alpha Theta (mathematics), Phi Kappa Phi (scholarship), and Sigma Xi (science) honor societies. His clinical residency comprised Internal Medicine/Neurology at UCLA and Laboratory Medicine at the University of Washington, Seattle. He is boarded in Clinical Pathology (ABP), was elected to the National Academy of Clinical Biochemistry (NACB, AACC Academy), served on its Board of Directors, and is licensed to practice medicine in California. For over three decades, he was Director of POCT/Clinical Chemistry for UC Davis Health. In 1995, he founded the POCT•CTRTM, and in 2016, the POC Institute. He held an Edward A. Dickson Endowed Emeritus Professor Award in the Department of Pathology and Laboratory Medicine, School of Medicine. A Founding Father of the medical field known as point-of-care testing (POCT), he has invented numerous additional signature concepts, including therapeutic turnaround time, the hybrid laboratory, the spatial care pathTM, and point-of-care culture. POCT is diagnostic testing at or near the site of care. By helping to implement POCT worldwide, he has moved rapid diagnostics and evidence-based treatment directly to points of need in the home, primary care, ambulances, emergency rooms, critical care units, and hospitals. Now ubiquitous, POCT is helping to stop epidemic outbreaks and to facilitate disaster preparedness, thereby improving medical and economic outcomes.

Dr. Kost's seminal books codified the fundamental principles for this new field—*Handbook of Clinical Automation, Robotics, and Optimization* (Wiley); *Principles and Practice of Point-of-Care Testing* (LWW); and *Global Point of Care: Strategies for Disasters, Emergencies, and Public Health Resilience* (AACC Press-Elsevier). He was a founding editorial board member of the journal, *Point of Care,* and serves on several other editorial boards. His recent chapters in *A Practical Guide to Global Point-of-Care Testing* (CSIRO, Australia) address the rapid detection of Ebola virus disease and other highly infectious threats and disaster resilience. He has received over 200 honors, awards, grants, speaking invitations, keynotes, and leadership positions worldwide and has been highlighted in approximately 20 Who's Who editions. He is the recipient of the Marquis Who's Who Worldwide Lifetime Achievement Award. His career total of published creative works exceeds 800.

While a Fulbright Scholar (2003-04) in demography/medicine/economics at Chulalongkorn University in Thailand, he helped implement POCT throughout the ASEAN member states, as well as India, Japan, South Korea, and China. He has designed a complete curriculum for teaching the principles and practice of POCT (see https://doi.org/10.3389/fpubh.2018.00385). He was Principal Investigator/

Director of the UC Davis POC Technologies Center (2007-14) funded by the NIBIB at NIH. In 2015 and 2016, he received Outstanding Speaker Awards from the American Association for Clinical Chemistry, and in 2016, the AACC (NorCal) Award for *Outstanding Contributions to Clinical Chemistry through Science and Technology* recognizing "outstanding work in POCT, including recent work with Ebola testing and disaster readiness." He contributes to NIH, National Academy of Sciences, and U.S. GAO expert panels. His recent global outreach encompasses Affiliate Faculty at Chulalongkorn University and Visiting Professor at Siriraj Hospital, Mahidol University in Bangkok; invited keynoter in Riyadh, Saudi Arabia; educational tours in Vietnam (Ho Chi Minh City, Hue, Hanoi); an International Symposium he organized at Hue University; presentations in Munich, Germany; and several contributions to WorldLab 2017, South Africa, as an inaugural member of the International Federation of Clinical Chemistry and Laboratory Medicine POCT Task Force. He is President and CEO of Knowledge Optimization® in Davis, California. An avid trumpet player, he performed recently in Carnegie Hall, New York City.

Implementing Point-of-Care Testing in a Limited-Resource Country

This presentation provides an overview of why, how, when, and where to implement point-of-care testing (POCT) in a developing country.

For background, please see Kost GJ, et al. "Critical Care and Point-of-Care Testing in Cambodia and Vietnam. Point of Care. 2006;5(4):193-198, which reports results of field surveys that determined needs for rapid response diagnostic testing. At that time, we concluded, "In Cambodia, point-of-care testing was rudimentary or absent, and evidence-based diagnosis was deficient in community hospitals and rural areas. Cambodia must invest heavily, particularly to provide blood gas testing for critical care and ventilatory management, and in preventative medicine, treatment of infectious diseases, and other compelling areas."

Today's learning objectives are: a) to understand the importance of needs assessment surveys; b) to identify clinician goals for rapid response, test clusters, and disease management using POCT; c) to describe a framework for quality assurance, reduction of errors, and oversight by the POCT Coordinator, who now can receive professional certification by the American Association for Clinical Chemistry (see https://www.aacc.org/education-and-career/aacc-certification/point-of-care-testing-professional-certification); d) to highlight suitable implementation models, such as small-world networks, geographic information systems, surveillance-ring vaccination preparedness, cultural safety, a quality "toolkit" for POC operators, and educational curricula (see https://www.frontiersin.org/articles/10.3389/fpubh.2018.00385/full, open access; e) to recognize national POCT policy and guidelines (Malaysia, Thailand); and f) to prepare for emergencies, outbreaks (e.g., Ebola virus disease), and disasters.

For the global viewpoint, please see Kost GJ, Curtis CM, Eds. *Global Point of Care: Strategies for Disasters, Emergencies, and Public Health Resilience* (https://www.aacc.org/store/books/9200/global-point-of-care-strategies-for-disasters-emergencies-and-public-health-resilience) and Shephard M, Ed. *A Practical Guide to Global Point-of-Care Testing* (https://www.publish.csiro.au/book/7500). In the latter, see Kost GJ, "POCT for Ebola and other highly infectious threats: principles, practice, and strategies for stopping outbreaks." pages 291-305. POCT is growing exponentially worldwide and has a bright future for advancing emergency preparedness and standards of care in Cambodia.

URWIJITAROON Yupa

President of The Medical Technology Council, Thailand

Yupa is a president of Medical Technology Council Thailand. Furthermore, she was a dean of faculty of Medical Technology, Khon Kaen University from 2000 until 2004. From 1984 to 1998 she was a Director of Blood Transfusion Centre, Faculty of Medicine, Khon Kaen University. Her major interests are Blood Transfusion with strong Academic experience. She has been trained Blood Transfusion Service at Auckland Blood Transfusion Centre in New Zealand. In 1983, she achieved certification in Medical Laboratory Tutor from Royal Free Hospital in London. Yupa is going to give a presentation entitled " Thai education program for Medical Technology and Professional Licensing of Medical Technology" at 1st Cambodian National Medical Laboratory Quality Conference.

Education and Professional Licensing for Medical Technologist in Thailand

The education of Medical Technology in Thailand was first established since the founded of the Faculty of Medical Technology, University of Medicine (now: Mahidol University) in 1957 as diploma level at Siriraj and Chulalongkorn Hospitals. The diploma curriculum was extended to 4-year program for Bachelor of Sciences in Medical technology (BSc. in Medical Technology) since 1960. At the present, there are 10 government and 4 private universities offer BSc. program In Medical Technology.

Due to insufficient supply of Medical Technologist for clinical laboratories in the past, one year certificate program laboratory assistance was also established in the Faculty of Medical Technology Mahidol University in 1968 and later was upgraded to be two year program. Because of high demand of medical laboratory personnel throughout the country. Laboratory assistance program was expanded in Schools of Medicine, Schools of Medical Technology and Public Health Academic institutes. However, laboratory assistance program was gradually discontinued in the universities and the last in 2014 at the Institute of Medical and Public Health Technology.

According to the Practice of The Medical Technology ACT B.E. 2547 (2004), the institutes and core curriculum for medical technology education have to be accredited by the Board of Medical Technology Council. Graduate Medical Technologist from accredited institute has to pass the licensure exam for registration to be a practitioner of the medical technology from the Medical Technology Council. They also need license renewal every five years by accumulated score of continuing education.

More detailed information about curriculum and the role of Medical Technology Council will be presented.

CHOU Monidarin, PharmD, PhD
Director of Rodolphe Mérieux Laboratory
Vice-dean of Faculty of Pharmacy
University of Health Sciences

Dr Monidarin Chou, PharmD, PhD, is the Director of the Rodolphe Mérieux Laboratory of Cambodia and Vice dean of Faculty of Pharmacy at the University of Health Sciences. He graduated his pharmacist doctor from the University of Health Sciences, Cambodia, and graduate his PhD in Pharmacokinetic and genetic from University of Paris XI, France and also got a diploma of health professional education form UP Manila, Philippine. He is coordinator for master degree of medical biology at University of Health Sciences, Cambodia. Moreover, he actively participates in the strengthening of laboratory quality in the laboratory network and also active member of working group on Antimicrobial Resistance of the Ministry of Health. He also participated in development many programs for training of laboratory personnel including pre and in-service training and form associate to master degree. Collaboration network at the national and international, he interest study and has more than internal 20 peer review publication in particular in characterization of pathogens in environment, animal and link to human pathogen, on acute respiratory pathogen, enteric pathogen, antibiotic resistant and influence CYP450 polymorphism on variability of concentration ARV drug in plasma in therapeutic monitoring.

Cambodia Medical Technology training Program

The laboratory technicians are trained in different curricula depending on the level of skills and responsibility during their work, such as a National curriculum of associate degree of laboratory Technician had been develop since the year 1980 and review and enforced by the Joint Declaration of the Ministry of Health and the Ministry of Education, Youth and Sport in 2016.

The purpose of the curriculum is to train students to become a laboratory technician with a good knowledge, skills and attitude in order to be able to provide a basic laboratory technique that can be trusted and accepted in accordance with the health strategies. The duration of this study program is three years with a total of credits of 112 equivalent to a total of 3150 hours including a final internship. Beside this program, there are many other program had been also developed training people to work in the clinical laboratory such as, Pharmacy, Medicine, Diploma Specialize in Medical Biology which had been transferred to Master of Medical Biology and bridging program of Bachelor degree of Laboratory Technic continue form Associate degree.

ORAL PRESENTATION

OP1: CamLQMS Audit: Experience from Cambodia-China Friendship Preah Kossamak Hospital Laboratory

Chroeng Sopheap[1]*; Yin Chanpirak[1]; Sroeun Malin[1]; Pin Sorphorn[1]; Khum Ravy[1]; Sok Ke[1]; Ho Yang[1]; Yi Putheary[1]; Sum Sarorn[1]; Song Sophanna[2]; Ong SiewKim[2]; Sau Sokunna[3]

*presenting author
[1]Cambodia-China Friendship Preah Kossamak Hospital (CCFPKH) Laboratory, Phnom Penh; [2]International Training and Education Center for Health (I-TECH), Cambodia; [3]Bureau of Medical Laboratory service (BMLS), Ministry of Health, Cambodia.

Background: Auditing is an important task for medical laboratories to measure the status of their laboratory quality management system (LQMS) and complying with accuracy, timeliness, safety and reliability of services. This study used the Cambodia LQMS (CamLQMS) auditing checklist that is based on ISO 15189 to audit the CCFPKH laboratory.

Methods: The external audit was conducted on X date. From March 2018 to March 2019, the lab focused on gaps identified from the audit and focused on laboratory improvement in X QSE's. During this time the lab developed the quality manual, a document control log, and trained staff to write standard operating procedure (Section 1); prepared Management Review, presented to the hospital management and followed up on the recommendations (Section 2), updated roles and responsibilities of the laboratory organization and management (Section 3); developed and promoted laboratory handbook and monitored/feedback on client complaints (Section 4); monitored and documented installation, maintenance records of equipment and conducted new analyzer verification (Section 5); planned and conducted internal audits (Section 6); planned diagnostic consumption, reviewed supply requests/inventory and supplier performance (Section 7); prepared workflow, developed sample reception, rejection and registration criteria, and monitored internal quality control performance (Section 8); developed system for method verification (Section 9); trained staff to identify non-conformities, made corrective actions and documented (Section 10); monitored quality indicators, periodically reviewed occurrences and developed improvement plan (Section 11); updated biosafety manual and conducted staff training (Section 12).

Results: The final audit showed improvement changes that ranged from 7-93% in all sections except Section 9 that decreased 11% compared to baseline score that could be explained via moderation process of the laboratory information system. The average summary scores showed an increase from 43% (Level 1) to 79% (Level 4) over 1.25 years of LQMS training.

Conclusion: Implementation of LQMS has been successful through staff engagement on continuous improvement of quality to reach commendable Level 4 from last score of Level 1.

OP2: Strengthening Diagnostic Testing Capacity to Identify Salmonella Isolated from Blood Culture at Takeo Provincial Hospital Laboratory.

Chak Chanthou[1]*; Seang Sosorphea[1]; Morn Sineang[2]; Letchford Joanne[2]

*presenting author
[1]Takeo Provincial Hospital Laboratory; [2]Diagnostic Microbiology Development Program, Phnom Penh, Cambodia

Background: Microbiology testing was initiated in 2011 at the Takeo Provincial Hospital Laboratory. With the goal of improving evidence-based treatment for patients and improve the understanding of the bacterial causes of infection in patients. The goal of this study was to improve the lab's capacity identify *Salmonella* species and provide more timely reporting to clinicians and notification to the MoH for surveillance efforts.

Methods: This work focused on capacity building of the microbiology unit staff at the Takeo Provincial Hospital Laboratory to enable presumptive identification of *Salmonella* species by;

- Reviewing laboratory documents, including a flowchart developed by DMDP, Standard Operating Procedures and Job aids.
- Implementing sustainable, affordable methods using media from the Central Media Making Laboratory located at UHS.
- Improving recording on worksheets.
- Implementing standardized Laboratory Information System (LIS) reporting to ensure immediate notification.
- Confirmation testing by the National Public Health Laboratory (NPHL) and Naval American Research Unit 2 (NAMRU2).
- Blood culture was the most common specimen collected.

Results: During the period January to April 2019, 794 blood cultures were submitted by hospital wards for testing. Of the 51 true blood stream infections the majority were *Salmonella* (30). From January to April 2019, 30 isolates identified in the lab as presumptive *Salmonella* (6 *Salmonella typhi* and 24 *Salmonella paratyphi*). These were subsequently sent to NPHL and NAMRU-2 labs for confirmation and no result discrepancies were found, indicating a 100% accuracy of detection.

Conclusion: Presumptive identification of *Salmonella* by the Takeo Provincial Hospital laboratory matched result confirmation by NPHL and NAMRU-2. Presumptive identification allowed correct immediate reporting and timely notification.

OP3: Evaluating Quality Improvement in Kampong Cham Provincial Referral Hospital Laboratory, 2017-2019

Heng Chanvisal[1*]; Nhem Somary[1]; By Borady[1]; Yin Sinath[1]; Sau Sokunna[2]; Ong Siewkim[3]; Song Sophanna[3]

[*] Presenting author
[1]Kampong Cham Provincial Referral Hospital (KCPRH); [2]Bureau of Medical Laboratory Service (BMLS), Ministry of Health (MoH); [3]International Training and Education Center for Health (I-TECH), Cambodia

Background: From June 2017 to June 2019, BMLS and I-TECH supported a laboratory quality improvement program in KCPRH Laboratory to improve the laboratory quality management system (LQMS) in order to generate accurate, and reliable result in timely manner. This study evaluates the quality improvement of KCPRH Laboratory during baseline and final external audit.

Methods: Several methods and activities supported by BMLS and implemented by I-TECH are helping KCPRH Laboratory manager, staffs, and organization to enhance laboratory quality to meet accreditation standards by using Cambodia LQMS (CamLQMS) checklist. In addition, there were nine(9) on-site training courses, five(5) on-site monitoring, twenty(20) weekly remote training by using Zoom call technology and leadership training for laboratory key officers (laboratory managers, quality officer, safety officer, stock officer, and equipment officer). LQMS principles and knowledge from I-TECH mentors was utilized to support staffs to implement quality in our laboratory, with weekly and monthly meeting to follow up the activities and improvement results. Quality improvement was evaluated by two external audits: January 11-12, 2018 (baseline) and March 21-22, 2019 (final).

Result: Table of baseline and final data of external audit in KCPRH Laboratory

Quality System Essentials	% Baseline	% Final	% Improvement = (Final-Baseline)/Baseline*100
Section 1	50	64	28
Section 2	7	71	**914**
Section 3	45	82	82
Section 4	90	90	0
Section 5	71	82	15
Section 6	47	100	11
Section 7	88	92	4.5
Section 8	72	88	22
Section 9	90	87	-3
Section 10	58	58	0
Section 11	17	75	34
Section 12	86	88	2
Total	**65**	**82**	**17**

The table above shows progress in 9 sections out of 12 sections of the CamLQMS checklist. Notable improvements were made in section 1 (28%), section 2 (91%), section 3 (82%) and section 11 (34%). Gaps still exist in quality improvement . Section 4, section 9, and section 10 had no progress. These weak points are because of limitation of staff competency in recording, reporting, and documenting.

Conclusion: KCPRH Laboratory has made progress on improving quality as all staffs were engaged to CamLQMS principle, follow I-TECH mentoring and consultation, and support from BMLS. Training is still the key practice to maintain staff technical competency and to improve their reporting and documenting competency.

OP4: Bloodstream Infections Detected from Patients Admitted to Battambang Provincial Hospital Between 2014 and 2017

Hem Sreypeou[1]*; Chiek Sivhour[1]; Letchford Joanne[2]

*presenting author
[1]Microbiology Unit, Battambang Provincial Referral Hospital; [2]Diagnostic Microbiology Development Program (DMDP), Cambodia

Background: Bloodstream infection (BSI) is a life-threatening medical condition. Since opening in 2011, the microbiology unit in Battambang Provincial Referral Hospital (BPRH) Laboratory has been working with laboratory strengthening partners and the Ministry of Health to build diagnostic capacity. This retrospective study aimed to evaluate blood stream infection data detected in hospitalized patients with the goal to understand.

Methods: A retrospective review of the microbiology unit database was conducted from January 1, 2014 through December 31, 2017. BPRH and other private clinic patients were included. standard operating procedures in BPRH Laboratory were used for isolation, identification and antibiotic susceptibility testing (AST).

Results: Of 1,988 blood cultures collected, 157 (8%) were positive with 119 (6%) true positive and 38 (2%) deemed 'contaminated'. The most common blood cultures pathogens isolated were *Escherichia coli* 37 (31%), *Staphylococcus aureus* 18 (15%), *Klebsiella pneumoniae* 13 (11%), *Burkholderia pseudomallei* 13 (11%) and *Salmonella spp* 5 (4%). We detected methicillin resistant *Staphylococcus aureus* (6), carbapenemase producing *Escherichia coli* (0) and *Klebsiella pneumoniae* (0). Extended-spectrum beta lactamases *Escherichia coli* (21) and *Klebsiella pneumonia* (10) detected by key hold and confirmation test by comparing Caftazidime and Caftazidime/Clavulanic acid, Cefotaxime and Cefotaxime/ clavulanic acid grater or equal 5mm. Fluoroquinolone resistant *Salmonella* (2).

Conclusion: In order to understand AMR in these pathogens it is best to classify BSI as community-acquired (CA) or healthcare associated (HA) infections. A limitation of our study is the lack of patient data indicating CA or HA infection, previous clinic or self-treatment with antibiotics before patients were admitted. Expanding standard patient data records and improved appropriate and timely collection of blood cultures is required to better understand resistance data. Patient results contribute to improved patient care and Infection Prevention and Control in the facility.

OP5: The Secret of Quality: Diary of a Quality Assurance Officer

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Background: CCFPKH laboratory quality manual and Cambodia Laboratory Quality Management System (CamLQMS) checklist stipulate that the quality assurance officer (QAO) is pivoted to implementation of laboratory quality management system (LQMS). The key functions of QAO are assessment of good laboratory practices (GLP), training of personnel, review of quality year plan, seeking advice from clinical authorities, adhering to internal audit program, monitoring and ensuring compliance to standards and QMS training. This study aims to disclose the daily activities and responsibilities of QAO at CCFPKH Laboratory.

Methods: Documentation of CCFPKH QAO activities started on Jan 1, 2018 till March 17, 2019 = 441-day diary. During this duration, 284 were working days. Review of the diary-written activities separated into seven(7) category of LQMS tasks performed.

Results: From January 2018-March 2019, QAO spent a total of equivalent 199/284 days (70%) on LQMS improvement activities: a) Assessment of workflow, reviewing and updating SOPs and monitoring daily quality controls performance=56/199 days (28%); b) Joined 11 workshops conducted by development partners and Ministry of Health, and sharing of knowledge to staff =33/199 days (17%); c) Conducted weekly laboratory quality meetings=8.5/199 days (4%); d) Trained hospital ward staff on specimen collection=8.5/199 days (4%); e) Conducted internal audits and analysis=6/199 days (3%); f) Daily and monthly quality indicators monitoring=48/199 days (24%); g) Conducted staff training on LQMS and documenting non-conformity/occurrence reports= 39/199 days (20%).

Conclusion: CCFPKH QAO spent 70% of working time on monitoring quality on compliance to standards and ensuring GLP. That is the secret of elevating CCFPKH Laboratory CamLQMS achievement from Level 1 to Level 4 within 1.25 years of LQMS commitment.

POSTER

PP1: Strengthening the Microbiology Unit in Kampong Cham Provincial Referral Hospital Laboratory by Using Blood Culture Data Analysis as a Quality Indicator.

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Background: Kampong Cham Provincial Referral Hospital (KCPRH) has 260-beds and the hospital laboratory provides various diagnostic testing services including bacterial culture testing in the microbiology laboratory. In this study, specimens were collected from patients suspected of bacterial infection for blood culture. Data analysis of these samples included a study of the pathogen, antibiotic susceptibility, and contamination rates. The goal of this study was to evaluate common blood pathogens and their resistance patterns and to strengthen blood culture requesting from clinicians for quality improvement efforts.

Methods: We conducted a retrospective study and analyzed blood culture data including AST results from 2015 to 2018 microbiology activity reports (MAR) and the Cambodia Laboratory Information System (CamLIS). Indicators for quality improvement were selected and monitored for developing action plans.

Results: Among 3695 blood cultures collected from 2015-2018, we found 477(12.9%) were positive, 237(6.4%) were true positives and 240(6.5%) were contaminants. Common pathogens isolated were *Klebsiella pneumoniae* 43(18%), *Escherichia coli* 31(13%), *Staphylococcus aureus* 26(11%), *Burkholderia pseudomallei* 23(9.7%), *Acinetobacter* 30(12.6%) and *Salmonella* 12(5%). Extended spectrum β-lactamase (ESBL) were detected in *Klebsiella pneumoniae* 26/43(60%) and *Escherichia coli* 19/31(61%). Carbapenemase producing *Escherichia coli* and *Klebsiella pneumoniae* were not isolated. We detected 9/26(35%) Methicillin Resistant *Staphylococcus aureu*s (MRSA). Blood culture contamination rates during the period 2015-2017 were 7.7%, 6.1% in 2018 and 4.8% in the first quarter of 2019.

Conclusion: Strengthening laboratory quality improvement at KCPRH contributed to awareness of pathogens *(K. pneumoniae, E. coli, Acinetobacter*, *B. pseudomallei, S. aureus)* and their resistance patterns in KCPRH which potentially improved infection prevention and control. After a quality improvement action plan was implemented on specimen collection, blood culture contamination declined.

PP2: Method Verification of Glucose and Creatinine on Dimension XL (Siemens) at Cambodia-China Friendship Preah Kossamak Hospital Laboratory

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Background: The appropriate operation of equipment provides effective accuracy, reliability and turnaround time of test results. The verification of new analyzers minimizes total error of laboratory measurements. We report the verification of glucose and creatinine tests on DimensionXL.

Methods: We studied the following parameters: a) Accuracy, on 15 patient samples and results from DimensionXL (Siemens) were compared to current HumaStar analyzer; b) precision, performed by using control materials: RandoxN, RandoxP and pooled patient specimen, analyzed three times a day for five consecutive days. Inter-day mean, Sd and %CV were calculated; c) lowest detection limit, performed on five different lowest concentrations of known-diluted patient sera with saline; d) reportable range, performed in triplicate on five samples with concentration obtained mixing low with high concentration samples and establishing linearity; e) carry-over, performed by alternating between blank and high concentration samples.

Results: a) Accuracy experiment showed creatinine correlation graph as DimensionXL=1.083 HumaStar + 0.066 and R^2=0.982; Glucose correlation graph as DimensionXL=0.999 HumaStar200 + 2.394 and R^2=0.998;
b) Precision (%CV) on glucose at mean 100mg/dL, 259 mg/dL and 131mg/dL are 1.19%, 1.24% and 0.2% respectively; on creatinine mean 1.35mg/dL, 4.28mg/dL and 3.25mg/dL are 4.26%, 1.39% and 3.25% respectively. Both glucose and creatinine precision are less than the expected 5 CV%.
c) Lowest detection limit on DimensionXL detection was glucose=6mg/dL compared with manufacturer limit 0mg/dL; creatinine=0.2 mg/dL compared with manufacturer limit= 0.1mg/dL;
d) Reportable range for glucose is linear at 47-486mg/dL (y=0.9994x+10.213); creatinine is at 0.15-12.56mg/dL (y=0.9982x-0.0504).

Conclusion: DimensionXL is precise and accurate with no detectable carryover. All selected parameters of the verification were within expected criteria.

PP3: Study Tour- the elements of success

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Background: Study tour activities are beneficial to knowledge seekers. It is bound by budget, achievement of knowledge/skills and conducted at specific times. The design knowledge-seeking participants selection, immediate outcomes and identified new knowledge. The process starts with pre-tour preparation, logistics planning and implementation of a guide towards the learning journey. We report a study tour of laboratory personnel learning from ISO15189 laboratories in Singapore.

Methods: Budget management is selecting low-season air-flight and affordable standard hotel. Seeking laboratories with ISO15189 accreditation started 6-month early with emails stating objectives from Cambodia laboratory quality management system (CamLQMS) checklist. Participants were selected, and agreed to submit their objectives of learning and written reports on the tour. Pre-study tour preparation were conducted via telecommunication meetings.

Results: On July 31-August 3, 2018, 13 participants: three(3) Ministry of Health staff, two(2) hospital directors, four(4) laboratory managers, three(3) I-TECH staffs and one(1) consultant visited a small-sized laboratory, three laboratories that serviced 1000-bed capacity, a large private laboratory, a diagnostic site and attended a laboratory medicine conference. Our logistics covered pre-post laboratory visits and group meals. Anecdotal reporting of a tour-group banner left on the plane as group disembarked at Singapore airport, and on Day 1, one participant overslept of due to time difference. Travel was via public transportation and taxi-cab. Each laboratory visit started with host briefing. During the tour, participants had to achieve their own objectives by asking the host questions, taking observation notes and request for documents compliance with ISO15189.

Conclusion: All participants submitted study tour reports with implementation plans. Evidence of implementation was noted during the CamLQMS (March-May 2019) laboratory audit. Indeed, study tour encourages learning via global perspectives, networking, building confidence and appreciating laboratory quality. Accomplishing objectives and within budget are the success elements of the study tour.

PP4: Laboratory Quality Improvement in Preah Ang Duong National Hospital

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Background: The concept of laboratory quality management is relatively new among most public laboratory staff in Cambodia. As a result, the national strategic plan of the Ministry of Health includes strengthening medical laboratory capacity especially public laboratories in Cambodia. The laboratory of Preah Ang Duong National Hospital (PAH) participated in quality improvement initiatives to develop their quality management system. An improved Quality system supports effective diagnosis for medical management, patient safety and disease surveillance. This study evaluates the improvement of quality management system (QMS) by focusing on the laboratory activities between year 2015 and 2016 in the Laboratory at PAH.

Methods: This study analyzed the national laboratory quality management data collection from 2013 to 2015. All data were aggregated, and database field formats were standardized using the WHO laboratory assessment tool (LAT) quality specifications to evaluate the improvement of quality in laboratory. Four steps were mentioned for standardized technique of analysis using LAT: 1) focuses on the primary process of operation correctly and safely in the laboratory, 2) control and assures quality and creates traceability, 3) follows by ensuring proper management, leadership and organization, and 4) finally is to create continuous improvement and prepare for accreditation.

Results: A total of 465 step-by-step activities, integrated quality laboratory services have performed this assessment with baseline overall scores of 36% and have completed overall scores 58% in the laboratory at PAH.
By divided in four phases, where activities for each phase achieves 85% of phase 1, 69% of phase 2, 57% of phase 3, and 20% of phase 4 activities. 22% can be seen in General Indicator Score which describes the level of improvement from the baseline.

Conclusion: There were a lot of improvements in laboratory capacity at PAH base on baseline assessment 2013 to assessment 2016. However, laboratory need to understand more on implemented, management and policy to improve the service.

PP5: Auditor trainee practicum: what did I learn?

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Background: I-TECH trained twelve (12) auditor trainees. Training consisted of four (4) theory lessons via telecommunication and one (1) practicum that trainee would be paired with an audit team that was conducting the laboratory quality management system (LQMS) audit. This report summarized my practicum at KTR Hospital, a CPA2-level hospital defined by clinical services.

Methods: The audit team met with the KTR Hospital Director and laboratory manager at 8.30am. We explained our objective to audit the using Cambodia LQMS (CamLQMS) checklist and would share our findings when the audit was completed. At the laboratory, we met the staff and we explained our auditing procedure using the 12 Sections quality system essentials of CamLQMS checklist that have 117 questions with total score of 275. Summary scores would be designated from the lowest Level 1 to highest Level 6.

Results: In addition to the 117 questions, the audit team had to ask several other supporting sub-questions to solicit the correct answers. The laboratory staff received its first LQMS training and laboratory manager was trained on "Quality Manual". Hence, were no differential roles such as for quality assurance or equipment or stock or biosafety officer. No standard operating procedures except for some job aids pasted on the bench wall. The higher scoring sections were information management (Section 9=55%) and purchase and inventory (Section 7 score=50%). Sections 2 (management review), 3 (evaluation and audits), 10 (corrective actions) and 11 (occurrence management and process improvement) had zero (0) scores. External quality assessment was not available to KTR laboratory. The total score was 21% (Level 1)

Conclusion: Practicum at KTR hospital laboratory allowed me to ask sub-questions to clarify on the CamLQMS requirement. The low score reflects the lack of LQMS training that would be beneficial to staff on laboratory quality continual improvement.

PP6: Correlation study of Complete Blood Count Analyzers in Kampong Cham Provincial Referral Hospital Laboratory

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Background: Kampong Cham Provincial Referral Hospital (KCPRH) Laboratory is equipped with 2 analyzers for complete blood count (CBC) test: Sysmex-KX-21 and Sysmex-XP-100 to analyze 100 specimen/day. This study evaluated the correlation between these two analyzers.

Methods: We performed the correlation study for five(5) critical parameters: WBC, RBC, HGB, HCT, and PLT. Twenty random patient specimens were selected to be tested by current Sysmex KX-21 and new Sysmex XP-100. Data were analyzed in Excel for CV% (intra-day data patient patients; inter-day data internal quality controls), R^2 and Linear Regression. Acceptable verification criteria for R^2 >0.95; Imprecision WBC 8%, RBC 2.5%, HGB 2.0%, HCT 2.2%, PLT 9.9% < 5%; Slope 0.95 – 1.05

Result: Correlation data of parameters WBC, RBC, HGB, HCT and PLT with R2 and CV% are tabulated as shown (Table 1). All 5 parameters were within acceptable criteria.

Table 1: Results of the verification study of comparing Sysmex-KX-21 and Sysmex-XP-100

Parameters	CV% (mean)		R^2	Sysmex-XP-100 = (a)Sysmex-KX-21 + (b)	
	Intra-day	Inter-day (Range)		Slope (a)	Intercept (b)
WBC	1.9	2.0-3.2	0.9994	0.98	0.12
RBC	2.4	0.8-1.0	0.9964	0.95	0.07
HGB	0.9	1.3-2.1	0.9984	0.98	0.32
HCT	0.9	1.4-1.5	0.9966	0.93	0.37
PLT	4.6	2.7-7.1	0.9948	1.01	6.34

Conclusion: Sysmex-KX-21 is precise and accurate for routine CBC test.

PP7: Blood Culture Contamination and Quality Improvement in Siem Reap Provincial Referral Hospital Laboratory 2018

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Background: Bloodstream infections are severe diseases characterized by high morbidity and mortality throughout the world, including Cambodia, so blood culture is a critical test for diagnosing bloodstream infections. In Siem Reap Provincial Referral Hospital (SRPRH) Cambodia, blood cultures have been collected since the laboratory opened in July 2014. Microbial contamination during sampling and testing may lead to overuse of antimicrobial agents. We used cumulative blood culture data including the volume of blood collected to evaluate and implement methods for improved pathogen detection and reduced contamination.

Methods: We analyzed blood cultures collected at SRPRH during 2018. We evaluated 6 quality indicators: Total number of blood culture bottles, Total number of blood culture patient requests, Total blood stream infections (True positive/Clinically Significant Organisms)-deduplicated, % True positive blood culture, Total blood culture bottles growing a contaminant, % of Contamination rate (Total number of blood culture bottles containing skin contaminants divided by total number of blood culture bottles). Correct blood culture volume were set at: neonate 0.5-1ml per bottle, children 2-5ml per bottle and adult 8-12ml per bottle. We assigned three categories for blood volume: too high, too low and correct level. Training was provided for interns and nurses responsible for blood sampling and transportation of specimens, and the blood culture data was analyzed by month.

Results: 4139 blood culture bottles were collected in 2018 with 2064 blood culture patient requests. 196 blood stream infections were detected (9.5 % true positive rate). Contaminants were detected in 85 blood culture bottles (2.1% contamination rate). 8% of bottles were categorized having blood volume too low, too high blood culture volume in 1% of bottles and correct blood culture volume achieved in 91% of collections.

Conclusion: The evaluation of blood cultures in 2018 showed that collection staff achieved the desired blood volume.in 91% of blood culture collections. The contamination rate, 2.1%, is acceptable at less than the international target of 3%. To improve evaluation, we monitored individual wards monthly to implement blood culture collection training when required. It is important to continue to monitor indicators and detect areas for quality improvement in blood culture processing and reporting.

PP8: Successes and Challenges Of Cumulative Antibiogram Development In Cambodian Provincial Hospitals

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Background: A cumulative antibiogram (CA) is a summary of pathogens and their susceptibility to antimicrobials. CA can be used to inform clinical decision making and contribute to antimicrobial stewardship and infection control programs but are rarely available in low resource settings. In collaboration with the Cambodian Bureau of Medical Laboratory Services (BMLS), Diagnostic Microbiology Development Program (DMDP) has strengthened laboratory capacity of provincial hospitals in Battambang, Kampong Cham, Siem Reap, and Takeo with implementation of Clinical Laboratory Standards Institute (CLSI) M100 and M02 for disc diffusion antibiotic susceptibility testing (AST) in 2014.

Methods: Data were collected from four provincial sites through Monthly Activity Reports (MAR) which were systematically reviewed, revised and analyzed with government scientists. Subsequently, annual cumulative antibiograms were prepared. Here we present blood culture data from 2014-2017.

Results: Significant resistance patterns were detected in *Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus, Streptococcus pneumoniae, Acinetobacter spp. and Salmonella spp*. Prevalence of *Burkholderia pseudomallei* and its consistent susceptibility pattern was confirmed for this important endemic pathogen. Successes include isolation and detection of important blood pathogens and implementation of the international standard CLSI for AST. Laboratories continue to need diagnostic supply support and technical mentoring to provide reliable pathogen identification and quality AST results.

Conclusion: Limitations include lack of systematic specimen and patient data collection which may limit utility for informing treatment guidelines. Clinical and laboratory strengthening should continue in Cambodian hospitals to provide reliable patient and microbiology data. Addressing these challenges will expand capacity to undertake high quality AST throughout Cambodia for reliable national surveillance.

PP9: Monitoring and Improvement of Antibiotic Susceptibility Testing errors on worksheets and Cambodia Laboratory Information System (CamLIS) at Cambodian Government Microbiology Laboratories Supported by Diagnostic Microbiology Development Program (DMDP)

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Background: Reliable and accurate AST result reporting is critical for patient treatment and surveillance. The Diagnostic Microbiology Development Program (DMDP) strengthens microbiology laboratories in resource-poor countries. In 2018 we began to monitor AST errors recorded on laboratory worksheets and entered into CamLIS at several provincial and national government microbiology laboratories. Using the DMDP AST Guideline, based on CLSI M100 28th ed., laboratory staff choose antibiotics for testing according to pathogen, interpret zone diameters, and should report the results appropriately including cascade or selective reporting to clinicians. To improve Antibiotic Susceptibility Testing (AST) interpretation and reporting by review of laboratory worksheets and entries into Cambodia Laboratory Information System (CamLIS) for blood and CSF cultures.

Methods: From January through March, 2018, DMDP laboratory mentors reviewed AST errors on worksheets and CamLIS reports for blood and CSF cultures at four DMDP-supported provincial diagnostic laboratories. We calculated the % AST error rate and classified the most common errors. We provided feedback to staff and assisted with troubleshooting and corrective action.

Results: Of 1580 blood and CSF cultures (range 209 to 565 per hospital), 193 (12.2%) were positive. AST errors were detected in 15.5% of positive results. Errors were procedural (20), transcription (7), and incorrect category interpretation (3). 22 of 30 errors were in CamLIS entries. The laboratory receiving most specimens had 9 reports with AST errors from 69 positive reports; the other laboratories had 5, 6 and 10 reports with AST errors. Laboratory staff were advised to amend the reports and document corrective actions. Amended reports were sent to clinicians.

Conclusion: To improve performance, we recommended designating a second staff member to review and validate results before finalizing. Additional improvement could be achieved by modifying CamLIS to flag missing or unusual results for immediate review.

PP10: Implementation of antibiotic susceptibility testing guidelines for Burkholderia pseudomallei in Cambodian government laboratories

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Background: The Diagnostic Microbiology Development Program (DMDP) strengthen microbiology laboratories in resource-poor countries. In 2014, we developed and implemented Antibiotic Susceptibility Testing (AST) guidelines for *Burkholderia pseudomallei* (*Bps*) in Cambodia, where *Bps* is an important endemic pathogen. To build capacity for accurate and reliable *Bps* identification and AST result reporting for improved patient care and contribute surveillance data for Ministry of Health, Cambodia.

Methods: We implemented a range of activities to enable appropriate testing and reporting of *Bps* including;

- Development of *Bps* AST guidelines adapted from CLSI M100 by consultation with regional *Bps* experts.
- Development of Standard Operating Procedures (SOPs) for isolation, identification and AST of *Bps*.
- Revision of SOPs during the Cambodia Training Event for Awareness of Melioidosis workshop, October 2017
- Development of isolate handling procedures to improve laboratory biosafety and biosecurity
- Implementation of weekly AST IQC and AST competency testing
- On-site mentoring to five DMDP supported laboratories
- Continuous review of laboratory worksheets, patient reports and monthly reports

Results: The SOPs and DMDP AST guidelines for *Bps* have been implemented in five DMDP supported laboratories and are a resource for additional government laboratories. Since 2014, laboratories have consistently reported *Bps* susceptibility to ceftazidime, carbapenems, amoxicillin-clavulanate and trimethoprim-sulfamethoxazole when using zone diameter breakpoints adapted from CLSI M100 performance standards.

Conclusion: Susceptibility patterns observed agree with published regional patterns. Implementation of the SOPs and AST guidelines strengthened laboratories to report appropriate and accurate *Bps* results. Standardization has allowed tracking of prevalence and susceptibility patterns for *Bps* in Cambodia.

PP11: Quality Management System Improvement in Takeo Provincial Hospital Laboratory, Cambodia 2017-2019

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Introduction: International Training and Education Center for Health (I-TECH) had work in Cambodia began in 2013 on a laboratory program focused on building capacity through improved quality assurance and management practices. To improve quality of service point of care in public health in Takeo Provincial Hospital Laboratory

Methods: Use the tool of Cambodia Laboratory Quality Management System (CamLQMS) checklist for accreditation. CamLQMS had 12 sections with 114 questionnaires. Recognition is provided using a 6 levels approach base on audit of laboratory operating procedure, practices and performance.

Result: Base on result of audit conduct in January 2017, we received 51% (Level 1). At this level, laboratory is learning the complexities quality and compliance for clinical laboratories. After 28 months, we had learning and moving out of this phase and into next level 4 (82%) in re-audit in April 2019. Labs focus on building a robust, quality management and workflow to practice at its optimal level.

Conclusion: The results we have achieved now are due to the onsite specific training from I-TECH and the support and encouragement of hospital directors and the efforts of key officials and staff participation. The work as the good team to reach the goal, level 6 in 2021.

PP12: Biosafety progress in Microbiology Laboratories in Cambodia, 2013 to 2018

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Background: Biosafety and biosecurity are fundamental elements in the governance of good laboratory procedures, ensuring not only the appropriate containment of infectious agents but also protecting those agents against deliberate intent to misuse against humans, animals and/or the environment. The Ministry of Health in Cambodia recognizes this, and has worked towards strengthening biosafety in the Cambodian laboratory system. For this, laboratory assessments have been performed on a yearly basis to monitor progress and address gaps. The aim of this study is to describe the progress made throughout the years in terms of laboratory biosafety.

Methods: A baseline assessment was conducted on 22 laboratories in 2013-2014, and subsequent biosafety assessments were yearly performed in 2016 (6 laboratories), 2017 (7 laboratories) and 2018 (10 laboratories). The assessments were conducted throughout two days, with a briefing to the hospital director on day 2. A modified version of the World Health Organization Laboratory Assessment Tool (LAT) was used to assess national and provincial laboratories. The biosafety module was used, composed of 10 indicators with a variable number of questions each.

Results: An overall increase in biosafety was observed throughout the years within each laboratory. The lowest scoring indicators (<50%) in the baseline assessment were availability of procedures, safety training, staff services and equipment disinfection, which remained approximately the same throughout the subsequent years, except in 2018, with only safety training scoring <50%. Availability of personal protective equipment and sterilization were the highest scoring indicators throughout the years.

Conclusion: Even though there has been a general increase in the total biosafety score within each laboratory each year, the lowest indicators have remained fairly constant, which indicates a need to strengthen laboratory biosafety training in those areas. Frequent laboratory monitoring and engagement of hospital directors should be encouraged.

End of Program Book