Australia-China-Papua New Guinea Pilot Cooperation on Malaria Control Project

Six monthly report

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List of Acronyms and Abbreviations

ACT	Artemisinin-based Combination Therapy
ADFMIDI	Australian Defence Force Malaria and Infectious Disease Institute
AHC	Australian High Commission
AUD	Australian Dollars
CHW	Community Health Worker
CPC	China-based Project Coordinator
CPHL	Central Public Health Laboratory
DFA	PNG Department of Foreign Affairs
DFAT	Department of Foreign Affairs and Trade
DNPM	Department of National Planning and Monitoring
ECAMM	External Competence Assessment for Malaria Microscopists
ENB	East New Britain
eNHIS	electronic National Health Information System
EQA	External Quality Assurance
FIND	Foundation of Innovative New Diagnostics
GoA	Government of Australia
GoPNG	Government of Papua New Guinea
GoPRC	Government of People's Republic of China
G6PD	Glucose-6-Phosphate Dehydrogenase
HHISP	Health and HIV Implementation Services Provider
HRP2	Histidine-Rich Protein 2
IDD	Investment Design Document
IMR	(PNG) Institute of Medical Research
JPWG	Joint Project Working Group
LLIN	Long lasting insecticidal nets
M&E	Monitoring and Evaluation
MDA	Mass Drug Administration
MOFCOM	Ministry of Commerce (China)
MTR	Mid Term Review
NCA	National Competence Assessment
NDOH	National Department of Health
NEC	National Executive Council
NHC	National Health Commission
NHIS	National Health Information System
NIPD	National Institute of Parasitic Disease
NMCP	National Malaria Control Program
NMSP	National Malaria Strategic Plan 2014 – 2018
NRL	National Reference Laboratory
NSPI	National Strategic Performance Indicator (for NMSP)
NCD	National Capital District
ODK	Open Data Kit
OR	Operational Research
PCR	Polymerase Chain Reaction
P.f	Plasmodium falciparum
P.m	Plasmodium malariae
P.o	Plasmodium ovale
P.v	Plasmodium vivax
PCR	Polymerase Chain Reaction
PMU	Project Management Unit
PGK	Papua New Guinea Kina
PNG	Papua New Guinea
PO officer	Project Oversight Officer
PPM	Project Partnership Manager
QA	Quality Assurance
RAM	Rotarians Against Malaria
RDT	Rapid Diagnostic Test
RMB	Renminbi (Chinese currency)
SMHS	School of Medicine and Health Sciences (PNG)
SOP	Standard Operating Procedures
STA	Short Term Adviser
TA	Technical Advisor
TB	Tuberculosis
TD	Technical Directors
TES	Therapeutic Efficacy Study
TOR	Terms of Reference
TWG	Technical Working Group
WEHI	Walter and Eliza Hall Institute
WHO	World Health Organization

1. Executive Summary

The Australia-China-Papua New Guinea (PNG) Pilot Cooperation on Malaria Control Project (the project) commenced in January 2016 to improve the quality of malaria diagnosis in PNG through a range of laboratory strengthening and operational research activities, and to pilot effective cooperation between Australia, China and PNG. This report provides an update on the project for the period 1 January to 30 June 2019.

During this period the project disbursed **AUD $737,964.86** (approximately **72 percent** of total budget forecast) to deliver training courses and assessments, operational research, information sessions and supervisory visits by Papua New Guinean, Chinese and Australian project partners, resulting in skills and knowledge transfer to a total of **182 health workers, scientists, and researchers** representing all four regions of PNG.

Under the **laboratory strengthening component** of the project, PNG's Central Public Health Laboratory (CPHL) and its network of provincial and district laboratories are increasing their capacity to provide **quality-assured routine malaria diagnosis** in PNG (microscopy and Rapid Diagnostic Test (RDT)). To enable the decentralised quality assurance program training and supervisory visits are targeting provincial and district level laboratories, and the training-of-trainers for the National Core Group has been organised for August.

Through the project's **operational research** component, the PNG Institute of Medical Research (IMR) continued **longitudinal surveillance** at **four malaria sentinel sites** around PNG. IMR and partners have implemented a number of research activities addressing different aspects of malaria diagnosis at these sites. Data was also generated at the sites on the incidence of RDT-positive febrile cases. Finalising research activities, analysing data and disseminating the results and recommendations is the focus for the entire of 2019. At the request of NDOH, IMR undertook monitoring and evaluation of the mass drug administration implemented by the Guangzhou University of Chinese Medicine at Kiriwina Islands, Milne Bay. The report from this is expected later in 2019.

The project has continued to demonstrate how a three-country government-to-government cooperation approach to address a shared priority can be implemented using a partnership model of management and governance. This report outlines the results achieved through cooperation between the three government partners involved in this project during the reporting period.

Project partners have progressed the Phase 2 project design, as agreed at the Joint Project Working Group (JPWG) meeting in Melbourne in 2018. An independent design team was mobilised to develop a high-quality Options Paper that explored different areas in health security for potential collaboration. The JPWG reviewed the Options Paper in April 2019 and determined the key parameters and objectives of the next phase of trilateral health security collaboration. The JPWG agreed the project should continue to focus on malaria (potentially broadening beyond diagnosis) and look to pilot system strengthening in districts and provinces. In the second half of 2019 the design team will develop a detailed, implementable project design.

Outcomes against project objectives

This is the final year of implementation for the project and at this stage there should be evidence that the project is on the right track and contributing towards the eventual achievement of the project aim. The following are highlights of achievements against the project outcomes during the reporting period.

Objective 1: To increase the quality of malaria diagnosis in the PNG health services

Outcome 1: National and provincial laboratory institutions strengthened

- A total of **60 microscopists** have been certified by the WHO External Competency Assessment (ECA) program through the project (**12 in 2019**). This has improved compliance with the CPHL External Quality Assurance (EQA) program and correct diagnosis through microscopy (from **less than 60 percent in 2013** to **75 percent in the first half of 2019**). Feedback from supervisory visits indicates microscopists have a better understand of the importance of the EQA program and more pride in management and maintenance of the laboratory following participation in ECA. Feedback from ECA indicates microscopists want more regular refresher training to maintain and improve their skills.

Outcome 2: Continuous, systematic monitoring of malaria diagnostic products and services

- Supervisory visits are an important component of the quality assurance program, providing an opportunity to monitor, train and assess provincial and district laboratory staff and facilities. CPHL completed **two supervisory visits** to **eight provincial and district laboratories** in Morobe and Gulf Provinces, including training and assessing **9 microscopists**. The National Core Group (NCG) member from Morobe assisted with the supervisory visit in Morobe.
- CPHL have continued to build the reference malaria slide bank with support from the Chinese QA Technical Advisor (TA). One additional collection was done in East New Britain (ENB), during which 1,000 new blood slides were collected. All of the slides have been processed and catalogued and there are a total of **2,041 blood slides** in the slide bank. These were used to train **13 residents** and **2 registrars** from the Port Moresby General Hospital and to assess **9 malaria microscopists** during supervisory visits in two provinces.
- CPHL has progressed their long-term plan for molecular diagnostics. The project supported one CPHL staff member to develop an Options Paper, which CPHL management considered early in 2019. Based on the decision of CPHL management the project purchased a **qPCR machine**. A Chinese qPCR TA spent one month over June and July 2019 providing training for two CPHL staff in operating the machine and interpreting the results.

Outcome 3: Operational Research generates evidence relevant to diagnosis and treatment policy

- Operational research (OR) is underway at the sentinel sites focused on addressing current challenges to sustaining and enhancing PNG's malaria reduction achievements. **Two new**

OR were initiated in 2019, all other OR is complete and data analysis and report writing is underway. Sentinel Sites (SS) longitudinal data will be presented at the PNG Medical Symposium, and OR results and recommendations will be presented at the Annual Malaria Meeting and TWG meetings in the second half of 2019.

- Project partners continued to work with health care workers to strengthen malaria diagnosis (and treatment) across the PNG health services. The project supported partners to deliver a three-day refresher training to **32 Community Health Worker (CHW) teachers**; and to present information about the project at a Grand Round at Port Moresby General Hospital to approximately **100 health care workers**.
- A key component of the project is to ensure research findings is shared widely to inform malaria policy and practice. The project supported one NDOH partner to attend and present at the 10th Annual RBM Malaria Case Management Working Group meeting; one project partner to attend and present at the Asia-Pacific Network on Drug and Diagnosis Innovation on Neglected Tropical Diseases conference; and co-supported with STRIVE PNG six project partners to attend and present at the inaugural Global Health Security conference in Sydney. The project also supported the Publication Committee to review the first draft manuscript.

Objective 2: To pilot effective cooperation between Australia, China and PNG

Outcome 4: Lessons learned from cooperation between Australia, China and PNG

- Cooperation between partners has been effective for strategic, technical and administrative governance processes. The Joint Working Group (JPWG) successfully convened one meeting in Port Moresby. The main objective was to determine the focus of the Phase 2 project, based on the Options Paper, and to consider the partnership lessons learned. Technical Directors (TD) convened face-to-face and remote meetings during the period to progress technical issues, including the development (and ongoing revision) of the 2019 Workplans and Budgets. Key lessons learned include the importance of flexibility and of involving PNG implementing institutions in design and delivery of training activities and selection of technical expertise. Significant effort was invested by PO officers to ensure the successful delivery of the project, specific highlights include supporting and enabling the Phase 2 project design and JPWG meeting.
- Project partners, supported by the Project Management Unit (PMU), contributed to ensuring effective management, coordination and administration of the project. Key achievements include successful delivery of the Phase 2 project design; the provision of strategic, technical and administrative contributions from **72 personnel** from partner organisations; provision of procurement and logistics services for a total of **99 multi-day travel itineraries** (81 domestic and 18 international); financial management (including expenditure of **AUD 737,964.86** during the period); facilitating four formal training opportunities for **70 beneficiaries**; and project management (activity planning, management, monitoring, reporting and review).

2. PNG context

PNG has an estimated population of approximately 8.3 million and accounts for 81 percent of all malaria cases and 82 percent of the malaria-related deaths in the Western Pacific region[1]. Nearly 95 percent of PNGs population (almost 8 million people) live in areas at high risk for malaria, which represents a major health and economic burden for PNG. Modelling from 2015[2] estimated the economic impact of malaria in PNG of USD 90 million per year, of which 82 percent was due to loss of productivity. The modelling estimated the cost of elimination by 2030 of USD 425 million (approximately AUD 630 million) between 2016 and 2030. The return on this investment is 9:1, with savings from health care costs and wage and productivity losses of approximately USD 1.92 billion. Given that this estimation was done prior to the resurgence in 2016-17, all of these figures are likely to have increased.

The National Malaria Strategic Plan 2014-2020 (NMSP) focuses on reducing malaria-related morbidity and mortality through strategic interventions including universal coverage (80%) of Long-Lasting Insecticidal Nets (LLIN) and nationwide access to appropriate diagnosis and treatment. The project contributes to the NMSP by increasing the quality of malaria diagnosis in PNG health services.

The most recent IMR malaria indicator survey (2016-17) indicated a dramatic resurgence in malaria (from less than 1 in 2014 percent to 7.1 percent)[3]. This is consistent with a general worldwide trend of increasing malaria prevalence largely due to inadequate funding and the rise of antimalarial and insecticide resistance (currently not present in PNG). PNG's resurgence is not well understood however it is potentially the result of a number of influencing factors including shortages in malaria commodities (rapid diagnostic tests and antimalarials) changes in human and vector behavior, reduced LLIN bioefficacy and a reduction in funding (national and donor). The shortages in malaria commodities has been significantly improved since 2018[4], however it is likely that the current resurgence in malaria will continue to worsen unless malaria control is re-intensified, inclusive of sufficient funding for surveillance, vector control, diagnosis, treatment, behavior change campaigns and operational research.

Malaria diagnosis and treatment

PNG has an online information system that incorporates health data from almost 5,000 health centres throughout the country. Previously this information was collected in a paper-based system and

[1] Geneva: World Health Organisation. 2018. *World Malaria Report 2018*.

[2] Avancena A.L.V., Parr W., Makita, L., Escobar K., Baral R., Silal, S., White, L., Shretta R. 2017. *An investment case for malaria elimination in Papua New Guinea*. San Francisco: the Global Health Group, University of California,

[3] PNG Institute of Medical Research. 2018. *Papua New Guinea Malaria Indicator Survey 2016-17: Malaria Prevention, Infection and Treatment*

[4] Observational data and conversations with SS nurses, TWG meetings and RAM personnel; 2019.

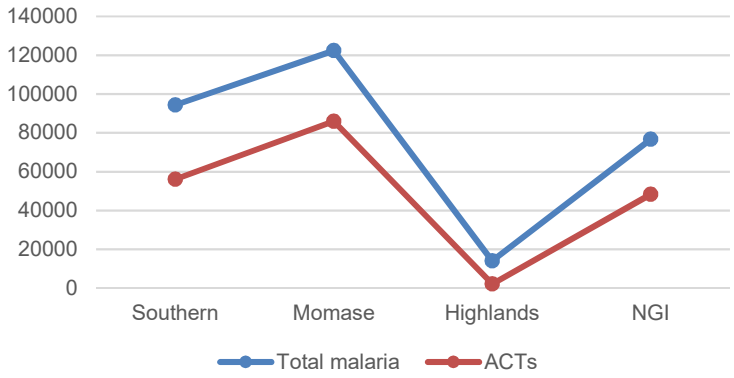
entered manually into FoxPRO[5] by the Provincial Information Officer on a monthly basis (the National Health Information System (NHIS)). However, PNG is in the process of moving to an electronic system (eNHIS) that will enable real time reporting, surveillance and response. The eNHIS was initially trialled in eight provinces and is expected to be rolled out around the country by the end of 2020. There have been some challenges with eNHIS uptake because of variable internet connectivity which means data is still being collected on paper and entered into the system manually (often months later). However, where health centres have reliable access to internet reporting timeliness has improved. There are still some issues with the quality of data being collected and the information flow (particularly for the laboratories where microscopy is not always captured), and NDOH are reviewing the system in 2020, with support from WHO.

The eNHIS receives data on the number of patients who are tested, diagnosed and treated for malaria (including clinical diagnosis and parasitological test). At the time of reporting 55 percent of health facilities had submitted the required monthly reports for 2018[6]. It is slightly higher in the Highlands region (59 percent) where malaria incidence is very low, than the coastal areas (Momase 55 percent; Southern 55 percent; New Guinea Islands 50 percent) where there is a high incidence of malaria.

According to eNHIS information, 380,287 suspected malaria cases received a parasitological test (Rapid Diagnostic Test (RDT) or microscopy) and 49,308 cases were diagnosed clinically across the PNG health services in the first half of 2019. This is a clinical diagnosis rate of 11 percent, which continues the improvement from 2018 (15 percent).

Of those cases which received a parasitological test, 258,389 cases were confirmed positive (all species). However, total Artemisinin-based Combination Therapy (ACT) treatment courses was 192,868, which is still significantly less than the number of positive cases, and (when combined with clinically diagnosed cases), means only 63 percent of positive cases received antimalarial treatment (Figure 1). While this is an improvement from 2018 (47 percent) it indicates there are still challenges with supply of effective treatment. Note that concerns with the

Figure 1: Total malaria cases and total ACTs treatment given by region, January to June 2019 (Source: NDOH eNHIS malaria report)



[5] FoxPro is an object-oriented programming language, originally published by Fox Software and later by Microsoft.

[6] Total expected reports are 4,872 (812 facilities, one report per facility per month), at the time of accessing 2,680 reports have been received. PNG National Department of Health, NHIS Malaria Report, accessed 30 July 2019.

quality of the data collected and the missing monthly reports means the above is an interpretation and should be taken as a guide.

NDOH and RAM cooperate to coordinate the distribution of RDTs, antimalarials and LLIN and continued to improve supply to ensure adequate stocks at all facilities. For RDTs and antimalarials they have implemented a push/pull system based on the reported usage in each district and LLIN are distributed on a 3-year rolling rotation. During the reporting period RAM distributed over 1.14 million RDTs, 680,000 ACTs and 618,000 LLIN throughout PNG.

3. Project Summary

The project has been designed to complement the existing interventions currently being implemented under PNG's National Malaria Strategic Plan (NMSP). It is a four-year project (including the 12-month extension) with a total funding allocation of AUD 5.5 million (including AUD 1.5 million for the extension).

The overarching aim of the project is to contribute to reducing malaria morbidity and mortality in PNG through effective trilateral cooperation. The project has two main objectives:

1. to increase the quality of malaria diagnosis in the PNG health services; and
2. to pilot effective cooperation between Australia, China and PNG.

The project focuses on building the capacity of two key national institutions in PNG, CPHL and IMR. The project's Investment Design Document (IDD) outlines that is expected that four outcomes will be achieved by the end of the project:

1. PNG laboratory institutions strengthened and providing quality malaria diagnosis that is used by health workers to determine appropriate treatment
2. Continuous, systematic monitoring of malaria diagnostic products and services
3. Operational research generates evidence of practical use to policy decisions on malaria diagnosis and treatment
4. Lessons learned from cooperation between Australia, China and PNG

The project Logical Framework is at Annexe 1. It summarizes the project's key outcomes (and associated high level performance questions), outputs, and activities.

4. Project Implementation

The project has continued strongly in the first half of 2019. Within objective one, implementing partners have progressed the laboratory strengthening and operational research components of the project, under the guidance of the TD. The partnership model piloted in objective two has continued to enable cooperation between the three governments.

The following describes achievements against key activities, disaggregated by outcome areas, including results against agreed indicators.

4.1. Objective 1: to increase the quality of malaria diagnosis in the PNG health services

Within objective one the project is supporting partners to implement laboratory strengthening activities and operational research to contribute towards malaria diagnosis.

Outcome 1: PNG laboratory institutions strengthened and providing quality malaria diagnosis that is used by health workers to determine appropriate treatment

Strengthening the capacity of national, provincial and district laboratories to provide quality diagnostic services is a critical component of PNG's National Malaria Strategic Plan 'test and treat' protocol. It is also a key component of CPHL's decentralization of quality assurance activities for public health priorities. The project provided training, competency assessment and knowledge transfer to national, provincial and district laboratory staff and health workers from across PNG. Key results are summarised below.

Training and skills development at CPHL

An important component of laboratory strengthening is capacity building within CPHL. The project provides a number of different types of capacity building including formal training courses, assessments, conference attendance and on-the-job mentoring and training. Fourteen CPHL staff attended training in data analysis (five staff), malaria refresher (two staff), external competence assessment (two staff), qPCR training (two staff), QA training (one staff) and an international conference (two staff). The data analysis training was facilitated by a project partner from PNGIMR (demonstrating value-for-money principles), and two of the participants have used these skills to develop a paper that will be presented at the 2019 PNG Medical Symposium. The project increasingly tries to focus on building the skills of permanent CPHL staff (as well as project staff) as this helps ensure the sustainability of the new knowledge.

Malaria refresher training and WHO External Competence Assessment for Malaria Microscopists

Twelve microscopists representing all four regions of PNG participated in a two-day malaria refresher training followed by a one-week External Competence Assessment for Malaria Microscopists from 6-14 June (Table 1, Image 1). This brings the total number of malaria microscopists supported by the project to participate in the ECA to 60. They were assessed by a WHO Assessor based at ADFMIDI and results were mixed. Eight of the participants were being recertified, and four of them maintained their certification level, while the other four dropped certification levels (one quite significantly from Level 2 to Level 4).

Image 1: ECAMM participants with assessor LTCOL Ken Lilley from the ADFMIDI, and project partners from NDOH, CPHL, DFAT and Yunnan Institute of Parasitic Diseases

Following this training ADFMIDI and CPHL have made some suggestions for cost-effective opportunities to make training more accessible to microscopists. The PMU is working with TD and CPHL staff to facilitate these suggestions with the hope that it will provide an improved result at the ECAMM in November 2019.

Participation in the ECAMM is based on a number of criteria which are assessed by CPHL. CPHL specifically target microscopists who require re-certification (eight participants from this group of twelve); staff from laboratories not participating in the QA program (one participant); provinces with low correct diagnosis by microscope (six participants); and high-burden malaria provinces (seven participants).

Table 1: Participants in WHO External Competency Assessment in 2018

Level	Males	Females	Location
Level 1		1	West Sepik Provincial Hospital, West Sepik
Level 2			
Level 3	2	2	Kavieng Hospital, NIP CPHL, NCD Kerevat District Hospital, ENB Kudjip Nazarene Hospital, Jiwaka
Level 4	5	2	IMR, Madang Goroka Provincial Hospital, EHP Angau Memorial Hospital, Morobe Morobe Provincial Malaria Lab, Morobe CPHL, NCD Popondetta Provincial Hospital, Oro
Total	**7**	**5**	

Development of National Core Group

CPHL progressed work to develop PNG's National Core Group (NCG) for microscopists to implement CPHL's decentralization of quality assurance activities for public health priorities (malaria, TB and HIV). In this strategy provinces with the required skilled personnel (for malaria, ECA-certified Level One and Level Two microscopists) are capacity built to provide quality assessment programs for testing lower level facilities in their respective provinces, and report results back to CPHL.

From the pool of 29 Level One and Level Two microscopists, CPHL have selected 11 appropriate to create the NCG (criteria also includes attitude, ongoing participation in the QA program, ability to teach and high-burden malaria provinces). These 11 microscopists and their officers-in-charge (OIC) have been invited to participate in a training-of-trainers in August to build their capacity to train and assess other malaria microscopists. The OICs are being included in the training to ensure they fully understand and support the role of the NCG members. The project has also supported the Morobe NCG member to assist during the supervisory visit to Morobe Province, for on-the-job learning.

National Competence Assessment

The WHO ECAMM program requires assessment every three years to maintain certification and this has proven challenging for PNG malaria microscopists. The cost associated withing bringing in an external assessor is significant, as it domestic travel for participants, which has meant participation and certification has been inconsistent. In 2018 a CPHL staff member participated in a WHO facilitated training to develop domestic capability in malaria microscopy assessment and had planned to run a Naitonal Competence Assessment (NCA) in the second half of 2019. However, following the ECAMM in June CPHL have determined that malaria refresher training is a priority for the remainder of 2019 so the NCA has been postponed.

Outcome 2: Continuous, systematic monitoring of malaria diagnostic products and services

During the reporting period, project partners continued collaboration with CPHL to establish key national reference laboratory functions, including supervisory visits to lower level laboratories (provincial and district level), development of the malaria slide bank and building capacity to expand molecular diagnosis and undertake quality control of RDTs. Key results are summarised below.

Supervisory visits

Supervisory visits are an important component of the quality assurance program, providing an opportunity for national staff to monitor, train and assess provincial and district laboratory staff and facilities. During the reporting period CPHL completed **two supervisory visits to Morobe and Gulf Province**, visiting provincial hospital and district laboratories in each province. A total of **9 microscopists in eight laboratories** were visited. On-site malaria microscopy proficiency assessments (using the malaria slide bank) and/or observation of diagnostic practice were made at each of the laboratory sites visited. Facilities were also assessed. Test results varied across sites, key

messages included the need for more regular malaria microscopy refresher training; ongoing emphasis on the need to participate in CPHL's EQA program; the importance of using the malaria register; and encouragement to use RDTs instead of microscopy for those sites with capacity challenges, deteriorating equipment and limited supplies. Improvements in diagnostic practice and laboratory maintenance and upkeep were noticed when staff had recently completed the ECAMM.

Establishment of Malaria Slide Bank

The malaria slide bank is an important resource for PNG as it will provide standardised and validated slides for continuous training and assessment of malaria microscopists and health care workers in clinical settings and in formal training and assessment programs. The malaria slide bank has been established using international requirements therefore slides can be also shared or swapped with malaria slide banks in other countries, providing PNG microscopists access to slides of malaria types that may not currently be in PNG.

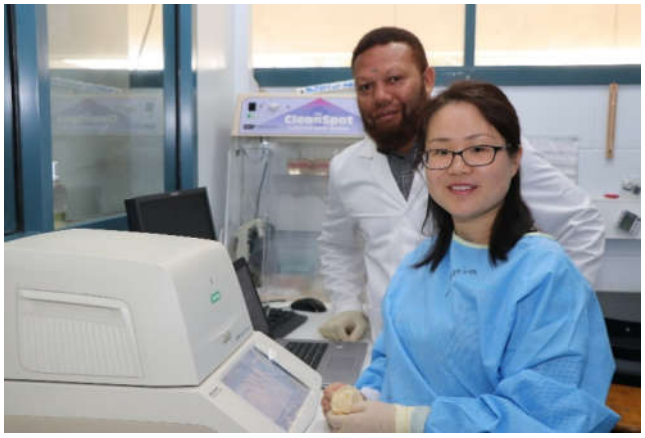
CPHL did a further sample collection in East New Britain in June with support from the Chinese QA TA, collecting **1,000 new blood slides**. CPHL worked with the Chinese QA TA to finalise processing and cataloguing the **2,758 blood slides** that have been collected during the life of the project and the 1,000 new blood slides. Unfortunately, a significant number had to be discarded due to poor staining and deterioration due to a delay in cover slipping. All of the slides have been processed and catalogued and there are **2,041 blood slides** in the malaria slide bank.

During the reporting period the slide bank was used at CPHL to train **13 residents** and **2 registrars** from the Port Moresby General Hospital and to assess **9 malaria microscopists** during supervisory visits in two provinces.

Establishment of Molecular Diagnostics (PCR)

CPHL continued to develop their capability in qualitative Polymerase Chain Reaction (qPCR) diagnosis, which is used to build the malaria slide bank and to develop malaria surveillance functions and quality assurance of RDTs. The infrastructure issues that were potentially compromising samples during preparation for PCR were rectified with support from NDOH. Instead the project supported CPHL to repair the cool room, enabling reagents to be stored correctly to ensure their quality for use.

Image 2: Francis Lelngei and Zhou Ruimin working on the new qPCR machine at CPHL



- **qPCR:** CPHL developed an Options Paper on their future molecular diagnostic requirements, particularly as they take on more of the functions of a national reference laboratory. The Options Paper was reviewed by Senior Management and they agreed to invest in qPCR, specifically choosing the same

technology that IMR use to enable shared resources and joint activities. The project supported CPHLs investment in this technology by purchasing qPCR equipment and reagents. A Chinese Technical Advisor from Henan Provincial Centre for Disease Control and Prevention with expertise in qPCR spent one month at CPHL developing SOP and building staff capacity and capability to operate the equipment and interpret the results (Image 2).

- **Molecular hub:** CPHL, IMR and SMHS have partnered together to develop a molecular hub with support through STRIVE PNG based at the SMHS. This hub enables them to share capacity and resources (equipment, reagents, laboratory space) and collaborate on molecular diagnosis. The National Malaria Program strongly support this development and appreciate the potential efficiency gains this can bring. They have requested the project support staff from CPHL and IMR to collaborate on molecular diagnosis of malaria by qPCR using Dried Blood Spots collected through the therapeutic efficacy studies in Madang.

Establishment of National Reference Laboratory

The National Reference Laboratory (NRL) remains a priority for GoPNG. It has been progressing through internal GoPNG processes; it was approved by NDOH Senior Executive Management in March and the three GoPNG partners are developing a joint submission to take to the National Executive Council (NEC).

At the JPWG meeting in April all three countries expressed a willingness to continue to discuss the NRL and to explore opportunities for joint funding. They also agreed focal points to continue the discussion, with Ms Kimberley Kawapuro and Dr Evelyn Lavu representing PNG; Counsellor Liu Linlin representing China and Ms Emeline Cammack representing Australia. Once GoPNG have a response to the NEC submission this group will meet to consider the next steps.

Quality Control for Malaria RDTs

According to eNHIS data, of the 429,595 suspected malaria cases in the first half of 2019, 380,287 received a parasitological test (malaria RDT and/or microscopy). This proportion receiving parasitological test is steadily increasing which means that quality control of malaria RDTs is a critical part of ensuring the quality of diagnosis in the PNG health services.

Lot testing (on arrival/prior to field deployment) of the RDTs in use in PNG (RapiGEN BIOCREDIT Malaria Ag/Pf/Pan (HRPII/pLDH) and CareStart Malaria Pf/PAN (HRP2/pLDH) Ag Combo RDT) and is currently supported by WHO and FIND[7]. Testing is done at the Research Institute for Tropical Medicines, Philippines. In January 2019 two batches of CareStart Malaria Pf/Pan (HRP2/pLDH) Ag Combo RDT were sampled and both passed (Table 2).

[7] FIND is an international non-profit organization that enables the development and delivery of diagnostic tests for poverty-related diseases, including tuberculosis, malaria and HIV

Table 2: RDT lot testing result

Lot no.	Manufacture date	Expiry	No. of boxes	No. of tests/ box	Lot size	Test. int.	Country	Inv. test.	Result	Comments
MR18F62	06/2018	11/2020	6	25	150	0	PNG	0	PASS	Incomplete clearing in 1/58 RDTs
MR18F63	06/2018	11/2020	6	25	150	0	PNG	0	PASS	Faint lines in 6/24 RDTs on P.f

Developing CPHLs capacity to carry out lot testing of RDTs is part of the organisation's long-term plan, and a key function of an NRL. To enable this, the project supported two CPHL staff to undertake training in 2017, and in 2018 they commenced discussions with FIND to develop the operating procedures to become certified to provide this service. However, CPHLs limited floorspace currently prohibits their ability to take on this additional function. In the second half of 2019 the project will support CPHL to renovate a storage facility to enable it to become a lot testing laboratory. This process is being led by NDOH Commercial Support Services Branch.

Outcome 3: Operational research generates evidence of practical use to policy decisions on malaria diagnosis and treatment

Achieving malaria control and moving towards malaria elimination requires evidence-based policies and protocol. The project supports IMR to maintain operation of four malaria sentinel sites across PNG, representing the four regions. These sites enable the collection of data for operational research as well as ongoing monitoring of trends in malaria indicators through collection of high-quality longitudinal background data.

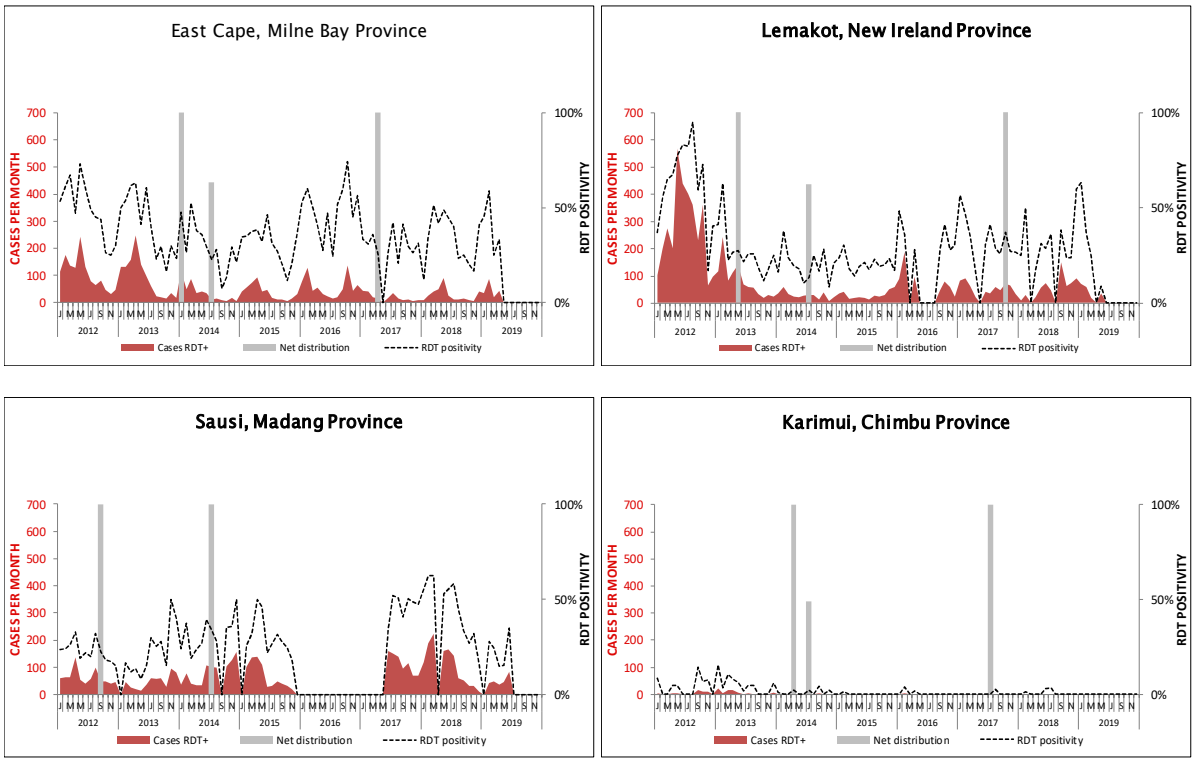
Support to Malaria Sentinel Surveillance Sites

The project continued to support IMR to maintain three of the four epidemiologically distinct malaria sentinel sites across all four regions of PNG (Table 3). The fourth site, Karamui, was temporarily closed in October 2018 due to tribal fighting, and will reopen once Lutheran Health Services (who run the health centre) evaluate the site and approve health workers resuming work. Another of the sites, East Cape in Milne Bay, is operational but has not been able to provide data for the months of May and June due to network issues. IMR continued the collection of high-quality longitudinal background data to monitor trends in malaria indicators at the three sites. This data will be presented by IMR at the PNG Medical Symposium in Port Moresby in September 2019.

Table 3: Summary of four surveillance sites including altitude and surveillance period

Health facility	Region	Province	Altitude (m)	Population (villages)	Surveillance period
East Cape	Southern	Milne Bay	15	5,684 (509)	02/2010-04/2019
Karimui	Highlands	Chimbu	1109	8,506 (24)	11/2010-06/2016 & 07/2017-10/2018
Lemakot	Islands	New Ireland	15	10,384 (33)	01/2011-06/2019
Sausi	Momase	Madang	170	5,158 (48)	08/2010-12/2015 & 06/2017-03/2018 & 05/2012-06/2019

Figure 2: Longitudinal febrile illness/RDT surveillance at the four sentinel sites from January 2012 to June 2019. Cases RDT+ describes the absolute number of RDT positive cases (red) in a month, and RDT positivity (dotted line) describes the percentage of RDT cases from the overall number of patients with febrile illness. Note that points on the graphs where the RDT positivity line hits zero are when the health centres are closed, usually due to stockouts. Source: PNGIMR



There is significant difference in malaria incidence across the four sentinel sites (Figure 2). There has been no data collection at Karimui since October 2018, however prior to that there has been almost no malaria since 2014, consistent with high altitude areas across PNG. At Sausi malaria incidence seems to have decreased slightly in 2019, from the high incidence in 2017 and 2018, which could be a result of more reliable supply of malaria commodities. At East Cape and Lemakot there were significant decreases in 2012-2014, however both sites experienced a resurgence from 2015. Both these sites traditionally had very seasonal malaria, however at Lemakot it appears to be becoming a year-round issue. Malaria transmission in heterogenous across PNG so it is important to be able to monitor trends in different areas to ensure policy is well informed. Longitudinal data from sentinel sites is utilized by NDOH and program partners to inform NMCP interventions.

Continuation of operational research at sentinel sites

IMR, with support from other PNG, Australian and Chinese project partners, continued the operational research at the sentinel sites focused on addressing current challenges to sustaining and enhancing PNG's malaria reduction achievements.

- **Roll out of e-data collection:** ODK has successfully been rolled out in all four sentinel sites and is being used to collect and upload data.
- **Comparison of WHO-approved malaria RDTs:** Comparison and assessment of two alternative WHO-approved mRDTs against the current mRDT used by PNG health facilities has been complete for all four sentinel sites. Report writing pending.
- **Point-of-care screening for G6PD status:** Glucose-6-phosphate dehydrogenase (G6PD) deficiency is an inherited condition that can cause haemolytic anaemia in individuals, leading to haemolysis when exposed to various oxidative stresses including anti-malarial drugs such as primaquine[8]. Primaquine is especially important in the treatment and control of *P. vivax* malaria. Identifying individuals with G6PD deficiency allows for tailored treatment regimens of primaquine that are likely to be safer than the standard prescribed course. G6PD RDT screening and test has been completed in all the four sentinel sites. Report writing pending.
- **Molecular diagnostics:** is being used to validate the importance of sub-patent *P. falciparum* and *P. vivax* infections and investigate the prevalence of histidine-rich protein 2 (HRP2) deletions in PNG. All of the samples collected (2636) have been extracted and initial *Plasmodium* genus PCR completed (SS will continue with sample collection, and these will be analysed in STRIVE PNG and the Phase 2 project). Forty one percent of these samples were *Plasmodium* positive (Table 4). PCR for Plasmodium species specific detection is underway (*P. falciparum, P. vivax* partially complete, *P. ovale* and *P. malariae* pending). Genotyping for HRP2 deletions will progress pending third reads for microscopy and species PCR results. IMR, CPHL and SMHS will collaborate in genotyping the HRP2 deletions. First and Second microscopy reads are almost complete (pending 32 slides from Alotau and nine from Karimui).
- **Investigating non-malaria causes of febrile illness:** IMR and NIPD are developing a novel approach for screening for the most common pathogens causing non-malaria febrile illness in PNG to inform protocol to guide health workers in the diagnosis of fever. This research aims to reduce the rates of clinical diagnosis and presumptive treatment practices for malaria. NIPD will use a protein microarray, which is a high-throughput method of tracking the interactions and activities of proteins that is able to look at a number of proteins in parallel. It is a rapid, automated, economical and highly sensitive.

[8] Carson P, Flanagan C, Ickes C, Alving A. Enzymatic Deficiency in Primaquine-Sensitive Erythrocytes. Science (80-). 1956; 124:484–5.

NIPD have worked with partners to develop a list of common non-malaria causes of febrile illness in PNG and are developing a chip to screen for these. IMR have extracted DNA from all of the samples and they are ready to be transported to NIPD for analysis. Part of this work will be complete in the third quarter of 2019, and some has been moved to the Phase 2 project.

- **Monitoring and evaluation of the MDA in Kiriwina Island:** At the request of NDOH, IMR undertook M&E of the MDA implemented by the Guangzhou University of Chinese Medicine at Kiriwina Islands, Milne Bay. The Guangzhou University group are doing internal M&E of the MDA, however NDOH requested this independent perspective to inform policy. The IMR M&E was conducted in April and May, including sampling from 30 households in four villages in Kiriwina Islands where MDA had been done (collecting a total of 545 blood samples), and two villages in neighbouring Goodenough Island where MDA was not done, to use as a baseline (collecting a total of 160 blood samples). The report is expected in the third quarter of 2019 but preliminary findings indicate the incidence of malaria at Kiriwina Islands is significantly lower than at Goodenough Island. However, sampling a single point in time will not give an indication of the impact of the MDA and IMR have recommended annual M&E for at least five years. Also the MDA did not address *P.v*, which should be considered in any pilot of malaria elimination.

Table 4: Summary of microscopy and molecular assays for operational research. Source: IMR.

Assay	Total	Pending	Comments
Molecular Assays			
DNA extracted	2636	Nil	DNA extractions completed
Plasmodium Genus PCR (Qmal)	2636	Nil	Genus PCRs completed.
Plasmodium species PCR (P.f/P.v)	1148	1488	Species (P.f/P.v) PCRs, half completed.
Plasmodium species PCR (P.m/P.o)	Pending		Pending P.f/P.v PCR completion. Qmal positives and P.f/P.v negatives to be genotyped for P.m/P.o.
Non-malaria febrile illnesses	Pending		Ready to be packed and shipped to NIPD for protein microarray analysis for causes of non-malaria febrile illnesses.
Genetic diversity	Pending		Pending completion of P.f/P.v PCRs.
Pfhrp2 deletion	Pending		Pending completion of P.f/P.v PCRs.
K13 Genotyping	1148	Nil	Subset of samples sent to Dulcie Lautu at WEHI, pending analysis of sequence data.
Microscopy			
Blood slides (read)	2636	41	
Lemakot	470	Nil	1st and 2nd reads Completed.
Sausi	1320	Nil	1st and 2nd reads completed.
Alotau	408	32	1st and 2nd reads completed except 32 pending slide results yet to be updated.
Karimui	438	9	1st & 2nd reads completed except 9 pending slide results yet to be updated.

Evidence-based Medicine to Improve Incorrect Diagnostic Practice (and Treatment)

Project partners continued to work with health care workers to strengthen malaria diagnosis and treatment across the PNG health services. Previous supervisory visits to hospitals and laboratories have identified systemic issues with malaria diagnosis and treatment, including high false positivity rates and incorrect diagnosis for malaria microscopy; low use of RDTs amongst clinicians due to mistrust; high rates of clinical diagnosis; presumptive prescription of antimalarials; and non-compliance with treatment protocols (e.g. prescription of obsolete drugs or monotherapies). eNHIS data indicates these issues are slowly improving however continual awareness and training is required to maintain their gains.

In March the project supported partners to deliver a three-day malaria refresher course for 32 teachers from 16 Community Health Worker (CHW) schools around PNG (Image 3). The course was held at SMHS and facilitated by partners from NDOH, IMR, CPHL and WHO. This course is part of the National Malaria Program strategy to build the skills of teachers at health schools to ensure graduates have up-to-date knowledge of malaria test-and-treat policy. The key outcomes of this training include improved knowledge and practise amongst all participants on correct malaria diagnosis and case management protocols.

The project also supported partners to present information about the project at a Port Moresby General Hospital Grand Round at SMHS in February to approximately 100 health care workers.

Image 3: Participants and facilitators from the Community Health Worker teacher training

Dissemination of Research Findings

A key component of the project is to ensure research findings, including results and analysis from project activities, is shared widely both within PNG and internationally to inform policy and practice in malaria control. In addition to the above, the project supported one NDOH partner to attend and present at the 10th Annual RBM Malaria Case Management Working Group meeting; one project partner to attend and present at the Asia-Pacific Network on Drug and Diagnosis Innovation on

Neglected Tropical Diseases conference; and co-supported with STRIVE PNG six project partners to attend and present at the inaugural Global Health Security conference in Sydney.

To enable dissemination of research findings through publication the PMU supported members of the Publications Committee, established in late 2018, to draft a Terms of Reference (ToR) (Annexe 2). This will enable the committee to consider and progress draft manuscripts in line with the project principles of mutual respect, equity, cooperation and transparency. Following development of the ToR, the PMU has supported the committee to consider the first draft manuscript, submitted in early 2018. The Committee has developed a plan to progress this manuscript and aim to submit it to the Malaria Journal in late 2019.

4.2. Objective 2: to pilot effective cooperation between Australia, China and PNG.

Within objective two the project has effectively demonstrated a three-country government-to-government cooperation approach to address a shared priority. Project partners from all three countries have reflected on the success of this pilot and the need for the project to continue to mature and challenge the partnership.

Outcome 4: Lessons learned regarding effective cooperation

This project has provided an opportunity for Australia, China, and PNG to pilot how to effectively cooperate, and to consider lessons learned from this cooperation. To assess performance against this objective, this section provides qualitative and quantitative data and analysis on lessons learned regarding effective cooperation, and resource contributions from all three governments.

Lessons learned

A key role of project partners is to identify lessons arising in the cooperation process and ways to apply these, including in future joint cooperation. Previously the PMU provided partners an opportunity to reflect on their lessons learned in a joint structured process, then in 2018 it was captured during the mid-term review (MTR) and in 2019 is it being captured as part of the Phase 2 project design. Below is a summary of the key lessons learned captured in 2019:

- The positive role of the trilateral project in promoting **coordination** between GoPNG agencies should continue in Phase 2 and be strengthened. This should include support to activities beyond the direct project design document.
- Building on the trust developed in the project, the partnership in the next phase should be **more ambitious**; for example, improving coordination between the Australian and Chinese bilateral aid programs in PNG. There should also be enhanced learning about the ways in which China and Australia plan, implement and manage their development cooperation programs.
- The **benefits and challenges** associated with the **trilateral nature** of the project, as opposed to two separate bilateral projects. This includes the potential for the project to leverage two of the

biggest donors in the Pacific working together with a strong sovereign nation for the benefit of the PNG health system.

- Establishing effective trilateral projects takes **time**, particularly for building relationships, exploring and understanding shared and individual objectives and expectations, and establishing ways of working which engender respect and shared power between the partners.
- Establishing the right **working model (governance and management system)** for the trilateral project is critical to engendering ownership by all development partners and implementing bodies. Shared and individual ownership is a powerful incentive to maintain cooperation and engagement.
- A **formal partnership approach** underpinned by principles and corresponding implementation mechanisms supports effective trilateral engagement. Trilateral projects bring diversity and complexity, a partnership approach provides a framework within which to value and utilise this diversity and manage the complexity.
- A trilateral project requires **strong and proactive project management**, ideally located in the operating context with support from corresponding mechanisms in the partner countries.
- **Communication and systems for learning** are essential if a pilot project is to influence policy and new programs.

Strategic, technical and administrative governance

Maintaining the strong relationships and documenting the project governance arrangements is a key priority in the final year of the project. This will help ensure the Phase 2 project builds on the relationships and the lessons learned from the current project.

The project involves collaboration amongst sixteen different agencies from three countries, including government and technical partners. The level of engagement varies within the sixteen agencies; for some it is limited to specific individuals (for example Curtin University and the Yunnan Institute of Provincial Diseases) while others are engaged at an organisational level (for example CPHL and NIPD). Six organisations are involved at a governance and administration level, and eleven are involved at a technical or implementing level (with NDOH involved in both).

Strategic

JPWG members continued to provide effective strategic oversight and high-level governance. The JPWG convened its sixth meeting in Port Moresby, PNG on 1 April (Image 4). The timing of the meeting was delayed to allow JPWG members the opportunity to jointly consider and discuss the Options Paper for the Phase 2 project. Key meeting outcomes were alignment on the focus of the Phase 2 project, revision of the organisational objectives and project principles and a shared willingness to continue to discuss the NRL, including formation of a working group with representation from all three countries.

Image 4: Project partners in Port Moresby for the JPWG meeting in April 2019

Technical

TD, representing the project's implementing institutions, ensure effective technical planning, delivery and evaluation of laboratory strengthening and operational research activities, supported by Technical Advisors where relevant.

TD held one face-to-face meeting in the lead up to the JPWG meeting, two teleconference meetings, and provided considerable remote inputs. Key topics discussed in these meetings included developing the 2019 Workplan and Budget, providing input into the Options Paper, reviewing technical aspects of the project and progressing the Publication Committee.

Administration

JPWG members are supported by the **Project Oversight (PO) officers**, who assist devolution of JPWG decision-making on project administration matters and work as a liaison point between their respective JPWG members and the PMU.

Significant efforts were invested by PO officers during the period to ensure the successful delivery of the project. Specific highlights include:

- **Phase 2 project design**: significant efforts to initiate the design of the follow-on project, through the Design Sub Working Group (DSWG). The DSWG worked with the PMU to design and facilitate the stakeholder consultations for the Options Paper and the project design missions, provide input into the Options Paper, contribute to the JPWG review of the Options Paper, and provided input into the response to the Options Paper.

- **Media**: support to the PMU to develop and publish five press releases, which were published on the Australian High Commission (AHC) Facebook page and in local newspapers.
- **JPWG meeting**: support to JPWG members and the PMU in developing agenda items and preparing detailed briefing for the JPWG meeting in Port Moresby, PNG in April.

Personnel contributions from all partners

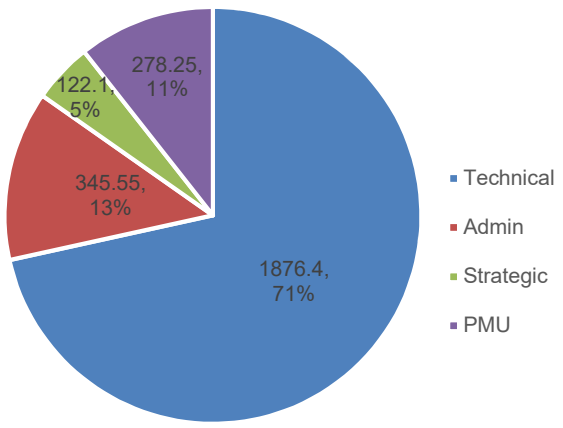
One of the key measures of success of this project is the provision of partner personnel and technical assistance from all three partner countries to design, implement and manage activities. This was successfully achieved with a total of **72 personnel** from Australia, China, and PNG involved directly in project governance, administration and implementation. These personnel contributed a total of **2864.05 work days** in January to June 2019. This continues the project trend of significant increases in personnel commitment from all three countries (Table 5).

Table 5: Daily personnel inputs by partners disaggregated by country for 2016-2019[9]

Partner Country	2016		2017		2018		2019 (Jan to June)	
	# personnel	# days	# personnel	# days	# personnel	# days	# personnel	# days
PNG	15	311	21 (13M, 8F)	1207	38 (22M, 16F)	2,754.5	41 (26M, 15F)	1,763.3
China	20	434	18 (9M, 9F)	767	16 (7M, 9F)	1,026	14 (6M, 8F)	418
Australia	11	420	13 (4M, 9F)	921	17 (5M, 12F)	1,272.5	17 (7M, 10F)	682.75
TOTAL	**46**	**1,165**	**52 (26M, 26F)**	**2,895**	**71 (34M, 37F)**	**5,053**	**72 (39M, 33F)**	**2,864.05**

It is notable that Technical inputs (including TD, Technical Advisors and implementing partners) make up almost three quarters of the total personnel days contributed to the project during the reporting period (71 percent, Figure 3). This is a demonstration of the continuted high level of activity in the project and also the technical nature of the project. Strategic inputs (JPWG members) make up 5 percent of personnel days, which is appropriate given the seniority of these partners, and Administrative input is at 13 percent. This supports the internal project

Figure 3: Number of personnel days by type



[9] Noting that partners are asked to estimate their inputs as either a total number of days or a percentage; in the case of a percentage input 130 days is considered 100 percent.

communication model, whereby most communication occurs between the PMU and PO officers, who then seek input from their JPWG member as appropriate (see Figure 6: Internal communication).

During the first half of the 2019 two new PNG JPWG members, one new Chinese PO officer and one new Australian PO officer were welcomed to the project.

The main capacity building models used in the project are 1) international and local advisory support to PNG implementing institutions; 2) delivery of formal training courses and 3) workplace exchange and on-the-job mentoring between technical partners. Using a partnerships-based model involves the promotion of mutual knowledge exchange and skills training between all three countries (i.e. there is not a one-way flow of “capacity transfer”), with strengthening PNG institutions’ capacity for laboratory strengthening and operational research activities is the primary focus.

In line with international evidence on effective capacity-building models, the project applied the principle that PNG institutions and training beneficiaries need to have influence on the content and delivery of the training (i.e. as partners know and trust each other, areas of genuine mutual benefit will be identified and resourced, and those that are less relevant will not be pursued).

In the second half of 2019 project partners will consider the capacity building models in the project to look at how it can be maximised in the Phase 2 project. Including developing guidelines for participants and agencies and making recommendations for what models should be continued and what may be required to ensure sustainability of capacity building impacts.

5. Effective Project Management and Coordination

GoA and GoPRC provided four staff in the PMU to oversee effective management and coordination of the project. This includes a Project Partnership Manager (PPM), Project Assistant and Project Coordinator (all full-time positions), located in Port Moresby within the Health and HIV Implementing Services Provider (HHISP); and a China-based Project Coordinator (CPC) (full-time), located within NIPD. The PMU provided deployment and management services for all personnel delivering project activities, procurement and logistics services, financial management (expenditure forecasts; approvals and acquittal), grants management, and project management (activity planning, management, monitoring, reporting and review).

5.1. Finance

HHISP is responsible for financial management of the project and accountable for accurate and transparent financial reporting. The Annual 2018 project budget was prepared by the PPM in consultation with TD and implementing agencies and endorsed by JPWG members. A Quarterly Financial Statement (January to March 2019) was provided to all three governments as per the agreed reporting schedule and accepted without changes. This report provides the January to June 2019 expenditure report for the project. As at 30 June 2019, all funds disbursed through the project

had been managed, disbursed and acquitted in line with agreed financial and procurement processes, and no financial mismanagement cases were reported during the period.

5.2. Project Expenditure Summary

The original total funding allocated to the project, through the Australian PNG aid program, was up to a maximum of **AUD 5,100,790.78** (as per the IDD and extension). This is complemented by the in-kind contributions (technical expertise; laboratory and office space; and access to existing laboratory equipment) provided by the Australian, Chinese, and PNG government and implementing partners.

Total expenditure for the period is **AUD $737,964.86** which is approximately **72 percent** of the budget forecast for the period (**AUD 1,023,785.02**) (Table 6). Under expenditure during the reporting period was associated with postponing the Phase 2 project design mission from May to July, reduction in the inputs from the second Chinese Technical Adviser (from three months to one month) and postponing a training course from April to August.

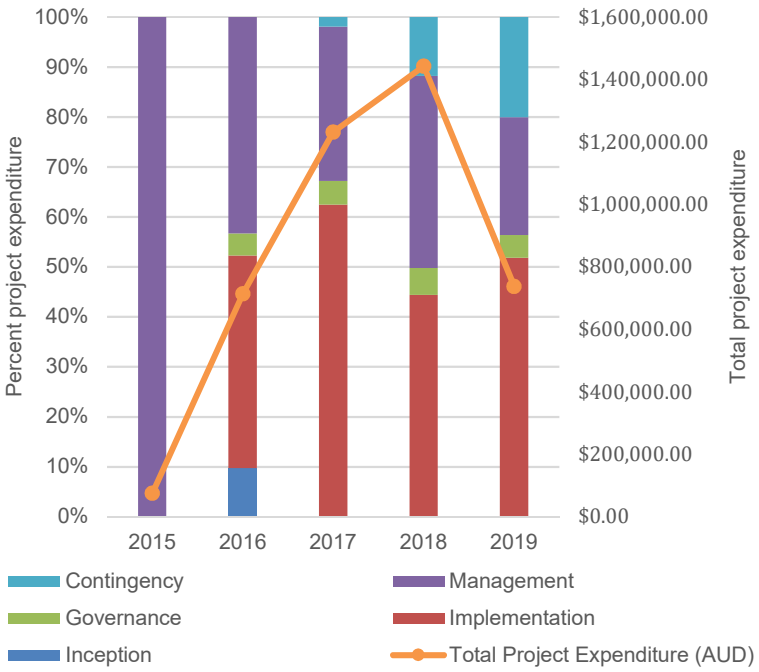
Total expenditure to date under the project (1 September 2015 to 30 June 2019) is **AUD 4,351,235.08**, or approximately **85 percent** of the total expected project expenditure **$5,100,790.78**. At this stage the project is on track to spend the allocated budget by the end of 2019.

Table 6: Project Expenditure as at 30 June 2019 (AUD)

Project Category	2019 budget forecast	2019 budget forecast as % total project budget	2019 actual expenditure	2019 remaining	Actual project to date expenditure
	a	b	c	d (a - c)	e
Inception	$0.00	0.00%	$0.00	$0.00	$69,347.58
Implementation	$774,638.82	30.60%	$382,177.99	$392,460.83	$2,095,786.55
Governance	$150,000.00	43.71%	$33,685.63	$116,314.37	$201,310.83
Management	$434,225.28	24.54%	$173,882.94	$260,342.34	$1,641,867.87
Contingency (Phase 2 project design)	$300,000.00	62.84%	$148,218.30	$151,781.70	$342,922.25
Total Project	**$1,658,864.10**	**31.75%**	**$737,964.86**	**$920,899.24**	**$4,351,235.08**

Project expenditure is categorised across five areas; inception, implementation, governance, management and contingency (Figure 4). Expenditure in inception only occurred in 2016, expenditure in management and governance have been fairly consistent amount throughout the life of the project. Expenditure in implementation has remained consistently high since 2017, at 52 percent in the first half of 2019 (almost evenly split between operational research at 55 percent and laboratory strengthening at 45 percent). Expenditure under contingency includes the NRL scoping study in 2017, the MTR in 2018 and the Phase 2 project design in 2019.

Figure 4: Project expenditure from 2015-19 (AUD)



5.3. Payments to Implementing Partners

As per the Project Manual, HHISP is responsible for making direct payments to service providers in line with requests from project partners to implement project activities. All required payments were made during the first half of 2019.

This includes payment to NIPD for implementation of China-based project activities under an HHISP-NIPD Exchange of Letters. In mid-2018 the project made a payment of AUD 165,900 to NIPD, which left approximately **AUD 146,644** remaining at the end of 2018 (approximately RMB 691,212.35). NIPD has drawn down these funds for governance, management and implementation as per Table 7, and there is approximately **AUD 106,224** budget for the remainder of 2019. The majority of this will go towards the non-malaria causes of febrile illness operational research study. This amount is not included in the expenditure above as it was captured in 2018 reporting.

Table 7: NIPD expenditure as at 30 June 2019

Category	Initial Balance (RMB)	Expenditure (RMB)	Balance Remaining (RMB)
Implementation	191,186.29	9,800.00	181,386.29
Governance	284,522.65	81,936.25	202,586.40
Management	176,150.35	81,936.25	94,214.10
NIPD management fee (5%)	39,353.06	8,683.40	30,669.66
Total	**691,212.35**	**182,355.90**	**508,856.45**

5.4. Procurement and logistics

The PMU provided a broad range of logistics, procurement and travel services to support implementation of project activities. This included the mobilisation of JPWG members, TD, project

partners, design team members, STA, other consultants and PNG trainers and training beneficiaries to a range of domestic (PNG) and international destinations and the associated procurements (accommodation, airfares, visas, insurances, per diems, training materials, catering) required.

The project organised **99 multi-day travel itineraries** across both domestic (81 travel itineraries) and international (18 travel itineraries) sectors, including **632 nights of accommodation.** This is illustrative of the continued high-level of implementation in the final year, with the multi-day travel itineraries in the first half of 2019 representing 63 percent of the total number of trips booked in 2018 (158). Of these, 58 were for training activities (facilitators and participants), demonstrating the projects ongoing commitment to capacity building.

The project also provides logistical support for project partners to undertake activities in and around Port Moresby through provision of transport. In the first half of 2019 the project provided regular transport to CPHL staff, National Malaria Program partners YWCA to undertake behaviour change campaigns in two schools in Port Moresby (New Erima Primary School and Butuka Primary School), and partners from DFA, DNPM and DFAT to attend meetings and events.

5.5. Value for Money

The project utilises DFAT's eight Value for Money Principles to guide decision-making and maximise the impact of this partnership.

The PMU worked with implementing partners to ensure cost-consciousness through seeking reasonable opportunities to reduce costs. Competitive procurement methods were consistently followed, and when direct appointment or procurements was considered value for money was considered. The PMU reviewed the logistical arrangement for activities held in Port Moresby and have made a number of changes resulting in savings of 30-50 percent of each activity.

A very good result observed throughout the life of the project is the value of "in-kind" contributions provided by all partners in the project. Through harnessing relevant experience, expertise and resources available within the partners themselves, such as the provision of technical experts, laboratory space, diagnostics equipment, access to in-house training programmes, and sharing specimens for referral, the partnership delivers excellent efficiency and effectiveness, as funding can stretch further and activities are relevant and sustainable. Some examples of this in the first half of 2019 was data analysis training provided to five CPHL staff by PNGIMR Deputy Director, Dr Laman; and coordinating TD meetings with STRIVE PNG to enable

Value for Money Principles

Economy principles of cost consciousness and encouraging competition

Efficiency principles of evidence-based decision-making and proportionality

Effectiveness principles of performance and risk management; results focus; and experimentation and innovation

Ethics principles of accountability and transparency)

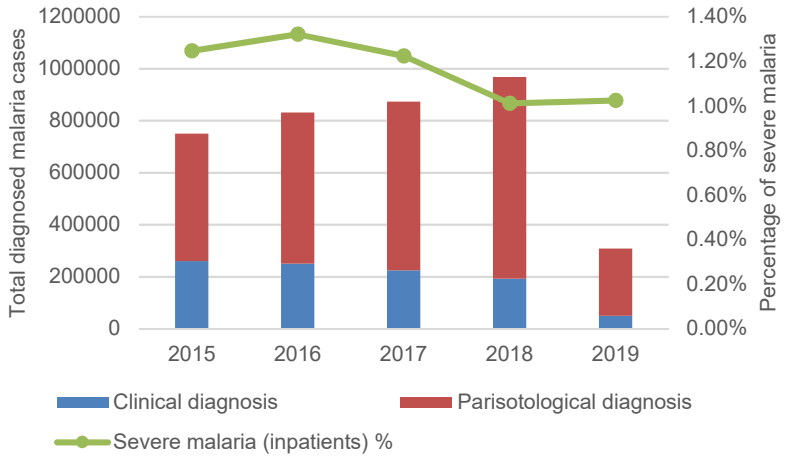
shared expenditure, resulting in reduced costs and more frequent opportunities for PNG and Australian TD to have face-to-face meetings.

5.6. Monitoring and evaluation

Ongoing collection of quantitative and qualitative data for both technical and cooperation-related activities was continued in 2019. For technical activities supported by the project, quantitative and qualitative data against activity-level indicators was collected by the PMU, TD and implementing partners, and key results (including progress/achievements against outcome- and output-level indicators) for the period are included in Annexe 3. Training participants completed evaluation questionnaires with key results/outcomes summarised by the PPM and tabled with TD to inform future training planning.

The PMU will work with technical partners in the second half of 2019 to review indicators in the logical framework to measure the project impact and achievements for the final report. Particularly considering the objective level indicators, which the project could be expected to be contributing towards in the final year of implementation. WHO indicate access to early and accurate diagnosis and effective treatment reduce the chance of uncomplicated malaria progressing to severe malaria[10]. Therefore, a reduction in the percentage and total number of severe malaria cases over the course of the project could be an indication of an improved diagnosis system (Figure 5). Other similar indicators utilising information from project partners, project activities and NDOH health data will be explored with Technical Partners.

Figure 5: Total malaria cases and the percentage of severe malaria between 2015 and 2019



5.7. Risk Management

The PMU works with partners to monitor and respond to emerging risks as per the project's updated Risk Matrix. No critical adverse events under the project have been encountered and Annexe 4 describes activities against the risk matrix during the first half of 2019.

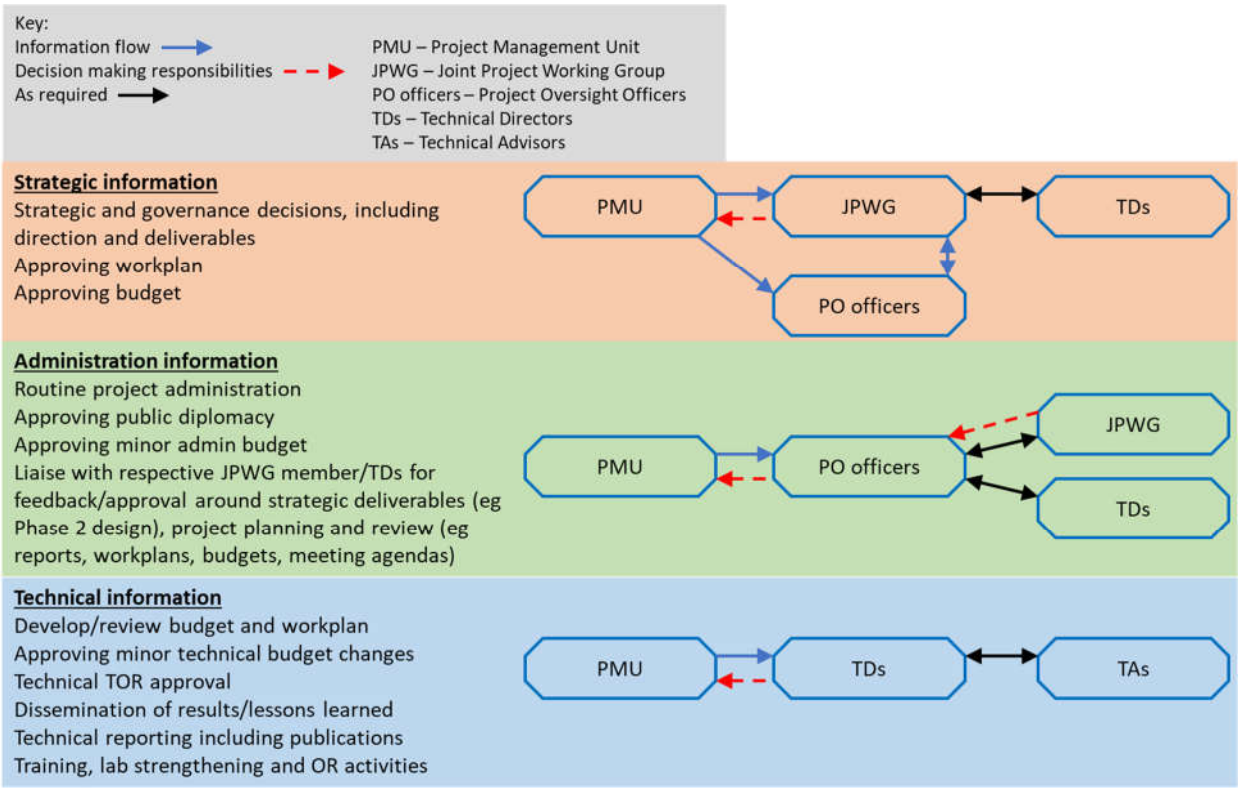
[10] What is the difference between clinical difference between

5.8. Communications and Public Affairs

PMU worked closely with relevant TD, PO officers and implementing partners to promote and communicate partners' achievements through the project. Communication highlights included a Grand Round at Port Moresby General Hospital and the School of Medicine and Health Sciences in February; celebration of World Malaria Day in April; development of posts for the AHC Port Moresby's social media platform; electronic publication of the MTR and Management Response; establishment of the TOR for the Publications Committee; media in the local PNG newspapers and ongoing use of the project portal for sharing key documents with project partners and the design team.

Internal communication is an important aspect of project management and has been recognised by the partners as critical to the success of the project. Initially the project developed an internal communication model based around the project governance structure, however this was overly complex and doesn't recognise that the project has systems and processes in place for different types of communication (eg technical, media, strategic etc). PMU supported the Communication Sub Working Group to reconsider how best to represent internal communication (Figure 6).

Figure 6: Internal project communication



The Publication Committee have elected their Chair and drafted a TOR (Annexe 2). They have considered the first draft manuscript, which was shared with the PMU early in 2018. The committee have developed a way forward for this draft manuscript that will ensure it reflects the contributions of all three partner countries and the project principles. Given this first publication will communicate the

partnership model with a broader audience TD have agree it is a priority and aim to have it finalised and submitted before the end of the project.

World Malaria Day 2019

The NDOH Malaria Program led celebrations for World Malaria Day on 25 April 2019, with the global theme of *Zero malaria starts with me*. Activities included school surveys, net distribution and awareness in the lead up to the day; and an event led by the Minister on World Malaria Day. The PMU worked closely with NDOH in planning and implementing these activities.

As part of the awareness activities, Young Women Christian Association ran a two-week malaria program with the students at New Erima Primary School. The program focuses on teaching students about the spread, prevention, diagnosis and treatment of malaria through sports-based activities. The success of the program was demonstrated by the awareness and understanding students had of malaria.

Image 5: (clockwise from top) World Malaria Day celebration led by Sir Puka Temu, Minister for Health and HIV/AIDS (5th from left); YWCA coaches teaching students about proper net use; NDOH conducting a school survey.

6. Cross-cutting Issues

Through its use of Australian aid management tools and approaches, the project aims to demonstrate and share effective development policies, strategies and approaches. Gender, disability and child protection have all been identified through the Australian aid program as forming critical components of an effective and accountable aid investment.

Some population groups are at a considerably higher risk of contracting malaria and developing severe disease. These include pregnant women, infants, children under five years of age and patients with HIV/AIDS, as well as non-immune migrants, mobile populations and travellers. WHO recommends that national malaria control programs need to take special measures to protect these population groups from malaria infection.

6.1. Gender

The project continues to consider DFAT's *Gender equality and women's empowerment strategy*[11] throughout all activities. Focusing on promoting women's economic empowerment through participation in training activities, enhancing women's voice in decision-making and working to combat violence against women and girls.

Opportunities to support equal participation in project activities amongst men and women were pursued, with consideration for the best outcome for individuals and organisations. Of the 72 partner personnel involved in the project, 33 are females (46 percent). Of the 70 training beneficiaries, 32 were female (46 percent). Attempts were made in all training and workshop opportunities to have equal numbers of men and women. However, there are some activities where this is not possible, particularly for things like supervisory visits where laboratory staff are determined by Provincial Health Authorities and CPHL train all available staff. Chinese and Australian advisers are a mix of men and women, contributing to a balanced gender approach across project implementation.

The M&E system collects sex-disaggregated data, hence the percentage figures provided here. All project activities adhered to Workplace Equal Opportunity practices and provided a supportive and respectful learning environment for both men and women.

6.2. Disability

The laboratory strengthening and operational research activities supported by the project do not directly target disability-related outcomes. However, the project approach is informed by DFAT's *Development for All 2015-2020: Strategy for strengthening disability-inclusive development in Australia's aid program.*[12]

[11] DFAT, February 2016: http://dfat.gov.au/about-us/publications/Documents/gender-equality-and-womens-empowerment-strategy.pdf

[12] DFAT, May 2015: https://dfat.gov.au/about-us/publications/Documents/development-for-all-2015-2020.pdf

The project has tried to include people with disability or other marginalised groups in project activities. However there have been no suitably qualified people identified to date, likely related to the broader issue of people with a disability being less likely to access education and employment opportunities.

6.3. Child Protection

Recognising that it is the shared responsibility of all adults to prevent child exploitation and abuse. The project uses the DFAT *Child Protection Policy*[13] to ensure all activities consider a risk-based approach to the management of child protection risks. The project is classified as a Medium Risk Child Protection project. All arrangements through this project include compliance with the ABT Associates *Child Protection Policy*, and all contractors sign off to this policy.

[13] DFAT, 2017: http://dfat.gov.au/about-us/publications/Pages/child-protection-policy.aspx

7. Annex 1: Logical Framework

		Indicator
Objective 1	To increase the quality of malaria diagnosis in the PNG health services	1. Case confirmation rate: Percentage of reported malaria cases confirmed either by microscopy or by rapid diagnostic tests (RDTs) (NSPI 11). 2. Adequate microscopy quality rate: Number and percentage of provincial hospital laboratories showing adequate performance among those that received quality assurance (QA) reviews (adapted from NSPI 17). 3. Appropriate treatment rate: Percentage of confirmed malaria cases receiving treatment in line with national guidelines (NSPI 12).
Objective 2	To pilot effective cooperation between Australia, China and PNG	1. Advantages and challenges of joint cooperation documented.

		Indicator	Performance Questions
Outcome 1	PNG laboratory institutions strengthened and providing quality malaria diagnosis that is used by health workers to determine appropriate treatment	1.1 CPHL delivers QA to agreed performance standards: e.g. response time for QA feedback, Standard Operating Procedures (SOP) followed. 1.2 Health workers who have received training deliver improved diagnosis and treatment.	*What changes have occurred in the capacity of national and provincial hospital laboratories and NDOH to provide quality assured diagnostic (and treatment) products and services?*
Outcome 2	Continuous, systematic monitoring of malaria diagnostic products and services	2.1 CPHL has capacity to deliver agreed reference laboratory functions: with skilled staff, equipment, supplies and budget to conduct assessment of diagnostic quality in line with standard operating procedures (SOP). 2.2 Microscopy QA coverage: Percentage of provincial hospital laboratories receiving at least annual QA by CPHL (adapted from NSPI 16). 2.3 Rapid Diagnostic Tests (RDTs) effectiveness and quality reviewed: RDT performance assessed at least annually, both quality of batches imported and accuracy in use (Point of Care)	

Outcome 3	Operational research generates evidence of practical use to policy decisions on malaria diagnosis and treatment	3.1 IMR (with partners) delivers relevant OR results for malaria control: NMCP and malaria technical working group consider evidence from 3 to 5 OR studies over 3 years	*What policy or programming decisions have been influenced as a result of this project's support to Operational Research activities?*
Outcome 4	Lessons learned from cooperation between Australia, China and PNG	4.1 Advantages and challenges of joint cooperation documented 4.2 Working arrangements refined by year 3 of the project	*What have the partners learned from the cooperation activities supported through the project?*

Outcome	Output	Output Indicator	Activity	Activity Indicator
PNG laboratory institutions strengthened and providing quality malaria diagnosis that is used by health workers to determine appropriate treatment	1. CPHL have strengthened capability to provide training and quality assurance to participating provincial and district malaria laboratories and health care workers to enable them to provide improved malaria diagnosis and treatment	1.1 CPHL has systemic improved capability to train, supervise and quality check provincial and district laboratories, including upskilled and resourced staff, with budget and SOP to follow workplans	1.1.1 Ongoing technical assistance and training for CPHL staff 1.1.2 Document internal systems and procedures to institutionalise improved malaria diagnostics and treatment at CPHL	1.1.1.1 Number of CPHL staff who have completed training and are using improved procedures 1.1.2.1 SOP and protocol for improved malaria diagnosis and treatment developed and CPHL staff aware of and using it.
		1.2 Provincial and District laboratory staff trained and using improved malaria diagnostics to provide appropriate treatment	1.2.1 WHO External Competency Assessments for Malaria Microscopists	1.2.1.1 Number of malaria microscopists who completed WHO External Competency Assessments
			1.2.2 Establish the National Core Group (NCG) of microscopists	1.2.2.1 SOP and protocol for the NCG developed and being used 1.2.2.2 NCG trained and implementing decentralised QA activities
			1.2.3 Document internal systems and procedures to institutionalise improved malaria diagnostics and	1.2.3.1 SOP and protocol for improved malaria diagnosis and treatment developed and provincial laboratory staff aware of and using it.

			treatment at provincial and district laboratories	1.2.3.2 SOP and protocol for improved malaria diagnosis and treatment developed and district laboratory staff aware of and using it. 1.2.3.3 CPHL and partners reporting non-compliance with test and treat protocol to NDOH
		1.3 SMHS pathology staff use current standards and procedures for microscopy curriculum for laboratory students	1.3.1 SMHS, with input from CPHL, revise the microscopy curriculum for laboratory students to reflect current standards and procedures, and upskill relevant staff	1.3.1.1 Curriculum for laboratory students at SMHS reflects current standards and procedures 1.3.1.2 SMHS Pathology staff have strengthened capacity to train laboratory students
		Has there been any change in laboratory diagnosis over the life of the project? What other changes have occurred? Has there been any change to malaria diagnosis and treatment by health care workers?		
Continuous, systematic monitoring of malaria diagnostic products and services	2. CPHL has improved capacity to conduct malaria reference laboratory roles and quality assurance	2.1 Number of provincial hospitals following SOP for submitting slides for QA to CPHL	2.1.1 Provincial Laboratory Supervisory Visits	2.1.1.1 Number of laboratory supervisory visits conducted 2.1.1.2 Number of malaria microscopists trained and assessed during supervisory vists
		2.2 SOP and blood slide and blood sample banks developed	2.2.1 Establishment of Malaria Slide Bank	2.2.1.1 SOP and supporting documents developed for Malaria Slide Bank 2.2.1.2 Number of samples collected for malaria slide bank
			2.2.2 Establishment of Molecular Diagnostics at CPHL (PCR)	2.2.2.1 PCR established at CPHL for quality assurance functions
			2.2.3 Scoping and establishment of National Reference Laboratory	2.2.3.1 Design and scoping work for National Reference Laboratory done 2.2.3.2 SOP and supporting documents developed for National Reference Laboratory 2.2.3.3 Partner Governments discuss supporting the development of a National Reference Laboratory

			2.2.4 Scoping requirements for CPHL to undertake LOT testing	2.2.4.1 CPHL receives WHO accreditation to undertake LOT testing
		2.3 CPHL develops systems and procedures to institutionalise and sustain project benefits	2.3.1 Document internal systems and procedures to institutionalise improved malaria reference laboratory roles and QA	2.3.1.1 SOP and protocol for malaria reference laboratory and QA developed and CPHL staff aware of and using it
		2.4 CPHL staff have improved capacity to review and make recommendations on new tools for diagnosis	2.4.1 CPHL and partners review new diagnostic tools and make recommendations regarding implementation	2.4.1.1 New tools for diagnosis of malaria reviewed and evidence-based recommendations made
		What has changed within CPHL in its position as the national laboratory through involvement in the project?		
	NDOH has improved capacity to conduct Therapeutic Efficacy Studies (discontinued)	*Establishment of research protocol for TES for ACT vs CQ; PQ (discontinued)*	*TES for ACT vs CQ; PQ (discontinued)*	
Operational research generates evidence of practical use to policy decisions on malaria diagnosis and treatment	3. Collaborative operational research on malaria diagnosis and treatment in PNG conducted by IMR with PNG, Chinese and Australian institutions	3.1 Operational research studies completed and results analysed and disseminated	3.1.1 Support to Malaria Sentinel Sites 3.1.2 Design and implement research investigation topics for Sentinel Sites 3.1.3 Evidence-based Medicine to Improve Compliance with Test and Treat Protocols 3.1.4 Dissemination of Research Findings	3.1.1.1 Ongoing operation of malaria sentinel sites 3.1.2.1 Design and implementation of new operational research topics 3.1.3.1 Number of health workers attending evidence-based information sessions to improve incorrect diagnostic practice 3.1.4.1 Dissemination of research findings

		3.2 IMR and partners develop and implement documented systems and procedures to institutionalise and sustain project OR benefits	3.2.1 IMR and partners embed practices developed in the project in their organisations	3.2.1.1 Improved systems and procedures in IMR, SMHS, NDOH and CPHL
		What changes have occurred for malaria diagnosis and treatment following OR? Changes in policy? SOP? New processes?		
Lessons learned from cooperation between Australia, China and PNG	4. Joint planning, implementation and reporting of project activities involving the three country partners.	4.1 All three country partners engaged in project planning, delivery and JPWG (number of daily personnel inputs by partners)	4.1.1 Strategic cooperation between partners 4.1.2 Technical cooperation between partners 4.1.3 Effective project administration, management and coordination	4.1.1.1 JPWG meetings convened on a six-monthly and annual basis 4.1.2.1 Technical Directors meetings convened on a quarterly basis 4.1.3.1 PO officers engaged in project administration
		4.2 Project expenditure as a percentage of budget for annual workplan	4.2.1 Project expenditure is consistent with budget forecast	4.1.4.1 Project expenditure by cost category (implementation, governance, management, contingency) 4.1.5 Effective procurement of goods and services, and disbursement of payments to implementing partners, in line with value for money principles
		4.3 Contributions from all partners quantified at end of project (including time inputs provided by experts)	4.3.1 End of project activities to quantify partner agency contributions	4.1.6 Development of project documentation to enable effective project management, including communication, M&E, risk, and cross-cutting issues
		Do you think this project is different to other donor projects? In what way?		

8. Annex 2: Publication Committee Terms of Reference

Official Name: Trilateral Malaria Project Publication Committee

Background: The Trilateral Malaria Project is a pilot cooperation project between the governments of Papua New Guinea, Australia and China that commenced in January of 2016. The aim of the Trilateral Malaria Project is to contribute to reducing malaria morbidity and mortality in PNG through effective cooperation. The project has two main objectives which are: i) t*o increase the quality of malaria diagnosis in the Papua New Guinea health services, and ii) to pilot effective cooperation between Australia, China and Papua New Guinea.*

Following the completion of a Mid-term review of the Trilateral Malaria Project in 2018, an important recommendation of the Mid-term review was that the project needed to give consideration *to the development of a comprehensive communication strategy in order to provide an increased range of communication practice internally, between project partners, and externally to a wider audience. Although the dissemination of non-academic forms of publications such as news articles posed less significant scientific and cooperation challenges, the dissemination of peer-reviewed scientific publications needed an additional layer of scrutiny in order to ensure the scientific rigour and cooperation aspects of an abstract or manuscript reflect the contributions of scientists and technical experts from all three countries in an equitable manner. Consequently, the Trilateral Malaria Project Publication Committee was formed.*

Roles and responsibilities: The primary role of the Trilateral Malaria Project Publication Committee is to review scientific manuscripts and conference abstracts to:

- Ensure scientific publications and conference presentations related to the Trilateral Malaria Project and its findings are reviewed for scientific appropriateness prior to submission.
- Ensure from a cooperation and ethical perspective that the data are presented accurately without undermining the contribution of a country, institution and/or the individuals involved in the Trilateral Malaria Project.
- Ensure investigators from all three countries have an equal and equitable opportunity to gain authorship based on merits as per their contributions.
- Communicate the decision of the publication committee on manuscripts or abstracts within 30 days of receipt.

Authority: The publication committee retains the right to: i) request amendment to any draft abstract or manuscript, ii) to refuse permission for publication, or iii) to request delay in submission for publication until all scientific, cooperation and ethical issues deemed inappropriate are addressed.

Membership: The membership of the Trilateral Malaria Project Publication Committee is composed of core institutions who are currently involved in the Trilateral Malaria Project, representing all three governments. This was discussed and approved by the Technical Directors of the Trilateral Malaria Project as follows:

- CPHL: Dr Evelyn Lavu
- NDOH: Mr Leo Makita
- PNGIMR: Dr Moses Laman (**CHAIR**)
- NIPD: Dr Junhu Chen, Ms Huang Lulu
- Burnet Institute: Dr Leanne Robinson
- UPNG: Dr Paul Pumuye

The committee reserves the right to seek expert opinion or review from individuals within or outside of the Trilateral Malaria Project, depending on their expertise and availability, to be involved as reviewers.

Meeting arrangements: The committee will communicate primarily through emails but also through via teleconferencing and face to face meetings when required. The time interval between meetings will be at an ad hoc basis depending on when abstracts or manuscripts requiring review are submitted to the committee. The PMU of the Trilateral Malaria Project will assist in facilitating these meetings and provide secretariat support.

Reporting: The publication committee will report to the Trilateral Malaria Project Technical Directors.

9. Annexe 3: Monitoring against the logical framework

Outcome 1: PNG laboratory institutions strengthened and providing quality malaria diagnosis that is used by health workers to determine appropriate treatment

Outcome Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
CPHL delivers QA to agreed performance standards: e.g. response time for QA feedback, Standard Operating Procedures (SOP) followed	On track	NA	On track	NA
Health workers who have received training deliver improved diagnosis and treatment.	On track	NA	On track	NA

Output Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
CPHL has systemic improved capability to train, supervise and quality check provincial and district laboratories, including upskilled and resourced staff, with budget and SOP to follow workplans	Achieved	NA	Achieved	NA
Provincial and District laboratory staff trained and using improved malaria diagnostics to inform appropriate treatment	64	Not specified	33	Not specified
SMHS pathology staff use current standards and procedures for microscopy curriculum for laboratory students	New in 2019	NA	On track	NA

Activity Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
Number of CPHL staff who have completed training and are using improved procedures	9	Not specified	13	Not specified
SOP and protocol for improved malaria diagnosis and treatment developed and CPHL staff aware of and using it.	On track	NA	On track	NA
Number of malaria microscopists who completed WHO External Competency Assessment	24	24	12	24
SOP and protocol for the NCG developed and being used	On track	NA	On track	NA
NCG trained and implementing decentralised QA activities	2019	NA	August 2019	NA
SOP and protocol for improved malaria diagnosis and treatment developed and provincial laboratory staff aware of and using it.	On track	Not specified	On track	Not specified
SOP and protocol for improved malaria diagnosis and treatment developed and district laboratory staff aware of and using it.	On track	Not specified	On track	Not specified

CPHL and partners reporting non-compliance with test and treat protocol to NDOH (through TWG)	No incidence in 2018	NA	No incidence in Jan-Jun 2019	NA
Curriculum for laboratory students at SMHS reflects current standards and procedures	New in 2019	NA	On track	NA
SMHS Pathology staff have strengthened capacity to train laboratory students	New in 2019	NA	On track	NA

Outcome 2: Continuous, systematic monitoring of malaria diagnostic products and services

Outcome Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
CPHL has capacity to deliver agreed reference laboratory functions: with skilled staff, equipment, supplies and budget to conduct assessment of diagnostic quality in line with standard operating procedures (SOP)	Progress achieved	NA	Progress achieved	NA
Microscopy QA coverage: Percentage of provincial hospital laboratories receiving at least annual QA by CPHL	86%	2015: 50% 2018: 100%	82%	2015: 50% 2019: 100%
Rapid Diagnostic Tests (RDTs) effectiveness and quality reviewed: RDT performance assessed at least annually, both quality of batches imported and accuracy in use (Point of Care)	On track	NA	On track	NA

Output Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
Number of provincial hospitals following SOP for submitting slides for QA to CPHL	18	2015: 10 2018: 21	18[14]	2015: 10 2019: 21
SOP and blood slide and blood sample banks developed	On track	NA	On track	NA
CPHL develops systems and procedures to institutionalise and sustain project benefits	On track	NA	On track	NA
CPHL staff have improved capacity to review and make recommendations on new tools for diagnosis	1 assessment done	NA	None in Jan-Jun 2019	NA

[14] Provincial hospitals that have not submitted slides for QA include Modilon Hospital (does not currently have a malaria microscopist), Popondetta Hospital, Kimbe Provincial Hospital and Wabag General Hospital.

Activity Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
Number of laboratory supervisory visits conducted	4 provincial visits (13 labs)	4	2 provincial visits (8 labs)	4
Number of malaria microscopists trained and assessed during supervisory visits	34	Not specified	9	No specified
SOP and supporting documents developed for Malaria Slide Bank	On track	NA	On track	NA
Number of samples collected for malaria slide bank	1,660 new blood slides (2,758 total)	Not specified	1,000 new blood slides collected (2,041 in slide bank)	Not specified
qPCR established at CPHL for quality assurance functions	On track	NA	Achieved	NA
Design and scoping work for National Reference Laboratory done	NA	NA	NA	NA
SOP and supporting documents developed for National Reference Laboratory	On track	NA	On track	NA
Partner Governments discuss supporting the development of a National Reference Laboratory	Deferred	NA	On track	NA
CPHL receives WHO accreditation to undertake LOT testing	On track	NA	Deferred	NA
SOP and protocol for malaria reference laboratory and QA developed and CPHL staff aware of and using it	On track	NA	On track	NA
New tools for diagnosis of malaria reviewed and evidence-based recommendations made	1 assessment done	Not specified	None assessed in Jan-Jun 2019	Not specified

Outcome 3: Operational research generates evidence of practical use to policy decisions on malaria diagnosis and treatment

Outcome Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
IMR (with partners) delivers relevant OR results for malaria control (NMCP and Malaria TWG consider evidence from 3 to 5 Operational Research studies over 3 years)	On track (1 OR to TWG)	3-5 OR studies by 2019	On track	3-5 OR studies by 2019

Output Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
Operation research studies complete and results analysed	On track	NA	On track	NA
IMR and partners develop and implement documented systems and procedures to institutionalise and sustain project OR benefits	On track	NA	On track	NA

Activity Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
Ongoing operation of malaria sentinel surveillance sites	On track	NA	On track	NA
Design and implementation of new operational research topics	On track	NA	On track (1 new)	NA
Number of health workers attending evidence-based medicine information sessions to improve incorrect diagnostic practice	30	Not specified	182	Not specified
Dissemination of research findings	On track	NA	On track	NA
Improved systems and procedures in IMR, SMHS, NDOH and CPHL	On track	NA	On track	NA

Outcome 4: Lessons learned from cooperation between Australia, China and PNG

Outcome Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
Advantages and challenges of joint cooperation documented	On track	NA	On track	NA
Working arrangements refined by year 4 of the Project	In progress	NA	In progress	NA

Output Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
All three country partners engaged in project planning, delivery and Joint Project Working Group	On track	NA	On track	NA
Project expenditure as a percentage of budget for annual workplan	78%	100%	73%	100%
Contributions from all partners quantified at end of project (including time inputs provided by experts)	NA	NA	NA	NA

Activity Indicator	2018 Achieved	2018 Target	2019 Achieved	2019 Target
JPWG meetings convened on a six-monthly and annual basis	On track	NA	On track	NA
TD meetings convened on a quarterly basis	On track	NA	On track	NA
Project Oversight officers engaged in Project administration	On track	NA	On track	NA
Project expenditure by cost category (implementation, governance, management, contingency)	On track	NA	On track	NA
Effective procurement of goods and services, and disbursement of payments to implementing partners, in line with value for money principles	On track	NA	On track	NA
Development of project documentation to enable effective project management, including communication, M&E, risk, and cross-cutting issues	On track	NA	On track	NA

10. Annexe 4: Monitoring against the risk matrix

Risks to project success	Likelihood / consequence	Measures built into design to manage risks	Experience in 2019
A novel partnership: this new, three-sided partnership adds to the complexity of project management and decision-making. In particular, Australia and China may have different approaches to foreign aid projects, and this may cause delays in trying to harmonise their support.	Medium / Major	Joint oversight body at high level to address issues arising (JPWG). Joint team to conduct mid-term review that will look at processes and any barriers to effective cooperation. Standard approaches for design and evaluation of project activities to build on each other's experience and approach to aid management. Clear management procedures in place to ensure effective communication and decision making.	*All decisions require approval from all three countries and where there are differences of opinion these are discussed in an open forum, with consideration for different drivers and objectives. Project partners adhere to the project principles during discussions and decision making.* *Project partners have developed strong relationships during the life of the project and approach all decisions and discussions with respect.* *Noting the project seeks alignment, rather than agreement.*
Capacity and incentives: limited capacity of key PNG institutions (CPHL and IMR) to absorb support and limited motivation for staff to introduce new ways of working.	Medium / Major	Annual plans to identify feasible and gradual expansion of roles and capacity in CPHL and IMR. Project to support additional scientific staff in CPHL, if essential to increase capacity. Project funding for OR to include researcher costs (as normal for IMR funding), to retain staff and build capacity in the Institute, especially as other research grants come to an end. Selection of technologies that are likely to be sustainable – in terms of funding and skills required.	*PNG implementing institutions drive the planning and decision-making for all activities, giving them ownership and ensuring the project is relevant.* *Continuing capacity building with CPHL permanent staff and project staff, to ensure sustainability and share the responsibilities.* *Providing capacity building opportunities for staff from PNG implementing institutions.*
Varying expectations among project partners on next steps are not met, undermining engagement and relationships between them.	Medium / Major	Involve all partners in the development of next steps after the pilot project, including a session at the JPWG face-to-face meeting in 2019. Ensure all partners have adequate time to consider the design and priorities for a follow-on project, and	*Facilitated conversation at JPWG in April 2019 to provide partners an opportunity to consider their expectations for the Phase 2 project. Representation from all three governments in the follow-on project Design Sub Working Group.*

		decision-making, design and progress is transparent.	*Delayed consideration of the Options Paper and design mission for the Phase 2 project design, to allow partners adequate time to consider the documents.* *Facilitated conversations between TD to provide an opportunity to share drivers and objective on specific activities, to help partners understand each other and move forward together.*
Personal security issues: a serious risk in PNG, which applies in Port Moresby and elsewhere. In addition to high levels of violence in the community, foreigners may be a target for economic reasons.	Medium / Major	Project to arrange security briefing and secure living arrangements and transport for Chinese and Australian visiting PNG under the project, in line with standards for others in the Australian health program in PNG. Appropriate insurance to be funded from project funds (HHISP to organise).	*Security monitored by ABT Associates security team, and Australian and Chinese partners provided for during their travel in PNG.* *Insurance provided for all travel associated with the project through HHISP.*
Procurement issues in the PNG health system limit the country's ability to treat and control malaria.	Medium / Major	Technical Project Working Group to work with NDOH to support the NMCP and associated procurement system. Project to provide assistance to NDOH to implement the NMCP and associated procurement system.	*Project partners communicate any instances of nil stocks of RDT and antimalarials to NDOH Malaria Program Manager.*
People who have received training are not able to apply their learning in their workplace for various reasons	Medium / Moderate	Project to support Partners to identify options to support people in their return to work, including support to access appropriate equipment and engagement with leaders and managers. Project to provide continuing support to people through follow-on training and additional opportunities. Project to develop training guidelines to maximise relevance of training and support for participants when they return to work.	*Developing guidelines for trainers, trainees and agencies on how to maximise the benefits of training.* *Working with PNG training recipients to support them to incorporate the training benefits into their workplace.*

Deployment of Chinese technical staff: lack of sufficient motivation for Chinese technical staff to participate in the project due to low incentives and their engagement with other programs.	Low / Major	Joint work planning by NIPD with the PNG participating agencies. Closely monitoring and reporting on the issues. Timely review of the process of TA selection and deployment.	*Workplan for the Chinese TA is jointly developed by Chinese TA and CPHL, to ensure it is appropriate and interesting.* *Selection of Chinese TA has considered their skills/experience and the expectations of the role, to ensure the person is an appropriate fit.* *CPHL and NIPD jointly recruited a new Chinese TA, to ensure the individual was suitable for the role.* *Engaging Chinese TA in the policy development associated with their role (where appropriate) to engage at a deeper level.*
Cultural differences: some Chinese technical staff may not have experienced Pacific or Australian culture and their working approach may be very different. Similarly PNG and Australian staff may have little experience of Chinese working and social culture.	Low / Moderate	Selection process for all TA to systematically consider personal skills and language skills as well as expertise. Pre-deployment briefing pack including PNG culture circulated prior to Chinese technical staff's arrival to PNG. Proper briefing provided by HHISP to all international experts and technical staff upon their arrival in PNG. Pre-visit briefing for those staff participating in training or study visits to China.	*All partners have demonstrated respect and goodwill in their dealings with each other throughout the project, and relationships have been strengthened through this partnership.* *Recruitment for a new Chinese TA was conducted, and language and experience were considerations in the joint selection by NIPD and CPHL.*
Expansion of project activities to achieve the project goals isn't appropriately monitored and assessed for risks, leaving the project unable to measure and sustain project achievements.	Low / Moderate	Ensure all project activities address the criteria and project outcomes and are sustainable. Assess the risks for individual activities, including in the current PNG context for malaria. Document any risks that are not considered in the Project risk matrix. Record and report on all project activities, as part of the Project reporting.	*The workplan and associated activities are developed by implementing partners and TD, then endorsed by JPWG.* *All activities are assessed for risks PNG implementing partners and the PMU, as well as by the Abt Associates security team.*