Senate Standing on Committee Foreign Affairs, Defence and Trade

Parliamentary inquiry – Use of the Quinoline anti-malarial drugs Mefloquine and Tafenoquine in the Australian Defence Force Hearing – 11 October 2018

ANSWER TO QUESTION ON NOTICE

Department of Defence

Topic: SSCFADT - Use of anti-malarial drugs in the ADF - Q1 - number of military people in East Timor - Gallacher

Question reference number: 1

Senator: Alex Gallacher
Type of question: Spoken
Date set by the committee for the return of answer: 2 November 2018

Question: CHAIR: To put this in perspective, we had how many people in East Timor at the time?
Air Vice-Marshal Smart: How many in total?
CHAIR: Yes.
Air Vice-Marshal Smart: I'd have to take that on notice.
Vice Adm. Johnston: A battle group, as we describe it, is about 1,100 people, but they weren't the only formations that were deployed. We can take that on notice for you.

Answer:

Defence has identified that 5,165 Australian Defence Force members (covering all three services) were 'Force Assigned' or 'Assigned for Temporary Duty' during the period August 2000 and May 2001.

Senate Standing Committee on Foreign Affairs, Defence and Trade

Parliamentary inquiry – Use of the Quinoline anti-malarial drugs Mefloquine and Tafenoquine in the Australian Defence Force Hearing – 11 October 2018

ANSWER TO QUESTION ON NOTICE

Department of Defence

Topic: SSCFADT - Use of anti-malarial drugs in the ADF - Q2 - US financial support for collaboration - Gallacher

Question reference number: 22

Senator: Alex Gallacher
Type of question: Spoken
Date set by the committee for the return of answer: 2 November 2018

Question:
Col. Nasveld: That one—the one that has got the most attention. The mefloquine/tafenoquine prevention study was funded in part by the US Army, so our arrangements were literally with the US Army. They provided funding and we provided the personnel and the equipment to conduct that study, so it was a collaborative relationship between the US Army and the Australian ADFMIDI.
CHAIR: I can understand the collaboration, but they provided what—$10,000 or $1 million? How does it work?
Col. Nasveld: I can't remember the exact number. I can take it on notice, but I think it was about $523,000 from memory.

Answer:

The United States Army contributed US $406,438.00 toward the tafenoquine prevention study conducted by the then Army Malaria Institute.

This money covered the operational costs of the study, such as consumables, equipment and external specialist medical costs.

The Australian Defence Force's contribution was to provide the study personnel, including salaries and allowances, travel, accommodation and services.

Senate Standing Committee on Foreign Affairs, Defence and Trade

Parliamentary inquiry – Use of the Quinoline anti-malarial drugs Mefloquine and Tafenoquine in the Australian Defence Force Hearing – 11 October 2018

ANSWER TO QUESTION ON NOTICE

Department of Defence

Topic: SSCFADT - Use of anti-malarial drugs in the ADF - Q3 - Review of ADFMIDI - Moore

Question reference number: 3

Senator: Claire Moore
Type of question: Spoken
Date set by the committee for the return of answer: 2 November 2018

Question: Senator MOORE: In terms of the evidence we have in the papers about your organisation—it refers to a review in 2012 with some very impressive referee comment. It's in the papers about the various organisations that value what the organisation does. What's the status of the centre now, because that review was from 2012? Where does the organisation fit now?
Prof. Shanks: We're a part of the Australian Defence Force. We're largely, but not entirely, Australian Army. A third of our people are reservists. A third are civilians, like myself, often with a military background. That organisation is ongoing. Its name has been changed because we don't just do malaria. We are interested in anything that will stop an operation, and that's our job.
Air Vice-Marshal Smart: Senator, ADFMIDI comes under Joint Health Command. The review was done at the time to look at whether we had the right structures and whether it was in the right place—those sort of things. The answer was, yes, there has been—
Senator MOORE: Was the review public?
Air Vice-Marshal Smart: We can provide copies—
Senator MOORE: Just in terms of getting on record the status of the organisation—
Air Vice-Marshal Smart: Absolutely.
Senator MOORE: It would be useful to see the review…

Answer:

The 2012 Report on the Review of the Army Malaria Institute, now known as the Australian Defence Force Malaria and Infectious Disease Institute, was an internal review and was not published publicly. As requested by the Committee, the report is attached.

VICE CHIEF OF DEFENCE FORCE GROUP

Joint Health Command

DFHC/OUT/2012/R13476134

REPORT ON THE REVIEW OF THE ARMY MALARIA INSTITUTE

References:

A. CJHLTH/OUT/2012/R11916902 *Review of AMI – Draft Terms of Reference* dated 25 Jul 12

B. AMI/OUT/2012/O4003360 *Discussion Brief – Review of Army malaria Institute* dated 10 Aug 12

C. *Report on the Review of ADF Health Services Following Transition of Garrison Health Care to Joint Health Command* dated 20 Jul 12

INTRODUCTION

1. At Reference A, VCDF directed a review be conducted of Army Malaria Institute (AMI) following an audit of financial management practices at the unit. COL Craig Schramm was appointed team leader of the review team and tasked to examine the activities of AMI, in particular the tasking and governance of the research carried out at the unit, and the capabilities required of the unit by ADF. This report will outline the methodology used to conduct the review, provide background to the review, offer observations and findings, and recommend actions to ensure that AMI continues to deliver high quality health research and clinical outcomes to the ADF.

METHODOLOGY

2. A three member review team was appointed on 25 Jul 12 and comprised COL Craig Schramm (JHC/Team Leader), Dr Ian Gardner (OHSC) and Dr Kent Harding (DSTO). The objectives of the review were to ascertain the current activities of AMI, to define current ADF requirements for AMI, and to make recommendations for the future management and governance structures for AMI. The scope of the review specifically excluded the financial management arrangements of AMI, as these had been addressed in a previous audit (Ref A).

3. The Terms of Reference (TOR) at Annex A instructed the team to examine the activities of AMI, and to develop a clear and unambiguous strategy for the future capability requirements, command and control structure, and research governance requirements. The review was directed to:

a. Identify the core capabilities Defence required from AMI;

b. Identify the scope of research activities that are required to support this Defence capability;

c. Identify clinical support activities conducted by AMI;

d. Identify the current activities of AMI that fall outside of what is required to support Defence capability;

e. Identify current collaborative research activities, and any governance considerations surrounding these;

f. Identify any additional collaborations that AMI could exploit within Defence to further whole of Defence activities (e.g. 4 x 2 medical countermeasures project being coordinated by DSTO)

g. Identify the views of external Government agencies (e.g. AUSAID) on the role of AMI in supporting whole of government activities;

h. Identify the views of other military agencies on the role of AMI, if known.

i. Recommend to VCDF a clear and unambiguous strategy for AMI in order to meet Defence's capability requirements; and

j. Recommend to VCDF an appropriate command and control structure and appropriate research governance framework (including risk management) for AMI.

4. The team collated and reviewed a wide range of documentation regarding the activities of AMI, including a brief provided by AMI detailing recent and current research activities, proposed future structures, and the future potential roles of AMI within ADF (Ref B). Additionally, a number of letters from a diverse array of military and civilian research and clinical agencies were received by the review team, detailing the support provided (Annex C). A classified report from DIO was received and is available separately. The team consulted widely and conducted a fact-finding visit to AMI, where they were briefed on current activities and how these activities relate to current capability.

BACKGROUND

5. AMI is a mixed military / civilian organisation of approximately 43 personnel located in a purpose built facility at Gallipoli Barracks in Brisbane. Its mission is to conduct lab and field research in order to prevent malaria / arthropod vector borne diseases from stopping ADF operations in the tropics. Malaria field research must be done overseas in malarious areas of current and potential interest to the ADF. AMI is a hybrid organisation that reports through the Joint Health Command and currently conducts scientific research independently and in collaboration with a number of other research organisations, most notably through an affiliation with the University of Queensland (UQ).

6. Historically, command and control of AMI has fallen under a variety of military organisations including: Land Headquarters; Director Army Health, Defence Support Group, Defence Personnel Executive, and Joint Health Command. AMI currently receives limited funding from the ADF, such that many projects, particularly field research, require obtaining outside funding from scientific (NHMRC) or other agencies (AusAID). Prior to AMI relocating to Enoggera, an MOU was in place with the University of Sydney. Upon relocation in 1998, an MOA between the Commonwealth, the University of Queensland (UQ), and the Queensland Institute of Medical Research (QIMR) regarding AMI, was developed but never enacted (Annex D).

7. Currently, ADF does not have large numbers of personnel deployed to malaria endemic areas in our region. This does not mean that AMI is idle. AMI has an ongoing task to ensure

that they can provide current advice on health threats in our region, including the most effective countermeasures to these threats. At present, this task is principally achieved through studies resourced by external funding sources. Additionally, AMI provides a clinical role to ADF as a reference laboratory for malaria, as well as a number of other vector-borne diseases.

OBSERVATIONS AND RECOMMENDATIONS

Core Capabilities Required From AMI

8. A number of core requirements have been identified for AMI. These requirements are those which directly support ADF capability. AMI capabilities which are considered core business, and essential to maintenance of ADF capability in our region include:

a. Support to Operations and Exercises – A number of vector-borne diseases are endemic in Australia's training areas. The ability to recognise and counter these threats are essential to maximise capability in both deployed operations and training;
b. Vector and pathogen risk assessments;
c. Vector-borne disease prevention and treatment advice. AMI provides evaluation and advice on medical countermeasures to vector borne diseases – particularly prevention and treatment in military populations;
d. Knowledge base – It is essential that JHC remains aware of new drugs and vaccines relevant to our region. This work is currently conducted by AMI;
e. Contribute to biosurveillance –regional health intelligence – including specialist advice to DIO;
f. Support to WoG initiatives as mandated by Defence.
g. Maintenance of Central Malaria Registry. This is an essential reference laboratory capability for the region;
h. Maintain a deployable capability for support of Health Assessment Teams and ongoing operations;
i. Provision of tropical medicine and specialist travel medicine advice;
j. Provision of IET training on vector borne disease for preventive medicine personnel on behalf of ALTC; and
k. AMI maintains a clinical trials capability for medical countermeasures against vector-borne diseases. This allows ADF to investigate the most appropriate medical countermeasures for ADF personnel in operational environments.

Research Activities in Support of Defence Capability

9. The following broad research areas, conducted by AMI, are in direct support of Defence capability:

a. Pathogen strain identification and tracking, including determination of drug sensitivities and resistance;
b. Evaluation effective and safe prophylactic treatment regimes for ADF members; and

c. Evaluation of repellents, drugs and vaccines, including the evaluation of repellents for skin, clothing, tents, and bed nets).

Clinical Support Activities

10. AMI conduct a range of clinical support activities related to ADF capability. In some cases, these activities are not readily available in the Australian health system. Clinical support activities include:

a. The ability to identify pathogen strains and the maintenance of a strain database;
b. Tropical medicine and travel medicine advice to ADF;
c. Malaria and viral diagnostics. Currently deployed laboratories are failing to diagnose approximately half of all dengue cases in patients with fevers of unknown origin. AMI fulfils a reference laboratory role for ADF personnel. Diagnosis is conducted using both molecular diagnostic techniques and microscopy. This clinical role requires NATA or other relevant accreditation;
d. The conduct of drug level assays. This capability is essential in the investigation of treatment and prophylaxis failures, compliance, and gender differences in drug metabolism;
e. The conduct of blood smears for malaria diagnosis. AMI has the greatest concentration of certified microscopists in Australia. This expertise enables AMI to conduct credentialing microscopy courses for ADF personnel on behalf of WHO; and
f. Development of diagnostic assays for emerging health threats. AMI has demonstrated the ability to develop assays for viral threats within days. This was most recently conducted for Chickungunya virus.

Activities Which Fall Outside ADF Capability Requirements

11. Whilst a number of activities were identified as being carried out with and for for external agencies, it is assessed that these contribute significantly to ADF capability. Additionally, many of these activities contribute to skills maintenance, health intelligence gathering, and come at little or no expense to ADF. While consistent with the core capabilities of AMI, recommendations for oversight are warranted.

Current Collaborative Research Activities

12. AMI currently undertake a number of collaborative research activities in conjunction with military and civilian organisations. These are detailed in Reference B. The governance arrangements surrounding these activities vary between organisation. Research activities involving ADF personnel are conducted under the oversight of the Australian Defence Human Research Ethics Committee (ADHREC). Other research activity is governed through either the National Health and Medical Research Council (NHMRC) or QIMR. Most stakeholders consulted recognised that the role played by AMI as a centre of excellence in vector-borne disease research contributed significantly to ADF, WoAG, and globally.

Additional Collaborative Activities Within Defence

13. AMI has a range of capabilities, particularly in the areas of pharmacokinetics/pharmacodynamics, and viral diagnostics, which could be of benefit under the new Quadrilateral CBR Medical Countermeasures Consortium coordinated by DSTO. Tasking in this area needs to be coordinated and facilitated by JHC, with input from the Australian Medical Countermeasures Steering Committee

Organisation and communication

14. During the course of the review it became evident that there has been less than optimal communication between JHC and AMI. This has resulted in AMI taking on a semi-autonomous role in the determination of taskings and research priorities. While this has had the effect of the maintenance of skills and knowledge within AMI, it has also exposed Defence to risk. Some research tasks may not have met Defence priorities, and may have had potential for damage to reputation. Many of these tasks have also had the effect of increasing ADF knowledge of health threats and capabilities within the region. Strong regional relationships have been built with clinicians and laboratory networks, which have provided essential health intelligence information to DIO.

15. There is a widespread lack of understanding of the activities of AMI in support of Defence. While AMI bears some responsibility for this, in part, this may be a result of something so fundamental as the unit name. The name "Army Malaria Institute" gives an incorrect impression of both the organisational structure and the activities of the unit. While it maintains some historic ties, the renaming of the unit may alleviate considerable misunderstanding.

Recommendation [1]: That the unit be renamed as the Australian Defence Force Vector Borne Diseases Institute, or some other name which is acceptable to stakeholders.

16. The retention of AMI under command of JHC will allow the most direct tasking of a dedicated health research unit. Although it may be possible for AMI to be transitioned to another command structure, such as DSTO, it is considered that such a move would deprive JHC of both the flexibility and agility to respond to emerging health threats.

Recommendation [2]: AMI remain under command of JHC, specifically the Policy and Research Coordination Branch.

Recommendation [3]: JHC investigate potential efficiencies to be gained from the transfer of routine administrative support to Regional Health Service- Queensland.

17. Whilst there had been some direction to AMI regarding research priorities, this has been in general terms only, and is somewhat out of date. The most recent formal direction that could be found from JHC is dated 2006 (Ref B). It is essential that tasking is provided in a standardised and unambiguous format.

Recommendation [4]: JHC conduct a review of current taskings to AMI in order to ensure that they meet with current requirements. This must take into account input from other ADF stakeholders.

Recommendation [5]: Tasking to AMI should be conducted using the *Science and Technology Support Request* format, currently also utilised by DSTO.

18. Reporting from AMI to JHC has also been less than adequate. AMI reporting has consisted primarily of an annual report. This does not adequately address contemporary governance requirements, and does not provide JHC with adequate information to command and control.

Recommendation [6]: JHC direct that AMI activities are reported quarterly, via the Directorate of Health Research, to ensure coordination of research effort across JHC.

19. AMI has been successful in attracting external research funding to support its activities. This has not always been visible to JHC, and concern has been raised regarding appropriate management of external funds.

Recommendation [7]: All research proposals involving AMI are to be approved by JHC, regardless of funding origin.

20. The structure of JHC headquarters, including clear lines of operations, groups and tasks, and identifiable interlocutors aligned with the Services' common staff systems, is not well understood either internally or externally (Ref C). The team also observed that the direct staff support to CJHLTH lacks depth in comparison to similar commands.

Recommendation [8]: VCDF direct a review of the JHC HQ structure, including consideration of a common staff system, where practicable, to align with key ADF stakeholders.

21. There is no single coordinating and controlling authority for health research activities within JHC. Although there is a Directorate of Health Research, it is inadequately resourced to conduct this essential task.

Recommendation [9]: JHC review the role and structure of the Directorate of Health Research in order to achieve a central coordination point for all health research in JHC.

Finance

22. JHC has an annual budget allocation of approximately $400m. There is however a strong view that this is insufficient to allow JHC to meet all of the assigned responsibilities. AMI has been successful in obtaining significant external funding for its activities. These activities have tangible benefits to Defence, and are a cost-effective way of maintaining capability.

Recommendation [10]: VCDF direct a review of the financial management requirements of AMI, including appropriate mechanisms for the management of external research funding.

Facilities

23. AMI occupy a purpose built facility at Gallipoli Barracks. The facility was constructed in 1998, and requires substantial ongoing maintenance. The laboratories and

animal house will require investment in the near-mid term.

Recommendation [11]: JHC conduct a detailed analysis of the current state of the AMI facilities at the earliest opportunity. The analysis is to include the impact and cost of ongoing maintenance of ageing facilities and should articulate actions to be taken to manage impacts.

CONCLUSION

24. The Review Team observed that for a number of reasons there had been a lack of communication between JHC and AMI which had led to a reduction in the degree of oversight of AMI activities. AMI continue to provide a world-class service to Defence, as well as a meaningful contribution to Whole of Government activities in the prevention and treatment of malaria and other vector-borne illnesses in the region.

25. The JHC ownership of AMI remains the appropriate course of action for the ADF. However, a number of changes to the management of the unit are required to optimise the capability outputs, and to reduce organisational risk. More proactive direction from JHC to AMI, and more effective reporting from AMI are essential to the successful regeneration of trust between the organisations.

26. AMI remains under-resourced for the role it is required to provide. This is currently mitigated through external funding provided by a number of organisations. It is the management of this external funding which initially drew attention to the current activities of AMI. The solution to this issue is the development of appropriate financial and research governance frameworks which enable AMI to continue to provide a valuable resource to Defence, yet provide exceptionally good value for their Defence funding levels.

C.A. SCHRAMM
COL
Review Team Leader

13 Dec 2012

Annexes:
A. AMI Review Team TOR
B. AMI provided discussion Brief
C. Letters received from external organisations
D. Unsigned Agreement between Commonwealth of Australia and The University of Queensland and The Council of the Queensland Institute of Medical Research in Relation to The Australian Army Malaria Institute dated 27 Feb 98

VICE CHIEF OF THE DEFENCE FORCE
JOINT HEALTH COMMAND

CJHLTH/OUT/2012/R11916902

BRIEF FOR VCDF

REVIEW OF AMI – DRAFT TERMS OF REFERENCE

BACKGROUND

1. **Reason for Brief.** Recommendations from the CAE audit of AMI (12-068) required JHC to:

   a. develop a clear and unambiguous strategy to deal with future activities of AMI;

   b. undertake a risk assessment of AMI's activities to identify all potential risks in the area and assist AMI to put the appropriate arrangements in place in terms of its finance and research activities to ensure that AMI continue to provide world class research; and

   c. develop a submission to the CDF outlining options for the future of AMI.

2. **Scope of brief.** This brief will propose the Terms of Reference for a Review of the AMI which will address the recommendations of the Audit.

RECOMMENDATIONS

3. It is recommended that you

   a. **agree** to the proposed TOR for the Review, and

   b. **sign** the TOR.

REVIEW DETAILS

4. It is proposed the Review Team is led by COL Craig Schramm (Director Future Health Capability, JHC) supported by Dr Kent Harding (DSTO) and Dr Ian Gardner (DPG). Dr Harding is the Chief Scientist of the Canadian Defence Research and Development Centre Suffield who is on attachment with DSTO in Australia for one year. Dr Gardner is the ADF Senior Physician in Occupational and Environmental Health. Due to conflicting work priorities and planned leave arrangements the Review Team will not be able to formally commence until 08 October although it is envisaged that data collection will occur between now and October. It is envisaged that the report can be finalised within 5 weeks.

CONSULTATION

5. **Authorities Consulted.** Dr Ian Sare (DSTO), Dr Ian Gardner (DPG), Prof Dennis Shanks (AMI), Col Craig Schramm.

6. **Conflicting Views.** Professor Shanks noted "Although I find this detailed list more appropriate to a specific investigation rather than a general review of a unit and its mission, I have no further issues to add to this list

CONCLUSION

7. The proposed review of AMI will address the recommendations made by the CAE in his report IAW the agreed audit response timelines.

RECOMMENDATIONS

8. It is recommended that you

   a. **agree** to the proposed TOR for the Review, and

   b. **sign** the TOR.

(a) AGREED / NOT AGREED
(b) SIGNED / NOT SIGNED

R.M. WALKER
RADM, RAN
CJHLTH

25 Jul 12

M.D. BINSKIN
AIRMSHL
VCDF

25 Jul 12

Prepared by: RADM R. WALKER CJHLTH 24 Jul 12

Enclosure:
1. Draft TOR

Army Malaria Institute Review Team

Terms of Reference

The review of the Australian Army Malaria Institute is to:

- Identify the core capabilities Defence required from AMI;
- Identify the scope of research activities that are required to support this Defence capability;
- Identify clinical support activities conducted by AMI;
- Identify the current activities of AMI that fall outside of what is required to support Defence capability;
- Identify current collaborative research activities, and any governance considerations surrounding these;
- Identify any additional collaborations that AMI could exploit within Defence to further whole of Defence activities (e.g. 4 x 2 medical countermeasures project being coordinated by DSTO)
- Identify the views of external Government agencies (e.g. AUSAID) on the role of AMI in supporting whole of government activities;
- Identify the views of other military agencies on the role of AMI, if known.
- Recommend to VCDF a clear and unambiguous strategy for AMI in order to meet Defence's capability requirements; and
- Recommend to VCDF an appropriate command and control structure and appropriate research governance framework (including risk management) for AMI.

M.D.BINSKIN
AIRMSL
VCDF

R1-5-B025

4 Jul 12

AMI/OUT/2012/O4003360

DISCUSSION BRIEF

REVIEW OF ARMY MALARIA INSTITUTE

BACKGROUND

1. **Army Malaria Institute review to clarify its structure, mission and resources.**

2. **Scope of brief.** This brief will describe issues needing resolution from the AMI review:

   a. Hybrid mission / structure of AMI

   b. Possible models for modified structure of AMI

ROLE AND MISSION OF AMI TO 2027

3. AMI is a mixed military / civilian organisation of 43 persons located in a purpose built facility on Gallipoli Barracks near Brisbane. Its mission is to conduct lab and field research in order to prevent malaria / arthropod vector borne diseases from stopping ADF operations in the tropics. Malaria field research must be done overseas in malarious areas of current and potential interest to the ADF. AMI is a hybrid organisation that reports through the Joint Health Command for military purposes and conducts scientific research independently and in collaboration with a number of other research organisations, most notably through an affiliation with the University of Queensland (UQ). Mission priorities need rethinking especially given acute fiscal limitations of ADF and difficulties adapting government accounting structures to external research funding.

WHERE AMI FITS INTO THE AUSTRALIAN DEFENCE FORCE

4. Historically AMI has fallen under a variety of military organisations: Land Command Headquarters; Director Army Health, Defence Support Group, Defence Personnel Executive, and Joint Health Command. Although its mission relates to military deployments, AMI is disconnected from any operational planning process and fits poorly into an organisation designed to deliver health care in Australia. AMI's primary mission of preventing malaria and other vector borne diseases in deployed ADF members would be better addressed if AMI was part of a deployable

1

military force such as 17 Combat Service Support (CSS) Brigade (BDE). Research for military specific issues in the ADF occurs under the Defence Science Technology Organisation (DSTO). Academic research at Universities can co-exist with military organisations, (e.g. Centre for Military Veterans' Health at UQ) but priorities and funding patterns are quite different. AMI receives very little operational funding from the ADF such that any projects, particularly field research, require obtaining outside funding from scientific (NHMRC) or other agencies (AusAID).

ADMINISTRATIVE STRUCTURE MODELS

5. AMI must conduct medical research in order to accomplish its military mission. The hybrid nature of the task means that current structures do not work well especially in handling external funding. Hybrid models suggested have had military connections though 17 CSS BDE or DSTO. Although AMI is associated with UQ, it is not a part of UQ. Academic options include becoming an organic part of UQ through the School of Population Health or another University.

CONCLUSION

6. AMI's mission needs to be confirmed as being the provision of support to military operations, while scientific research is concurrently undertaken to advance knowledge and maintain scientific capability between deployments. Hybrid models for AMI containing both military and academic components would seem to best fit into combinations such as 17 CSS BDE / DSTO or University. AMI has to be exempted from many current JHC requirements such as overseas travel limitations or moved to another group with research (DSTO) or operations (17 CSS BDE) emphasis.

G.D. SHANKS
PROF
DIRECTOR AMI
Bld K10, Gallipoli Bks
ENOGGERA QLD 4051

August 2012

List of attachments to discussion brief:

3

Military Relevance of the Army Malaria Institute to the ADF

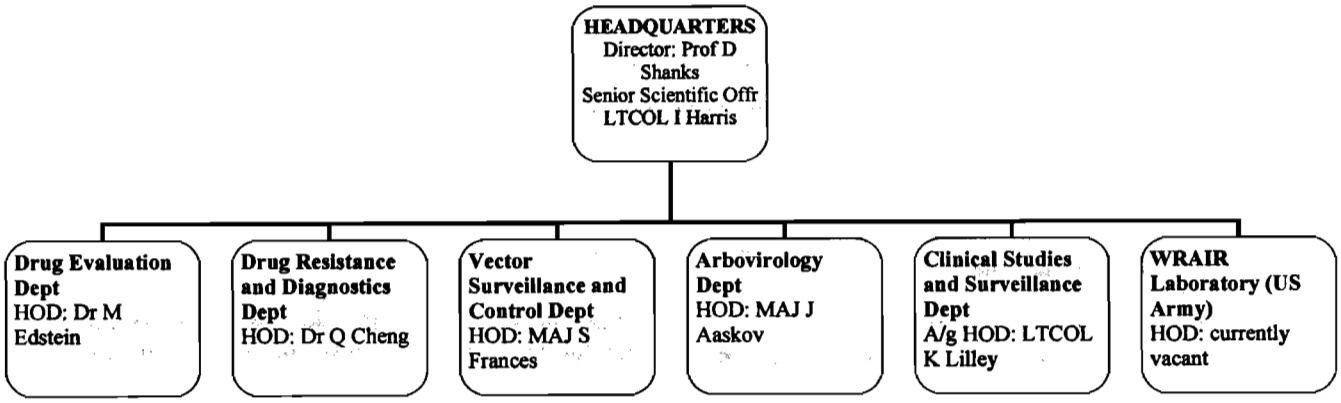
Combat operations of the ADF have been stopped three times by malaria: 1918 in Palestine, 1942-3 in New Guinea, 1968 in Vietnam. In each case disease casualties in excess of 1% per day left too few soldiers to accomplish the military mission. Also in each of the three instances, the Army Malaria Institute in its earlier forms was present (Mobile Malaria Diagnosis Station, Land Command Medical Research Unit, Army Malaria Research Unit) to prevent further malaria casualties. There are very few, if any, Australian Army units of < 50 persons that can claim to have made a major contribution by maintaining the Army's fighting strength in three wars.

The most recent major operational involvement of AMI was in East Timor 1999-2001. Lack of understanding of epidemic malaria in civilian disaster settings and ineffective use of chemoprophylaxis led to an outbreak of 400 malaria cases within the ADF, largely of relapsing malaria following return to Australia. AMI deployed as a unit to East Timor >2 years, provided immediate assistance to control the malaria epidemic, and conducted a successful field trial of a new antimalarial drug. The battalion commander of the unit that participated in the antimalarial drug trial with AMI was proud to be able to state his unit had no malaria cases while in East Timor.

AMI's military relevance continues for the most likely ADF contingency missions in the Asia Pacific Region. This is particularly true for the island states of Papua New Guinea and Solomon Islands, both nations having recently experienced armed conflict and associated political instability. Any deployment into PNG by the ADF would certainly experience malaria casualties and AMI remains the knowledge and experience base on how to prevent such losses. Through research AMI has built up its expertise in risk assessment, health intelligence and surveillance, chemo-prophylaxis, diagnosis, treatment and control of malaria and dengue. The ADF needs to preserve these skills and capabilities to minimize disease casualties when on tropical deployment.

AMI is valuable not only in preventing malaria but also in promoting social stability in fragile regional states through malaria control. Malaria has just been named by the Department of Foreign Affairs as a foreign policy priority of the Australian Government due to its pervasive effects on development in the Asia Pacific. A Whole of Government approach to malaria is being pursued in which AMI is already playing a part through the Pacific Malaria Initiative of AusAID. Malaria is also a great practical concern to large resource projects currently being developed in PNG. AMI is already collaborating with Esso Highlands and Wafi Golpu Joint Venture helping them to better control malaria in their work forces which closely approximates a deployed military unit.

AMI has conducted a very successful military to military engagement project with the Vietnam People's Army through the 12 year Vietnam Australia Defence Malaria / Dengue Project which has given the Vietnamese Army its own medical research capability. This collaboration has recently been expanded to include the US Navy's Naval Medical Research Unit 2 (NAMRU 2) from Singapore. Both the US Army Walter Reed Army Institute of Research and US Navy's NAMRU 2 either have or are considering posting US military officers to AMI as an important element of their regional medical research plans. AMI provides critical medical intelligence information on malaria and other infectious diseases of military importance through its wide network of contacts and extensive travel in the Asia Pacific region. A recent example was information following Cyclone Nargis in southern Burma requested by Director Strategic Health. AMI also provides travel medicine advice to ADF medical officers regarding protection against infectious diseases. In summary, AMI has valuable scientific experience and disease control capabilities, remains highly relevant to the ADF and should be retained in order to prevent mission failure due to disease epidemics during future ADF deployments in the Asia Pacific region.



Dr M Edstein
Dr M Chavchich
Dr G Birrell
Ms D Abberton
Ms K Rowcliffe
Mr T Travers
Mr S Mcleod-Robertson
Ms N Walpole
6 GRES
1 contractor

Dr Q Cheng
Dr N Chen
MAJ A Auliff
CAPT J Baker
LT S Dowd
1 GRES
3 contractors

MAJ S Frances
CAPT W Chow
LT L Rigby
2 GRES

MAJ J Aaskov
Dr W Liu
LT M Rourke
LT K Lowry

LTCOL K Lilley
CAPT F McCallum
3 GRES

HOD (US) Vacant
1 contractor
1 PhD student

HQ cell
Prof D Shanks
LTCOL I Harris
Ms B Green
2 GRES

Summary of Research Department Activities at Army Malaria Institute

Department of Clinical Studies and Surveillance (CSS)

Background and Research Activities

The role of the Clinical Studies and Surveillance Department (CSS) is to conduct clinical evaluations of antimalarial drugs and vaccines against vector borne diseases (VBD), and to monitor and evaluate the occurrence of VBD in order to optimize the protection of Australian Defence Force personnel against these diseases. CSS is the field studies arm of AMI that conducts malaria surveys, malaria drug studies and clinical vaccine trials against arboviruses such as dengue.

Capabilities and Major Achievements since 1997

- **Dengue vaccine study 2010-12:** Quadravalent live-attenuated dengue vaccine for registration in Australia if on-going efficacy studies in SE Asia continue to show protection.
- **Primaquine short course study East Timor 2009-11:** Modified post exposure regimen of primaquine tested for safety and tolerance in returning ADF soldiers.
- **Multiple malaria surveys in Vanuatu and Solomon Islands 2008-12:** Conducted in Tanna and Erromango Islands, Vanuatu as well as Santa Cruz, Isabel and Nggella Islands in Solomon Islands.
- **Health survey of PNG Defence Force personnel 2008:** Malaria, tuberculosis and other infectious disease survey of otherwise well PNGDF soldiers in both Port Moresby and Lae.
- **Japanese Encephalitis vaccine study 5 year follow up 2005-11:** Chimeric JE vaccine volunteers in ADF followed for 5 years in order to determine booster requirement for those deploying repeatedly to endemic areas of SE Asia.
- **Japanese Encephalitis vaccine study 2003-06:** randomized double-blind evaluation of safety and immunogenicity of genetically modified JE vaccine from yellow fever vaccine virus backbone. This vaccine is now registered in Australia but has not yet been released.
- **Tafenoquine vivax treatment study 2004-06:** Use of long-acting primaquine analogue for the treatment and prevention of relapse in soldiers returning from Melanesia with multiple relapses of vivax malaria.
- **Tafenoquine vivax prevention study 2002-08:** Three different post-exposure treatment regimens used to treat vivax malaria relapses in Australian soldiers following deployment to Bougainville PNG and East Timor.
- **Tafenoquine chemoprophylaxis study 1999-2003:** Battalion group in East Timor placed into randomized, blinded, active control trial of tafenoquine for malaria prevention while under exposure as well as following return to Australia.
- **Live attenuated dengue vaccine study 1999:** Trial of partially attenuated live dengue vaccine curtailed soon after vaccine was found to be inadequately attenuated for human use.
- **Education:** Frequent national and international malaria microscopy certification courses for senior pathology and public health technicians.

Department of Vector Surveillance and Control (VSC)

Background and Research Activities

The mission of the Department of Vector Surveillance and Control (VSC) is to provide the ADF with the best possible risk assessment, surveillance and protection against vectors of disease, and provide advice on control measures available for vectors, especially mosquitoes. The main activity is the evaluation of personal protection measures used by the ADF under field conditions and surveillance for mosquito and other arthropod vectors at ADF training sites and likely areas of deployment regionally.

Capabilities and Major Achievements since 1997

- **Malaria vector studies** of the distribution and transmission potential of mosquitoes in Papua New Guinea (1992-1997), Bougainville (1999), Timor Leste (2000-2001), Vietnam (2002-2010), Vanuatu (2007) and Solomon Islands (2008-2012).

- **Longitudinal surveillance** of arbovirus vector density, seasonality and infection rates in Shoalwater Bay Training Area (1998-2000) and Wide Bay Training Area (2005-2006). Provided entomological support to 2GHB health assessment team for surveillance of vectors and arboviruses at Townsville Training area (2010) and SWBTA (2011).

- **Repellents**: Conducted comparative tests of the ADF insect repellent formulation and against a variety of comparable products both commercial and military

- **Permethrin Treatment of ADF Disruptive Pattern Combat Uniforms** (DPCU): Conducted initial evaluation and recommended the treatment and retreatment regime of DPCU and ADF mosquito bednets.

- **Bed nets**: Conducted evaluation of protection provided by low profile bednets against malaria vectors in Bougainville (1999), and user acceptability of low profile bednets by patrolling soldiers in Timor-Leste (2001). The studies showed that ADF bednets were preferred by patrolling soldiers and provided excellent protection to personnel sleeping under them.

- **Barrier Protection**: Field evaluation of the treatment of ADF tents with bifenthrin as a barrier to mosquitoes conducted at Mt Bundey in 2003 and at Wide Bay Training area in 2005.

- **Training**: Conducted vector borne disease surveillance and control course for initial employment training for ADF Preventive Medicine technicians (2004-2012).

7

Department of Drug Evaluation (DE)

Background and Research Activities

The key function of the Department of Drug Evaluation (DE) is to find more effective prophylactic and therapeutic antimalarial drugs for the ADF, so that its personnel have the best available drugs to counteract drug resistant malaria in operational areas. DE achieves this by pursuing both preclinical and clinical development and evaluation of new antimalarial drugs and rational dose regimens.

Capabilities and Major Achievements since 1997

- **Preclinical drug development:** Evaluation of novel antimalarial compounds synthesized by the University of Queensland, Griffith University, the Australian Defence Force Academy at University of New South Wales, Jacobus Pharmaceutical Company, and Novartis Institute of Tropical Diseases, with funding support from the Australian National Health and Medical Research Council and the pharmaceutical industry.

- **Evaluation of a new DHFR inhibitor:** In collaboration with US Army and Jacobus Pharmaceutical Company, DE is leading the preclinical development of the 3rd generation dihydrofolate reductase (DHFR) inhibitor JPC 2997.

- **Evaluation of the new artemisinin derivative, artemisone:** In collaboration with the University of Hong Kong, Bayer Pharmaceuticals and Medicine for Malaria Venture.

- **Trials of different forms of ACT in Vietnam:** Since 2000, the SIPDIV sponsored defence cooperation with the Vietnamese People's Army has completed six field malaria treatment trials of ACTs and six hospital based pharmacology studies in healthy Vietnamese soldiers.

- **Participation in U.S. Department of Defense Global Emerging Infectious Surveillance (GEIS) program and collaboration with the US Navy:** In 2012, DE and US Navy Medical Research Unit 2 successfully obtained GEIS funding to collaborate with the Vietnam People's Army in the identification and monitoring of the spread of drug resistant malaria in Vietnam.

- **Timor-Leste (2009-2010):** Evaluation of the new regimen of primaquine to improve compliance and prevent relapses of vivax malaria in soldiers.

- **Timor-Leste (2000-2004):** Evaluation of tafenoquine to protect ADF personnel from malaria infections by US Army sponsored study.

- **Bougainville, Papua New Guinea (1999-2001) and Timor-Leste (2000-2002):** Evaluation of tafenoquine in preventing recurring vivax malaria after deployment.

- **Thailand (1998-2000):** Optimisation of the dose regimen of tafenoquine to prevent malaria infections in the Royal Thai Army

Department of Drug Resistance and Diagnostics (DRD)

Background and Research activities

Early, accurate diagnosis and appropriate treatment are key to prevent severe complications and death caused by malaria parasites, particularly in non-immune ADF personnel. DRD's focus has been to improve malaria diagnosis, to understand why and where antimalarial drugs are not effective. DRD has been actively exploring and evaluating novel malaria diagnostics which include molecular and rapid diagnostic tests (RDTs). Activities also include elucidating drug resistance mechanisms and molecular markers in malaria parasites with the aim to ensure effective treatement, to reduce the risk of relapse and to develop better drugs against parasites. DRD has provided malariometric data for malaria elimination efforts in Solomon Islands.

Capabilities and Major Achievements since 1997

- **Advise, perform and improve malaria diagnosis.** Investigated the performance and quality assurance of Malaria RDTs (partially funded by the WHO & FIND). The outcomes help to improve the performance of RDTs and to ensure only quality RDTs are procured by the WHO, NGOs, Country malaria programs and the ADF. Also the confirmation of malaria diagnosis for ADF personnel by microscopy and PCR. This information helps clinicians better manage patients and ensure the accuracy of data entered into the ADF central malaria register.

- **Identify phenotype and genotype markers for drug resistance in malaria parasites through the:** discovery of the mechanism of atovaquone resistance (Atovaquone is the major active component of Malarone used for malaria treatment by ADF); discovery of Arteminisin (ART) inducted dormancy as a cause of treatment failure and established a link between dormancy and ART resistance (partially funded by NIH); establishment of the mechanism of innate and acquired resistance to sulfadoxine in *P. vivax*; identification of the mechanism of antifolate treatment failures in *P. vivax* using a cutting edge gene transfection technology; and investigation of the phenotype change and molecular marker for CQ and mefloquine resistance in *P.* vivax in collaboration with Menzies School of Health Research.

- **Detect the development and monitor the spread malaria drug resistance through the:** determination of efficacy of chloroquine and Fansidar in East Timor; investigation of the evolution of chloroquine resistance in the Pacific region (partially funded by NIH); and monitoring of malaria drug resistance in the Pacific region (partially funded by Global Emerging Infectious Diseases (GEIS), US Department of Defence).

- **Investigate parasite biology relevant to the disease** through the investigation of relapse patterns and intervals, as well as genetics of parasites causing relapses in ADF personnel returning from East Timor. The findings help to reduce relapses.

- **Investigate malaria status and parasite population in different areas through the** assessment of baseline malaria status (partially funded by AusAID) using molecular tools. This allowed us to determine malaria prevalence, the type of parasites, their distribution and the drug resistance profile prior to elimination.

Department of Arbovirology (AV)

Background and Research Activities

The Arbovirology Department identifies risks posed to the ADF by mosquito-borne viral (arboviral) diseases and undertakes research into methods to prevent/minimise this risk. The Arbovirology Department participates in a regional arbovirus surveillance network which identifies viruses introduced, or emerging, in areas of interest to the ADF and makes this information available to Defence Health Intelligence and to HQ JOC. AMI staff played a pivotal role in providing diagnostic capacity during the large outbreak of dengue among the ADF in Timor Leste in 1999-2000.

The most effective defence against arboviral infections is immunisation. However, there are no vaccines against the most significant threats (dengue and Ross River viruses) and the original vaccine against Japanese encephalitis was of dubious value and the long immunisation schedule meant it was not "deployment-friendly". The Arbovirology Department initiated and supported the clinical trial of the Sanofi-Pasteur Japanese encephalitis vaccine and Australia became the first country in the world to license this vaccine. The ADF will soon be able to deploy personnel within 2-3 weeks of a single dose of this vaccine. The Arbovirology Department also initiated the recent trial of a dengue vaccine in adults essential for registration in Australia (international trials have focussed almost exclusively on children) and provided laboratory support for a phase I/II trial of a vaccine against Ross River virus infection.

The Department plans to expand its research activities to include a study of the role of arboviruses which are not being detected by conventional diagnostic methods in causing diseases and disability among ADF personnel.

Capabilities and Major Achievements since 1997

- **Established an arbovirus research and surveillance capacity** at AMI supported by a high containment capable (BSL 3) laboratory.
- **Completed dengue vaccine trial in 100 adult volunteers in Australia** using an investigational product from Sanofi Aventis, 2012.
- **Japanese encephalitis (Chimerivax® JE, Sanofi Aventis)** vaccine licensed, 2010.
- **Phase I/II clinical trial of Ross River virus vaccine** completed, 2010.
- **Demonstrated that sudden changes in dengue virus strains** at any locality are a predictor of major outbreaks of dengue due to the imported strains in collaboration with the U.S. Armed Forces Research Institute of Medical Sciences (AFRIMS), Bangkok, Thailand.
- **Established a dengue surveillance system in Vietnam** with the Vietnam Peoples Army and identified the flow of dengue viruses into and within the country.
- **Participated with VSC in monitoring arthropod borne viral diseases** in ADF training sites in Australia (Wide Bay, Shoal Water Bay).
- **Have become a significant source of information relating to arboviral disease** in the Asia Pacific region for the Defence Health Intelligence Section.

Influenza Virology

Background and Research Activities

Although not a separate department, additional virology work has been done at AMI regarding pandemic influenza particularly how it has affected military units in the past. Using extensive named individual unit and casualty lists from the 1918-19 influenza pandemic at the end of the First World War, we have been able to reconstruct its lethal consequences in great epidemiological detail. This is important because the reason the 1918 pandemic killed approximately 50 million people and 2009 killed at least 100 fold less even though caused by very similar viruses is not understood. This remains a critical gap in preparation for future pandemics. AMI has done this public health research in conjunction with our collaborators at the Australian Defence Force Academy of the University of NSW, Centre for Military and Veteran's Health at the University of Queensland and the Armed Forces Health Surveillance Center of the US Department of Defence. Extensive use of the Defence Library Service has occurred and we are particularly grateful to the Library staff at Gallipoli Barracks for their assistance in finding the raw data which drove these studies.

Capabilities and Major Achievements since 2007

- **Variable effect of 1918-19 influenza pandemic on military units** Some Australian military units had >1% of their personnel die while other similar units next to them had no deaths. This unexplained heterogeneity gives a means of dissecting the epidemiological causes of mortality during the pandemic especially given the ability to control for other factors in a military environment. Naval ships had few deaths during the pandemic despite large infection rates unless they were on isolated patrol duty in the Southern Hemisphere where >5% of the crew died on some cruisers. Our findings indicate that one's previous history of respiratory infections particularly in the recent past largely determined one's mortality risk during the pandemic. We are currently testing specific immunological hypotheses in swine infection models with collaborators at the US Department of Agriculture at the University of Iowa.

- **Severe viral epidemics on small Pacific Islands** Epidemic viral disease including but not limited to influenza devastated the Pacific Islands in the 19th and early 20th centuries. Population collapse of up to 90% allowed the disappearance or displacement of many Melanesian, Polynesian and Micronesian cultures. Measles was particularly devastating even to adults. Their vulnerability to lethal epidemics was widely observed, but never explained. Using unique data sets from the isolated island of Rotuma, we have described one of these "virgin soil" epidemics in great detail and are now working on its possible genetic components. A historian at the University of Cape Town has given us detailed mortality records from the Boer War Concentration Camps where half of the children died largely of pneumonia and measles. We are currently comparing the lethality of measles in the two very different settings in hopes of further defining mortality risk factors for future epidemics of exotic viruses.

Translational Medicine at the Army Malaria Institute

AMI collaborates with a network of pharmaceutical and research establishments to develop new drugs and vaccines that address important disease problems relevant to the ADF. These products are usually not commercially viable thus requiring material assistance if the ADF is to actually have the best preventive measures for malaria and other vector borne diseases available for use in its soldiers. Three vaccines and one antimalarial drug are either registered or will soon be presented to the Therapeutic Goods Administration (TGA) in which AMI played an important role in progressing the product from idea to a usable pharmaceutical.

1. **Tafenoquine to prevent malaria:** Tafenoquine is a long-acting primaquine analogue used for chemoprophylaxis especially against relapsing malaria such as *P vivax*. The vast majority of people ever to receive tafenoquine under investigational drug trial procedures have been Australian soldiers (>2000) in field trials designed and executed by the Army Malaria Institute. These have been conducted in clinical settings in Brisbane as well as field studies in deployed soldiers. Because of the safety and efficacy information gained during operations in Timor-Leste, the US Army (tafenoquine's sponsor along with GlaxoSmithKline) intends to submit tafenoquine for registration first in Australia. If licensed tafenoquine will provide an easier and thus much more reliable means of preventing malaria in soldiers deployed to endemic areas.

2. **Japanese Encephalitis (JE) Vaccine:** The currently used killed JE vaccine requires multiple doses over months making it difficult to rapidly prepare a unit for deployment into the area within a triangle formed by Pakistan, Korea and Indonesia. The new Sanofi Aventis product, JE Chimerivax®, requires a single dose of a modified live attenuated yellow fever vaccine. This modified virus vaccine approach is safe and effective which led the TGA to license the product on the basis of trials done at AMI and other centres. Once the new vaccine is released to the Australian market, it is expected to rapidly replace the current vaccine due to ease of use and the solid immunity it produces. AMI did the study to determine need for booster doses.

3. **Dengue Virus Vaccine:** The same modified virus concept used for the JE Chimerivax® vaccine has been used by Sanofi Aventis to create a live attenuated quadravalent (four serotypes) dengue vaccine. AMI has just completed its portion (100 volunteers) of an important investigational trial designed specifically to meet Australian standards. If the current studies in SE Asia show the expected efficacy results, then dengue vaccine will first become available in Australia, partially due to the work done at AMI. Currently many more dengue than malaria cases occur in ADF soldiers in Timor-Leste. Dengue's epidemic potential across the entire Asia Pacific indicates the military importance of a useful dengue vaccine should the current efforts succeed in obtaining TGA registration.

4. **Ross River Virus Vaccine:** Ross River Virus is endemic to Australia and PNG causing a debilitating chronic arthritis which sometimes is accompanied by fever, rash and range of non-specific symptoms. A killed Ross River Virus vaccine was designed and developed by an AMI staff member while working at QUT. Advanced clinical trials sponsored by Baxter Vaccines are being completed in Australia. AMI's role has been to provide viral serology testing in order to estimate the vaccine's effectiveness in stopping infection. Although not yet registered, there are good reasons to think that Ross River Vaccine will be available to the ADF in the near to medium future.

Listing of Overseas / Field Activities of Army Malaria Institute since 1998

1. Thailand (1998): Chemoprophylactic study of tafenoquine in 205 Thai Marines on the Thai Cambodian border.

2. Bougainville, Papua New Guinea (1999) and Timor-Leste (2000): Post-exposure prophylaxis using primaquine and tafenoquine in 1512 soldiers deployed, and evaluation of low profile and ADF bednets against malaria vectors as part of Operations Bel Isi and Tanager.

3. Timor-Leste 2000-02: Malaria and dengue control activities as well as an advanced clinical trial of tafenoquine versus mefloquine chemoprophylaxis in 653 soldiers and a surveillance study of mefloquine versus doxycycline in 1545 soldiers deployed, and surveillance of vectors as part of Operation Tanager.

4. Vietnam 2000-2012: Extensive operations with the Vietnam People's Army accomplishing 5 field malaria treatment trials of a wide variety of artemisinin combinations, 6 hospital pharmacology studies and several entomology surveys in two field sites in Central Vietnam (part of SIPDIV funded ADF-VPA Defence Cooperation Programme).

5. Shoalwater Bay Training Area (SWBTA) 1998-2000: Entomological surveys over 2 years for arbovirus vector mosquitoes.

6. Java, Indonesia 2001 for certification in microscopic diagnosis of malaria, and to participate in a clinical antimalarial drug trial at a US Naval Medical Research Unit 2 field site in Central Java.

7. Malo, Vanuatu in 2002 a malaria drug treatment trial on with US Naval Medical Research Unit 2 then from Jakarta, Indonesia.

8. Philippines 2002- World Health Organization sponsored field trip to Mindanao travelling to hospitals and field clinics in support of malaria diagnostic studies.

9. Mt Bundey Training Area 2003: Comparative evaluation of mosquito repellents and initial evaluation of the use of bifenthrin as a barrier treatment of tents for protection against mosquitoes.

10. Redcliffe, 2004-2012: Evaluation of a variety of mosquito repellents and personal protection measures against mosquitoes.

11. Cowley Beach Training Area 2004-12: Evaluation of mosquito repellents and collection of mosquitoes for laboratory colonisation.

12. Wide Bay Training Area 2005-2007: Entomological surveys over I year for arbovirus vectors, and evaluation of barrier treatments of military tents as protection against mosquitoes.

13. Santa Cruz and Temotu Province, Solomon Islands 2008: Malaria (8,700 people) and mosquito surveys in isolated South-eastern islands during RAMSI mission as part of AusAID Pacific Malaria Initiative.

14. Tanna and Tafea Province, Vanuatu 2008: Malaria and mosquito surveys (5200 persons) as part of AusAID Pacific Malaria Initiative.

15. Port Moresby and Lae, Papua New Guinea 2008: Medical and parasitological screening of PNG Defence Force personnel.

16. Timor-Leste 2009: Primaquine post-exposure prophylaxis trial in 228 ADF soldiers from 5 RAR returning to Australia.

17. Isabel, Solomon Islands 2009: Malaria survey (8500 persons) as part of pre-elimination campaign during RAMSI mission as part of AusAID funded Pacific Malaria Initiative.

18. Provided entomological support to EX TopHAT, Health Assessment Team, 2HSB exercise in Townsville Field Training Area (2010) and SWBTA (2011).

19. Nggella, Solomon Islands 2011-12: Malaria and mosquito surveys (3500 persons) as part of development of longitudinal malaria elimination studies (NIH funded International Centres of Excellence in Malaria Research).

20. Vietnam 2004-2012: Establishment of a dengue surveillance capacity in the Vietnam People's Army (VPA) based in military hospitals in DaNang, Quy Nhon, Nha Trang and Can Tho. Serotyping and genotyping of Vietnamese dengue viruses now occurs at the VPA Military Institute of Hygiene and Epidemiology in Hanoi. (part of SIPDIV funded ADF-VPA Defence Cooperation Programme)

Proposed Organisational Structure for Army Malaria Institute from 2013

1. **Defence Science Technology Organisation**: DSTO is the large multifaceted organisation that has evolved to answer research problems for the ADF. These questions largely relate to the deployment of new weapons systems but also include personnel protection technologies. DSTO is approximately 100 times the size of AMI and is organized into multiple divisions at 7 sites around Australia including one unit in Brisbane. The most comparable group to AMI in DSTO is the Human Protection Performance Division (HPPD) with which AMI already collaborates with on insecticide impregnated uniforms and antimalarial drug testing. DSTO already reports on progress to provide protection against vector borne diseases as a current objective CDF 11/0004. It is proposed that AMI be moved from Joint Health Command into DSTO with a reporting chain through the Chief Defence Scientist. DSTO would benefit by the inclusion of a highly productive applied research unit with an outstanding academic reputation. AMI's international and pharmaceutical industry collaborations using external funding would fit well into DSTO's current business model. AMI's location within the Army would emphasize DSTO's commitment to fielding products and technologies of direct benefit to the deployed soldier. DSTO's work with biodefence issues is problematic for AMI. If AMI is to come under DSTO, it would need to be as a separate entity in order to avoid perceived mission cross-over into issues covered by international treaties such as the Biological Warfare Convention. it won't

2. **17 Combat Service Support Brigade**: AMI has been a deployable military unit that has had an important positive impact during three wars (Palestine 1918, New Guinea 1942-5, Vietnam 1968) and one large regional deployment (Timor-Leste 1999-2001). AMI has supported ADF soldiers in Timor Leste over entire 6 month unit deployments. AMI's usefulness to the ADF in its primary mission of preventing arthropod borne diseases in ADF soldiers during operations is currently limited by its separation from those in the ADF who plan and execute deployments into areas with malaria and dengue. It is proposed that the military members of AMI be organized into 1 Malaria Control Unit (1MCU). Its mission would be to deploy with ADF forces entering a malaria endemic area in order to minimize casualties and devise scientifically sound prevention measures. 1MCU's proposed structure would comprise an OC, 1 medical officer, 2 senior entomologist scientific officers, 2 senior parasitologist scientific officers, 2 senior arbovirus scientific officers, and 4 junior scientific officers. All would be AIRN compliant and ARES personnel have "high readiness" status. 1MCU personnel would normally work at AMI on their research projects until required by Forces Command for overseas deployment. Given 1MCU's combat service support (CSS) mission and co-location with 2 General Health Battalion (2 GHB) at Gallipoli Barracks, 1MCU should be placed into 17 CSS Brigade within 2 GHB in association with the Preventive Medicine Company and the Health Assessment Team.

3. **University of Queensland**: AMI would continue in its collaborative relationship with the University of Queensland's School of Population Health in Herston as part of the Australian Centre for International & Tropical Health (ACITH). This arrangement has worked well for the AusAID funded Pacific Malaria Initiative and is likely to be important in the future as AusAID intends to expand its regional involvement with malaria control and elimination. Mining and natural resource companies such as Wafi Golpu Joint Venture are working with ACITH to devise multi-faceted disease control and prevention schemes in which AMI is likely to have a role as the centre of malaria control knowledge and field capability.

15

Discussion Paper: *"Options for Army Malaria Institute to become effectively integrated into the deployable capabilities of the ADF".*

Preamble: In order to remain a viable research institution and maintain an operational capability, AMI must have access to field sites in malaria endemic areas (overseas) particularly in regional areas of current and potential interest to the ADF such as the near north and SE Asia. Historically (WW2), the Army Malaria Institute was originally part of the Army Land Headquarters, as the LHQ Malaria Research Unit, due to malaria's huge impact on the deployed forces. However for at least the last 15 years, AMI has been moved through a variety of ADF command structures, none of which has had a primary operational or deployable focus.

The Problem: This has resulted in a lack of appreciation or consideration being given to AMI's potential value to the ADF during the next major deployment to a malaria endemic area. AMI is currently located within the Joint Health Command within the VCDF Group. The primary focus of JHC is the provision of health care to the ADF within the Australian support area. JHC has no involvement in provision of operational health support to the deployed forces, which occurs overseas in malaria endemic areas. Currently very little malaria occurs in the MEAO. The last large scale deployment to a malaria endemic area was to East Timor. AMI played a major role as a deployable malaria control capability in response to the 200+ malaria casualties that occurred during the Timor deployment from 1999-2000. Prior to this, AMI was also active in the Bougainville and Solomon Island deployments, both of which experienced significant numbers of malaria casualties both in the field and after return to Australia. AMI has also contributed the diagnosis of dengue in ADF personnel and to the identification of viruses circulating in East Timor. Since then, AMI has had no direct role in any ADF deployments (outside of simple provision of advice on vector borne diseases), and the relevant command elements (Joint Operations Command, Forces Command, or Directorate of Army Health, Army Headquarters) have little awareness of AMI's potential value to a deployed force, largely because AMI has no direct interface with overseas deployments. There is a risk of the ADF having to re-learn the old malaria lessons again next time the ADF deploys to a malaria endemic area, exactly as happened in 1918, (Palestine), 1942-43 (New Guinea), 1968 (Vietnam), and 1999 (East Timor). During the latter years of WW2, the Australian Army had 33 deployable malaria control units in PNG and the south-west Pacific area to manage the malaria problem. Each MCU comprised a medical officer (if available), several scientific officers (entomologists and parasitologists), several pathology technicians, and several field hygiene technicians. This was in addition to the usual allocation of insect vector control and field hygiene teams.

Despite being disconnected from the ADF's deployable elements, AMI has maintained a very strong record of successful overseas projects in a variety of contexts since 2001 with external funding. These have included:

- Defence Aid to the Civil Community (DACC) tasks (participating in AUSAID funded malaria elimination projects in Vanuatu and Solomon Islands)
- International Defence Co-operation Programs (SIPDIV and more recently US Navy funded malaria and dengue epidemiology and drug research projects in Vietnam)
- International Centres of Excellence in Malaria Research program (US National Institutes of Health funded malaria epidemiology research projects in Solomon Islands)
- Contributed as invited international expert speakers and research scientists to World Health Organization (WHO) regional scientific activities as a WHO Collaborating Centre funded by WHO.

AMI receives little or no credit from JHC for these activities (these activities are well outside JHC's area of primary interest) and little recognition from the wider defence organisation particularly from organisations with an operational focus like JOC and Forces Command. Indeed an approach from AMI to JOC to provide a minimal representation on the Pacific Partnership US/Australia DACC project this year was met with total indifference to the capabilities we offer.

Further, the continuation of these overseas activities while AMI is part of JHC is currently under extreme threat due to the imposition of the overseas travel expenditure cap which bizarrely includes AMI's externally funded operational travel. The valuable contribution AMI has made and can continue to make to broader government aims in the region as a form of "soft power" projection has also had little recognition, especially since malaria has just been declared a foreign policy priority by the Minister for Foreign Affairs.
http://foreignminister.gov.au/releases/2012/bc_mr_120713.html

The Suggested Solution: Army Malaria Institute includes 12 ARA personnel (1 medical officer: currently vacant, 11 scientific officers) and currently 19 army reservists (2 medical officers, 11 scientific officers, 3 pathology technicians, 1 medical assistant, 1 administrative officer, 1 administrative sergeant). Any combination of these personnel could readily comprise a "deployable malaria control section" attached to Joint Operations Command or with 2 General Health Battalion in the 17 Combat Service Support Brigade. This attachment could take one of two forms:

It could take the form of a "shadow posting" when not required for deployment, i.e. the personnel remain a part of AMI, where the personnel still have their primary posting. This has a zero cost to the ADF but still fulfils the valuable functions of elevating the profile of malaria as a medical and operational planning factor for headquarters staffs, and providing an opportunity to keep the malaria lessons foremost when planning operational deployments to endemic areas. Most importantly it could provide the highly experienced personnel required at very short notice. As a suggestion, the "deployable malaria control section" could comprise an OC (ARA LTCOL scientific officer), 1 medical officer (ARA or ARES CAPT/MAJ), 2 senior entomologist scientific officers (ARA CAPT/MAJ and ARES CAPT/MAJ), 2 senior parasitologist scientific officers (ARA CAPT/MAJ and ARES CAPT/MAJ), 2 senior arbovirus scientific officers (ARA CAPT/MAJ and ARES CAPT/MAJ), and 4 junior scientific officers (2 ARA LTS and 2 ARES LTS). All would be AIRN compliant and ARES personnel could be "high readiness" status.

Alternatively it could take the form of a structural division of AMI whereby all uniformed personnel comprise a "malaria control unit" within the structure of Joint Operations Command or 17 Combat Service Support Brigade. All AMI APS and contractor staff would comprise a "malaria research section" within some other organic structure, such as DSTO, CMVH, or a future defence/university affiliated unit. DSTO seems to us to be the solution which should be first explored. This form presents the advantage of significantly elevating the profile of malaria within the planning and mounting HQ staffs, as they have a dedicated malaria control capability within the land army or deployable ADF elements. This scenario of a structural division of AMI of course maintains the current working arrangement of a single AMI at Gallipoli Barracks in its current entirety during peacetime, unless otherwise required by deployment needs, but permits the deployment of the uniformed personnel for operational needs as required. Current "within unit" chains of command at AMI would remain intact unless the uniformed members were re-tasked or taken away for operational or exercise purposes. In other words, everything at AMI continues to support AMI's research mission unless/until operational deployments or exercise tasks supervene. Both of these solutions will promote a high level of interaction with the Health Assessment Team currently located within the Preventive Medicine Company at 2 GHB at Enoggera.

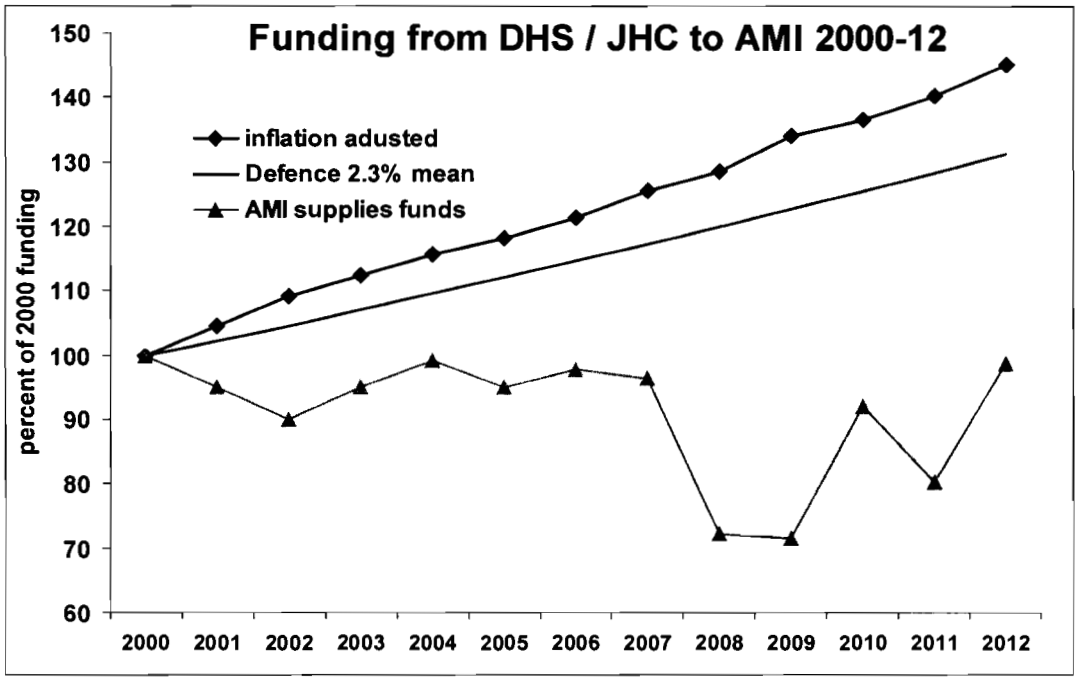
Financial Resources from Defence Health Services / Joint Health Command

Since the beginning of the twenty-first century, the AMI business model has been to actively seek industrial and academic funding outside of Defence Department in order to conduct research on vector borne diseases of interest to the ADF. This was a necessity occasioned in 2000 when then BRIG Wayne Ramsey (DGHS) instructed AMI to look elsewhere for research funding as limited funding would be provided by Defence Health Services. Currently, the Defence Department provides an estimated 4 million dollars worth of staff salaries and infrastructure support annually to AMI, which is invisible to the institute in higher level accounts.

The amount of supplier's funds (money that can be used for "day-to-day" administration) that AMI has received has markedly declined relative to inflation and the defence budget over the last decade (see graph below). Currently, AMI receives $138,000 which has to cover all activities including travel, training, some reagents, stationary, mandatory compliance and governance costs, and some scientific equipment. Equipment maintenance and repair have become critical issues since the DMO medical equipment fleet does not support AMI laboratory equipment items which have been purchased with external (non-ADO) funds, much of which is reaching the end of its expected serviceable lifetime. Also, consumables used for laboratory equipment purchased with external funds are the responsibility of AMI. Service contracts have become prohibitively expensive given the amount of funding available to AMI through JHC. Clinical registration and compliance fees have also recently also been shifted from JHC to AMI. Thus, AMI must seek external funding to supplement its supplier's funds in order to provide operational support to the ADF in the prevention and treatment of vector-borne diseases of military importance.

Collaboration in scientific research with academic and industry partners and ability to apply for and receive research grant funds is absolutely essential to the continuation of AMI's research mission. These activities include the provision of "support in kind" from AMI's resources, in the form of salaries and infrastructure, in the same manner as all other publically funded research entities (universities, state funded medical research institutes, CSIRO etc). We understand DSTO does the same. This of course is the underlying expectation by which the Commonwealth provides competitive research grants (NHMRC, ARC) to research institutes.

At AMI, non-ADO monies, labour and infrastructure are combined to jointly accomplish research of importance to the ADF, which usually has no commercial or intellectual property potential. This model has functioned reasonable well over the last decade except that following the dissolution of AMI's corporate entity (AVBDII), which existed from 2010-12, there is no satisfactory means of accessing funding from academic and industrial sources. In the past (till 2001) Special Public Money Accounts have been used and subsequently withdrawn as a means to manage external research funding at AMI. Since then we have used a mechanism for holding externally sourced research and project funds in ROMAN, which has always been problematical and cumbersome to operate. Medical research at AMI cannot continue without instituting a new workable model of receiving and expending external funding perhaps along the lines of what is done at DSTO and the Defence Science Institute. http://defencescienceinstitute.com/


Funding from DHS / JHC to AMI 2000-12
inflation adusted
Defence 2.3% mean
AMI supplies funds
percent of 2000 funding
150
140
130
120
110
100
90
80
70
60
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

19

Research Grants at Army Malaria Institute circa 2011-12

Aaskov, J

(Gibbons, Aaskov) 1/10/2011- 30/9/2012
GEIS (DOD) $US150,000
Phylogenetic predictors of dengue epidemics
Working with the Armed Forces Research Institute of the Medical Sciences (AFRIMS) this project will genotype a library of dengue viruses from across the region to determine if epidemics can be predicted.

Cheng, Q

613648 (Gatton, Cheng & Price) 31/1/2010 – 31/12/2013
National Health & Medical Research Council, Australia $AUD304,125
Development and application of theoretical models of Plasmodium transmission to guide malaria elimination efforts
The goal of this project is to develop theoretical models of *P. vivax* transmission and apply the models to evaluate possible impact of interventions.

C0555_12_AM (Waters & Cheng) 1/10/2011- 30/9/2012
GEIS (DOD) $US120,000
Surveillance of malaria drug resistance in Vanuatu and Solomon Islands of the South Pacific region
The major goal of the project is to monitor clinical efficacy of artemisinin combination therapies (ACTs) and the emergence of ACT and antimalarial drug resistance in Vanuatu and Solomon Islands.

APP 1021273 (Cheng, Waters, Chen, Chavchich & Gatton) 1/1/2012 – 31/12/2014
National Health & Medical Research Council, Australia $AUD478,675
The control and regulatory mechanisms of artemisinin induced dormancy in *P. falciparum*
This study investigates the role of cell cycle machinery in artemisinin induced dormancy.

R21app_3376758 (PI: Adams & Cheng; CI: Price, Edstein & Auliff) 1/1/2012 – 31/12/2013
National Institutes of Health, USA $US356,328
Genetic screen for P. vivax CQR
The goal of this project is to identify candidate gene(s) that plays significant roles in *P. vivax* chloroquine resistance.

1023438 (Price, Marfurt, Kenangalem, Cheng) 1/1/2012 – 12/31/2014
National Health & Medical Research Council $AUD566,983
Phenotypic characterization of chloroquine resistance in Plasmodia
The major goal of this project is to characterize the intrinsic and acquired resistance of *P. vivax* to chloroquine in order to understand the mechanisms underlying drug resistance and explore ways to interrupt this process.

Cooper, RD

ICEMR Solomon Islands site (Burkot, Cooper, Beebe) 1/10/2010- 30/9/2017
NIAID US NIH $US75,000 per year x7
Research studies to measure the effect of control on malaria transmission in Solomon Islands
As part of international efforts to eliminate malaria, eight sites across the world have been selected to conduct longitudinal studies to understand how to eliminate malaria transmission in defined areas.

Ebringer, A

CYD-17 (Ebringer, Teuscher, Shanks) 01/01/2011- 01/06/2012
Sanofi Pasteur $AUD500,000
Phase 2b clinical testing of new quadravalent dengue vaccine
This project involves immunogeniticity and tolerability testing of quadravalent dengue – yellow fever chimeric live attenuated vaccine in healthly adult Australians to support eventual liscensure in Australia.

Edstein, ME

APP1024314 (Davis, Coster, Andrews, Edstein, Charman) 1/1/2012 – 31/12/2014
National Health & Medical Research Council, Australia $AUD592,400
Evaluation of novel pyrrolo/iminoquinone antimalarial compounds
The goal of this project is to synthesise novel compounds that have been found to display promising in vitro antimalarial activity. We will modify these compounds to make them more drug-like and assess their efficacy in vivo using malaria animal models. These studies have the potential to identify compounds for the treatment and protection against malaria infections.

APP1030353 (Guddat, Hockova, Edstein, de Jersey, Naesens) 1/1/2012 – 31/12/2014
National Health & Medical Research Council, Australia $AUD483,585
An integrated study of acyclic nucleoside phosphonates as antimalarial drugs
The goal of this project is to further develop acyclic nucleoside phosphonates which are potent inhibitors of Plasmodium falciparum purine metabolism, which is essential for parasitic DNA/RNA production. This project has the potential to develop new therapeutic antimalarial drugs directed to validated targets.

C0525_12_N2 (Brice, Thanh, William, Cooper, Edstein) 1/10/2011- 30/9/2012
GEIS (DOD) $US135,000
Establishing malaria drug resistance surveillance program with the Vietnam People's Army and the Australian Defence Force
The major goal of this project is to establish a joint surveillance program between the VPA, the US Navy and the ADF in monitoring *P. falciparum* drug resistance to artemisinins, to continue in vivo studies comparing artemisinin combination therapies in different geographical areas of Vietnam; and to characterise malaria transmission by studying the behaviour of the host, parasite prevalence and behaviour of the vector.

21

(Edstein, Chavchich, Birrell, Jacobus, Shanks) 17/11/2010-17/11/2012
Jacobus Pharmaceuticals Company $US275,000
Preclinical development of JPC compounds for malarial chemotherapy
The major goal of this project is to assist Jacobus Pharmaceuticals Company in the development and evaluation of JPC2056 and JPC2583 as a potential therapeutic agent against malaria infections.

Frances, SP

Project 7.3.2 (Frances, Bhoyro, Bruck) 1/1/2012- 1/12/2013
Defence Material Technology Centre $US30,000
Improved habitability of combat uniforms with permethrin
DSTO and AMI are developing new ways to treat the fabric with permethrin for protection against biting mosquitoes and crawling vectors (ticks and mites).

Shanks, GD

ICEMR Solomon Islands site (Kazura, Whittaker, Mueller, Shanks) 1/10/2010- 30/9/2017
NIAID US NIH $US100,000 per year x7
Research studies to measure the effect of control on malaria epidemiology and transmission in Solomon Islands
As part of international efforts to eliminate malaria, eight sites across the world have been selected to conduct longitudinal studies to understand how to eliminate malaria transmission in defined areas.

(Vincent, Brundage, Shanks) 1/10/2011- 30/9/2012
GEIS (US DOD) $US100,000
Swine influenza vaccination to mimic genesis of 1918 influenza pandemic
The major goal of the project is to utilize the swine infection model of the USDA in Ames, Iowa to determine if the antigenic genesis of the 1918 influenza pandemic can be determined using genetically engineered viruses.

(Cooper, Lilly, Harris, Edstein, Shanks) 1/7/2011-30/6/2014
Esso Highlands Ltd $AUD250,000
Diagnosis and epidemiology of malaria in industrial workers in Papua New Guinea
This project is designed to support the occupational work and safety goals during construction of gas pipeline project in Papua New Guinea.

(Cooper, Lilly, Harris, Edstein, Shanks) 2007-2013
AusAID Dept Foreign Affairs and Trade $AUD5 million which AMI ≈ $1m
Pacific Malaria Initiative to control and eliminate malaria in Melanesia
On-going cooperative effort in Solomon Islands and Vanuatu to support indigenous malaria control efforts with scientific support and surveillance through the Department of Foreign Affairs of Australian Government.

Previous Research Grants at Army Malaria Institute prior to 2011

5RO1: AI-058973 (Kyle, Cheng, Chen, O'Neil & Wang) 2005-2010
National Institutes of Health, USA US$1,001,785
Artemisinin-induced dormancy and treatment failure.
The goal of this project was to investigate the mechanisms of artemisinin induced dormancy and resistance.

5RO1, AI047500-04 (Cheng, Gatton, Chen & Kyle) 2004-2007
National Institutes of Health, USA US$567,000
Antigenic variation and drug resistance in *Plasmodium falciparum*.
This project investigated the process and switch rates involved in PfEMP1 antigenic variation and the role of antigenic variation in the emergence and spread of drug resistance in *Plasmodium falciparum*.

5RO1, AI047500-01 (Saul, Cheng, Nasveld, Chen) 2001-2003
National Institutes of Health, USA US$475,000
Evolution of drug resistance in *Plasmodium falciparum*.
The project investigated host, parasite and community factors that impact on the emergence and spread of drug resistance in *Plasmodium falciparum*.

GEIS, (Waters & Cheng) 2008-2011
Global Emerging Infections Surveillance (GEIS), DOD US$610, 000
Surveillance of malaria drug resistance in the South Pacific.

Foundation for Innovative New Diagnostics (PI:Cheng & McCarty) Mar 2009-Mar 2010
FIND, Switzerland US$185,264
Investigation of factors interfering with HRP2-based malaria RDTs, and optimization of current assays.

World Health Organization (WHO) (PI: Cheng and McCarty) Nov 2008- Nov 2009
WHO, Switzerland US$40,030
Sequencing *pfhrp2* for the Specimen bank and characterization of *pfhrp2* and *pfhrp3* deletions in parasites from South American countries.

Foundation for Innovative New Diagnostics (PI: Cheng & McCarty) Dec 2007-Dec 2008
FIND, Switzerland US$230, 759
To produce rHRP2, to characterize parasite HRP2 for isolates included in the Specimen Bank and to assist malaria RDT product testing.

World Health Organization (PI: Cheng & McCarthy) 2006-2007
WHO, Switzerland US$42,600
To Produce and screen HRP2 to be used for quality assurance testing and to determine vulnerability of specific HRP2 MABs in diagnostic kits in a tropical environment.

World Health Organization (PI: Cheng & McCarthy) 2005-2006
WHO, Switzerland US$47,000
Testing available monoclonal antibodies to HRP2 against a representative range of parasite HRP2, test stability and most appropriate antibodies for parasite detection.

World Health Organization (PI: Cheng) 2004-2005
WHO, Switzerland US$32,000
Diversity of *Plasmodium falciparum* Histidine-rich protein II (PfHRPII) and its effect on the performance of PfHRPII based Rapid Diagnostic Tests (RDTs).

WHO-WPRO (PI: Cheng) 2003-2004
WHO US$5,500
Investigation of the effect of HRP2 variation on RDT sensitivity and technical support for rapid diagnostic test quality assurance development.

WHO-WPRO (Wang, Gao & Cheng) 2003-2005
Pilot study on the control and elimination of *Plasmodium falciparum* malaria in Hainan Province, P.R. China".

(Edstein, Cooper, Rieckmann, Shanks) 2000-2012
IPDiv $AUD2,168,000
Defence cooperation between the Vietnam People's Army (VPA) and the ADF on malaria studies
Train, transfer technology and support the VPA in conducting clinical trials of artemisinin based combination therapies for the treatment of falciparum and vivax malaria, drug resistance monitoring, and entomological surveys.

(Quinn, Davis, Avery, Andrews, Charman, Edstein) 2008-2009
Medicine for Malaria Venture $AUD1,540,000;
$67,500 for AMI
Preclinical evaluation of natural products for antimalarial activity
Synthesize novel antimalarial drugs from natural products derived from plants extracts and marine sponges, with AMI assessing the in vitro cytotoxicity and efficacy of the new compounds using the rodent-*P. berghei* malaria model.

(Rieckmann, Edstein, Kyle, Jacobus, Shanks) 2003-2010
Jacobus Pharmaceuticals Company $US168,000
Preclinical development of 3rd generation antifolates for malarial chemotherapy
Evaluate the in vitro antimalarial activity and efficacy of 3rd generation antifolates using the Aotus monkey-*P. falciparum* malaria model.

(White, Nosten, Edstein) 2000-2001
Mahidol-Oxford Tropical Medicine Research Unit $AUD50,000
Clinical evaluation of the pharmacokinetics of Malarone
Measure plasma atovaquone and proguanil concentrations in Thai patients treated with falciparum malaria for the estimation of the pharmacokinetics of Malarone.

(Haynes, Fugmann, Rieckmann, Kyle, Edstein) 1999-2004
Medicine for Malaria Venture $US6,500,000;
$374,000 for AMI
Preclinical development of the new semi-synthetic artemisone
Develop a new artemisinin derivative in accord with international regulatory guidelines, with AMI performing in vitro susceptibility testing and efficacy assessment of artemisone using the Aotus monkey-*P. falciparum* malaria model.

(Brundage, Shanks) 1/10/2008- 30/9/2010
GEIS (US DOD) $US80,000
Epidemiology of pandemic influenza in military units of First World War
Data collection and analysis of Australian, British, Canadian, New Zealand and US Armies as well as British Royal Navy and US Navy to determine mortality risk factors during influenza pandemic 1918-19.

(Frances) 2008-09
US Armed Forces Pest Management Board $US30,000.
Protection from mosquito bites provided by permethrin treated military fabrics.
Compare protection from mosquito bites of three treatment methods using permethrin in ADF DPCU shirt fabric. Collaboration with DSTO.

(Cooper, Frances) 2003-04
Army Research and Development Requirements Committee $AUD 25,000
Review of the use and effectiveness of mosquito repellents by the ADF.
Conducted field evaluation of ADF deet repellent and a new active ingredient, picaridin.

(Frances) 2002-03.
Queensland Health $AUD 15,900
Laboratory and field evaluation of chemical repellents against arbovirus vectors.
Compared protection provided in the laboratory and field of commercially purchased and military repellents against mosquitoes.

25

Honours or Graduate Students Trained at Army Malaria Institute

PhD

Joanne Baker (Supervisors: Cheng & McCarthy), School of Population Health, University of Queensland, completed 26 Aug 2011.

Alyson Auliff (Supervisors: Cheng, O'Neil & Gardiner), School of Population Health, University of Queensland, thesis submitted in Nov 2011.

Nelson Lee (Supervisors: McCarthy & Cheng), School of Medicine, University of Queensland, completed in 2010.

Herng Leow (Supervisors: McCarthy, Cheng & Fischer), School of Medicine, University of Queensland, 2nd year.

Veronica Zhang (Supervisors: Waters, Chavchich, Cheng & O'Donoghue), School of Biochemistry, University of Queensland, 2nd year

Sumi Britton (Supervisors: McCarthy & Cheng), School of Medicine, University of Queensland, 2nd year

Edwin Siu (Supervisors: O'Neil & Cheng), University of Queensland, completed in 2007
Bui Tri Cuong, PhD, awarded 2007 from The Ministry of Education, Hanoi, Vietnam, Thesis title: "The pharmacokinetics, tolerability of high dose primaquine in healthy Vietnamese and therapeutic efficacy of artesunate combined with high dose primaquine for the treatment of *Plasmodium vivax*".

Masters

Joanne Baker (Supervisors: Cheng & McCarthy), School of Population Health, University of Queensland, completion 2006

Scott Kitchener, MSc, awarded 2002 from The University of Queensland, Thesis title: "Evaluation of safety and adverse effects of mefloquine in the prophylaxis of malaria in non-immune Australian soldiers".

Aree Lukvisaitdee, MSc, awarded 1990 from Faculty of Tropical Medicine, Mahidol University, Bangkok, Thailand, Thesis title: "Plasma, erythrocyte and whole blood concentrations of quinine and guanidine in children with uncomplicated falciparum malaria".

V. Singhasivanon, MSc, awarded 1990 from Faculty of Tropical Medicine, Mahidol University, Bangkok, Thailand, Thesis title: "Pharmacokinetic study of mefloquine in Thai children suffering from uncomplicated falciparum malaria treated with MSP or MSP plus primaquine".

Undergraduate Honour's

Michelle Rourke (Supervisor: Aaskov) Institute of Health and Biomedical Innovation, QUT. Genetic diversity in populations of Ross River Virus, completed in 2011

Nur Sakinah Mahadi, 1st class honours, awarded 2009 from School of Chemical and Molecular Biosciences, The University of Queensland, Thesis title: Evaluation of the *in vitro* antimalarial activity of glutathione-depleting compounds alone and in combination with artemisinin derivatives".

Rebecca Kissell, 2nd class honours, awarded 2009 from School of Chemical and Molecular Biosciences, The University of Queensland, Thesis title: "*In vitro* characterisation of the antimalarial activity of purified compounds from natural products".

Claire Vickers, 1st class honours, awarded 2004 from School of Pharmacy, The University of Queensland. Thesis title: "The effect of grapefruit juice on the pharmacokinetics of primaquine and its major metabolite, carboxyprimaquine, in healthy Vietnamese volunteers."

Cassie Jansen (Supervisors: Cooper and Frances), 1st Class Honours awarded 2004, from the School of Biological Sciences, University of Queensland.

Nicole Cloonan (Supervisors: Cheng & Bushel), Griffith University; First class, completed in 2001

Nelson Lee (Supervisors: Cheng & McCarthy), University of Queensland; completed in 2006

Ben Beck (Supervisors: Waters & Cheng), University of Queensland; completed in 2008

Veronica Zhang (Supervisors: Waters), University of Queensland; completed 2008

Third year undergraduate

Nicole Cloonan (Supervisors: Cheng), Griffith University, completed in 2000

Petar Gojkovic (Supervisor: Frances) University of Queensland completed 2007.

Awards Received by Staff at Army Malaria Institute

Shanks, G Dennis
John Pearn Medal by the Australasian College of Tropical Medicine for work in tropical medicine 2008
SG John White Medal from Australian Medical Students Association for support to medical education 2009

Cheng, Q
Suncorp 2007 Queenslander of the year Finalist, 2007

Auliff, A
Keystone Symposia travel Scholarship (Drug Discovery for Protozoan Parasites 2012
Australian American Fulbright Queensland Scholar 2009-2010.
Chief of Army Scholarship, 2009-2010
Gregory Schwartz Enrichment Grant – Australian American Fulbright Commission, 2009
Vivax Malaria Research III: 2009 and Beyond conference travel scholarship, Panama City, Panama. 2009
ARC/NHMRC Network for Parasitology research travel scholarship for research exchange to the center for Tropical Disease Research and Training Department of Biological Sciences, University of Notre Dame, USA. 2006
Vivax Malaria Research II: 2005 and beyond conference travel scholarship, Washington D.C., USA. 2005

Baker, J
Young Investigator Award, American Society of Tropical Medicine and Hygiene, 58th Meeting, Washington DC, November 18-22, 2009.
Student Travel Award, American Society of Tropical Medicine and Hygiene 58th Meeting, Washington DC, November 18-22, 2009.

Peters, J
Second prize for best publications at Queensland Institute of Medical Research for 2002: Peters, J., Fowler, E., Gatton, M., Chen, N., Saul, A. and Cheng, Q. (2002) High diversity and rapid changeover of expressed var genes during acute phase of Plasmodium falciparum infections in human volunteers. *Proc. Nat. Acad. Sci. USA*. 99(16):10689-10694.

28

National and International Committee Memberships by AMI Staff

Shanks, G Dennis
Malaria Reference Group of AusAID Pacific Malaria Initiative 2007- present
Malaria Elimination Group from Global Health Group of University of California San Francisco 2008 - present
Advisory Board of Asia Pacific Malaria Elimination Network sponsored by AusAID 2009 – present
APMEN Vivax Working Group 2010 to present

Cheng, Q
Molecular Biologist, Biosafety Committee, Australian Army Malaria Institute
Category C, Animal Experimental Ethics Committee, Australian Army Malaria Institute
Invited member of the Organising Committee, "Vivax Malaria Research: 2005 and beyond", 9 – 10 Dec 2005.
Member of the WHO/TDR Malaria Rapid Diagnostic Tests (RDTs) Specimen Bank Steering Committee
Invited member of the Organising committee, MAM 2008.
Member of Asian Pacific Malaria Elimination Network, vivax working group

Auliff, A
Secretary, Biosafety committee, Australian Army Malaria Institute

World Health Organization Temporary Consultants (many over 20 years)
Qin Cheng
Ken Lilley
Michael Edstein
Joanne Baker

29

Army Malaria Institute's Regulatory Framework

Standard/Act/Regulation	Organisation	Depts Included	Status	Inspections	Monitoring
ISO 15189:2007	National Association of Testing Authorities, Australia (NATA)	DE (Pharmacology) Arbovirology	Accredited till May 2014	Every 3 years	AMI Quality Management System (QMS)
ISO 9001:2008	Nil	All	Not certified but conforming to all requirements	Nil external (Defence no longer pays for certification audits)	AMI QMS
Gene Technology Act 2000 Gene Technology Regulations 2001	Office of the Gene Technology Regulator (OGTR)	All	Complaint	PC2 – every 5 years PC3 – every 2 years	AMI QMS OGTR Committee Institute Biosafety Committee (IBC)
Quarantine Act 1908 Export Control Act 1982 Imported Food Control Act 1992	Australian Quarantine and Inspection Service (AQIS)	All	Registered and compliant	Bi-annually	AMI QMS
The Animal Care and Protection Act 2001	QLD Department of Agriculture, Fisheries and Forestry (DAFF)	Primarily DE	Registered and compliant	Yes, irregular	AMI QMS Animal Ethics Committee
The Animal Care and Protection Act 2001	QLD Department of Lands	Primarily DE	Compliant	Yes, irregular	AMI QMS Animal Ethics Committee
WHS Act (Cth) 2011	JHC WHS Branch	All	Conforming to JHC requirements	Internal inspection and audit program	AMI QMS and WHS system.
Quality Assurance Program (QAP)	Worldwide Antimalarial Resistance Network (WWARN)	DE (Pharmacology)	Current, ongoing	3 cycles/year	AMI QMS
Quality Assurance Program (QAP)	Royal College of Pathologists of Australasia (RCPA)	Arbovirology (Serology) CSS (Microscopy)	Current, ongoing.	AV – 2 tests/year CSS – 2 tests/year	NATA AMI QMS

30

Australian Army Malaria Institute Business Plan FY 12-13

JHC Strategic Business Plan Objectives – ADF joint health capability supports future operations

AMI 1.1 - To identify, monitor and advise on vector borne diseases of relevance to the ADF
Performance Indicators:
In areas of strategic significance to the ADF:

- Establish and implement epidemiological programs to improve knowledge of mosquito vectors, parasites and pathogens responsible for malaria and other vector-borne diseases (VBDs)
- Monitor and advise on the risk of VBDs to ADF personnel deployed overseas
- Determine the prevalence and level of antimalarial drug resistance.

SERIAL	INITIATIVE (funding source where applicable)	LEAD[1]	MILESTONES	STATUS/ END DATE
1.1.1	Monitoring of malaria and arbovirus vector species in the Southwest Pacific region (partially funded by AusAID and GEIS)	VSC AusAID UQ	• Incriminate vector species of malaria and arboviruses in Australia, New Guinea, Solomon Is. and Vanuatu • Develop effective tools for the identification of malaria and arbovirus vectors	Ongoing Ongoing
1.1.2	Conduct risk assessment of VBDs to ADF soldiers deployed overseas, and monitor and advise on: vector borne diseases such as malaria and those caused by arboviruses (partially funded by US DOD GEIS program)	CSS VSC AV QUT	• Conduct VBDs surveillance in operational and likely operational areas • Provide risk assessment • Provide advice and training to Preventive Medicine assets on control strategies	Ongoing Ongoing Ongoing
1.1.3	Monitor and advise on the prevalence of malaria species and levels of antimalarial drug resistance in areas of strategic significance to the ADF (Partially funded by AusAID and GEIS)	DRD CSS WRAIR GEIS AusAID WPRO Country MOH	• Conduct in vitro drug susceptibility tests in the field on drugs of relevance to the ADF • Collaborate with WHO and country malaria control programs to carry out clinical efficacy studies of antimalarial drugs in the Pacific region, particularly efficacy of artemisinin combination therapy (ACT) for P. falciparum and chloroquine for P. vivax in these countries. • Provide epidemiological information on prevalence of malaria parasite species and drug resistant mutation status for isolates collected in areas of interest to ADF • Present and exchange information at WHO and Asian Pacific region malaria conferences	Ongoing Ongoing Ongoing

31

SERIAL	INITIATIVE (funding source where applicable)	LEAD[1]	MILESTONES	STATUS/ END DATE
1.1.4	Monitor resistance in malaria vectors to insecticides used by the ADF (partially funded by AusAID)	VSC	• Monitor insecticide susceptibility in mosquito species in areas of interest to ADF	Ongoing
1.1.5	Molecular characterisation of malaria and arbovirus vectors including speciation, genotyping, and phylogeny for surveillance and disease risk assessment in collaboration with University of Queensland (UQ) (partially funded by UQ)	VSC UQ	• The distribution of malaria and arbovirus vectors in Australia and the southwest Pacific • Develop novel molecular based techniques for the identification of malaria and arbovirus vectors	Ongoing Ongoing
1.1.6	Serological or virological confirmation of infection of ADF personnel with mosquito-borne viruses	AV	• Testing as required with clinical results released to requesting medical officers • Maintain staff skills in diagnostic arbovirology • Pass in Royal College of Pathologists (RCPA) external quality assurance program.	Ongoing Ongoing Ongoing
1.1.7	Identify dengue and other arboviruses circulating in areas of possible ADF deployment (partially funded by GEIS).	AV	• Preparation of new phylogenetic maps for recently isolated dengue viruses. • Data passed to Defence Health Intelligence Section • Publication of results and presentation of data at international meetings	Ongoing Ongoing
1.1.8	Assist in the monitoring of incursions of exotic dengue vectors into Australia	VSC UQ AQIS	• Conduct mosquito surveys • Mosquito identification	Ongoing Ongoing
1.1.9	Conduct surveillance of potential vectors at Cowley Beach Training Area, in collaboration with the Health Assessment Team	1 PMC VSC	• Conduct surveys • Determine virus and mite borne typhus activity • Assist in report to JHC	Feb 2013 May 2013
1.1.10	Study of malaria vectors and transmission in Vietnam VADMP (funded by GEIS and NAMRU-2)	VSC MIHE	• Field studies • Processing of specimens • Publications: two submitted, two in preparation	Complete Complete Ongoing
1.1.11	Advise JHC on malaria prophylaxis, diagnosis and treatment	AMI	• Advice on malaria	Ongoing
1.1.12	Advise JHC on risks of exposure to arbovirus infection, diagnosis and treatment	AMI	• Advice on arboviral diseases	Ongoing

32

SERIAL	INITIATIVE (funding source where applicable)	LEAD[1]	MILESTONES	STATUS/ END DATE
1.1.13	Conduct molecular epidemiology investigation on malaria in Vanuatu and Solomon Islands as part of AusAID Pacific Malaria Initiative (partially funded by AusAID and GEIS)	DRD AusAID WRAIR lab PacMISC GEIS	• Examine the prevalence of malaria infection by PCR • Analyse and compare sensitivity of microscopy, RDT and PCR in malaria elimination setting • Examine the parasite lines, distribution frequency and repertoire size by genotyping • Examine prevalence of drug resistant parasites using molecular markers • Report findings at the ASTMH annual meeting	Ongoing Ongoing Ongoing Ongoing
1.1.14	Study the genetic diversity of *P. vivax* in ADF cases from East Timor and to investigate the trigger and mechanisms of *P. vivax* relapses	DRD	• Obtain consent from ADHREC and ADF personnel who had *P. vivax* to use their blood samples • Examine genetic diversity on 3 markers of *P. vivax* • Establish correlation between mixed infections, allelic types of infection and relapses • Examine polymorphisms in dormancy related genes in the ADF P. vivax samples	Complete Complete Complete Ongoing
1.1.15	Maintain diagnostic capability at AMI to make laboratory diagnoses of vector-borne diseases of importance to the ADF in returning and deployed soldiers: malaria, scrub typhus, dengue, Ross River, Japanese Encephalitis, Murray Valley, Barma Forest, Chikungunya, etc	CSS AV DRD	• Maintain NATA certified laboratory diagnostic tests at AMI for ADF use • Receive samples from deployed and returned ADF members for diagnosis, particularly confirmatory tests for vector borne diseases	Ongoing Ongoing

33

AMI 1.2 - Monitor VBD incidence in the ADF
Performance Indicators:

- Provide ongoing data and statistical analysis of VBD infections in ADF

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE

1.2.1	• Develop and maintain registers of VBDs in ADF personnel. Awaiting results of Defence Health IT review prior to transfer of CMR to defence-wide.
	• Develop service wide reporting system for VBDs in ADF personnel.
	• Undertake retrospective and prospective surveys on the incidence of VBDs in the ADF.
	• Collate reports on malaria cases in ADF personnel deployed to malarious areas
		CSS	• Train and develop a database management system.
			• Liaise with civilian reference centres which maintain similar registers of VBDs
			• Liaise with civilian flavivirus reference laboratories for AS cases
			• Report findings to:
			  • ADF Health
			  • International Journal yearly
			  • An Australian Tropical Medicine Conference annually
			• Service wide surveys of VBD reporting
				Ongoing
				Ongoing
				Ongoing
				Ongoing
				Ongoing

1.2.2	Develop tracking system of AMI/ADF trial volunteers through internal CSS database.	CSS	• Compile database on all ADF AMI trial members	Ongoing
1.2.3	Characterisation of malaria infections in ADF personnel deployed to malaria endemic areas	DRD CSS	• Collect blood samples from ADF personnel suspected of or diagnosed as having malaria infections • Determine the species, strains of malaria and their susceptibility to antimalarial drugs, as well as the level of exposure and immunity • Provide corrected information to CMR	Ongoing Ongoing Ongoing

34

AMI 1.3 - To provide ADF personnel with the best possible protection against VBD in Australia and on overseas deployments
Performance Indicators:

- More effective and better drugs and vaccines to treat and protect ADF personnel against malaria and arboviral infections
- Develop and evaluate field tests for the diagnosis and surveillance of VBDs
- Develop and evaluate more effective personal protection measures
- Greater understanding of the development of antimalarial drug resistance
- Greater understanding of the epidemiology of arboviruses

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
1.3.1	**Evaluate effectiveness and tolerability of new and standard antimalarial drugs for treatment of malaria infections**			
1.3.1 (a)	Multiple dose pharmacokinetics and in vitro pharmacodynamic assessment of artemisinin plus piperaquine (Artequick), artesunate plus amodiaquine (Coarsucam) in healthy Vietnamese soldiers (funded by GEIS and US Navy)	DE	• Trial - recruitment of volunteers • Measurement of drug concentrations • Ex vivo pharmacodynamic analysis • Analysis and report for publication	Completed Ongoing Ongoing Mar 13
1.3.1 (b)	Investigate tafenoquine for the treatment of acute malaria and assist US DOD and GSK in their regulatory application for tafenoquine prophylaxis	CSS WRAIR	• Develop protocol • Identify study population • Continue work with East Timor studies to support regulatory submissions to TGA and US FDA	Ongoing Ongoing
1.3.1 (c)	Assessment of the tablet content of chemoprophylactic drugs and determination of blood antimalarial drug concentrations in subjects infected with malaria on prophylaxis to confirm drug resistance (partially funded by Esso Highlands Limited)	DE	• Measurement of tablet content of chemoprophylactic drugs by LC/MS/MS. • Measurement of plasma antimalarial drug concentrations in subjects on prophylaxis by LC/MS/MS.	Ongoing Ongoing
1.3.1 (d)	Efficacy of artesunate alone and artesunate plus azithromycin for the treatment of *Plasmodium falciparum* in Vietnamese subjects	DE	• Trial – commencement of recruitment of malaria patients • Molecular analysis for recrudescence/reinfections and genetic markers for drug resistance • Present in vivo efficacy and tolerability data of artesunate alone and artesunate plus azithromycin for the treatment of falciparum malaria at ASTMH in Atlanta, USA • Report for publication	Completed May 12 Nov 12 Dec 12

35

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
1.3.1 (e)	Longitudinal survey of antimalarial drug resistance in central Vietnam using molecular markers	DE	• Molecular analysis for genetic resistant alleles (e.g., Pfcrt, Pfdhfr, Pfmdr1) in human blood samples from Phuoc Chien from 2006 to 2009 • Report for publication • Present epidemiological data at ASTMH in Atlanta, USA	Completed Jun 12 Nov 12
1.3.2	**Develop more effective and better antimalarial drugs, including optimisation of dose regimes and combination therapy**			
1.3.2 (a)	Identification of novel target sites for the assessment of new antimalarial compounds	DE	• Generate transfected parasites with pfmdr 1 gene • In vitro assessment of antimalarial drugs against these transfected parasites	Ongoing Ongoing
1.3.2 (a)	Cell cycling and drug targeting (partially funded by UQ and GEIS)	DRD WRAIR UQ	• identify proteins and enzymes responsible for stage development in the malaria parasite	Ongoing
1.3.2 (b)	Evaluation of new antimalarial drugs using a rodent-*P. berghei* model (partially funded by Jacobus Pharm. Inc and NHMRC project grants with Eskitis Institute for Cell and Molecular Therapies at Griffith University and the School of Chemistry and Molecular Biosciences at the University of Queensland)	DE	• In vivo efficacy of JPC2583, JPC2997 and JPC2056 • Dose escalation pharmacokinetic studies of JPC compounds • In vivo efficacy and tolerability of natural products developed by Eskitis Institute for Cell and Molecular Therapies • In vivo efficacy and tolerability of acyclic nucleoside phosphonates • In vivo and tolerability studies of ruthenium complexes developed by James Cook University, the University of New South Wales and the Australian Defence Force Academy • Present drug discovery data of new antimalarial drugs against rodent malaria at ASTMH in Atlanta, USA	Ongoing Ongoing Ongoing Ongoing Ongoing Nov 12
1.3.2 (c)	Evaluation of pharmacokinetics of antimalarial drugs in Aotus monkeys	DE	• Protocol for evaluation the PK of three reference drugs (artesunate, amodiaquine and piperaquine) in the Aotus monkey • Conduct of study • Drug analysis using LC/MS/MS	Completed Ongoing Ongoing

36

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
1.3.2 (d)	Evaluation of new antimalarial drugs using in vitro drug susceptibility testing against malaria parasites and cytotoxicity testing against mammalian cell lines (partially funded by Jacobus Pharm. Inc. and the University of Queensland)	DE	• In vitro testing of new synthetic compounds from Jacobus Pharmaceutical Company (JPC2583 and its analogues) • In vitro testing of new synthetic compounds (i.e. acyclic nucleoside phosphonates) from the School of Chemistry & Molecular Biosciences, the University of Queensland • Cytotoxicity assessment of various compounds including JPC2583 and natural products • Present in vitro and cytotoxicity data of JPC2583 at ASTMH conference	Ongoing Ongoing Ongoing Dec 11
1.3.2 (e)	Establish the latest methods for the analysis of all antimalarial drugs and their putative metabolites using LC/MS/MS technology and in vitro liver microsomal techniques for investigating drug metabolism	DE	• Establish LC/MS/MS methods for current and new antimalarial drugs • Establish in vitro liver microsomal assays to investigate the metabolism of new antimalarial compounds • Participate in the Clinical Pharmacology Component of the Worldwide Antimalarial Resistance Network (WWARN) for optimising the use of antimalarial drugs	Ongoing Ongoing Ongoing
1.3.2 (f)	Characterize the gametocytocidal and sporontocidal activity of new antimalarial compounds (partially funded by Jacobus Pharm. Inc. and Medicines for Malaria Venture)	DE VSC QIMR	• Establish the *Plasmodium berghei-An. stephensi* model for the assessment of the gametocytocidal and sporontocidal activity of new antimalarial compounds • Assessment of the ex vivo gametocytocidal activity of serum collected from ADF personnel treated with primaquine and tafenoquine for presumptive anti-relapse therapy in Timor Leste	Ongoing Apr 13
1.3.2 (g)	Evaluation of liver stage antimalarial drugs using in vitro liver stage assay with mosquito sporozoites and human liver cell cultures.	DE	• Analyse standard and new drugs for efficacy and synergy	Ongoing

37

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
1.3.2 (h)	Evaluation of new antimalarial drugs using the Aotus monkey-*P. falciparum P. vivax* model (partially funded by Jacobus Pharm. Inc and an NHMRC program grant with the Institute for Glycomics at Griffith University)	DE DRD	• Collection of blood samples prior to treatment with either JPC2583 or JPC2997 to investigate the molecular basis of chloroquine resistance in the AMRU1 strain of *P. vivax* • Evaluation of JPC2583 and JPC2997 for in vivo efficacy in the AMRU1 strain of *P. vivax* • Evaluation of JPC2583 analog for in vivo efficacy in the FV0 strain of *P. falciparum* • Development of attenuated malaria parasites using novel Adenine-Thymine binding drugs (such as centanamycin) for vaccine development and efficacy testing • Report for publication of JPC compounds	Mar 12 Mar 12 Mar 13 May 13 Jun 13
1.3.3	**Develop vaccines against operational health threats**			
1.3.3 (a)	Dengue Vaccine (II), conduct a study on the safety, immunogenicity and efficacy of a dengue vaccine. In conjunction with Sanofi-Pasteur	CSS	• Negotiations with vaccine sponsors • ADHREC submission • Recruitment of subjects • Trial completion • Final clinical report	Complete Complete Complete May 12 Oct 12
1.3.3 (b)	Ross River virus vaccine (partially funded by Baxter Bioscience)	AV	• Phase III trial • Registration of vaccine	Ongoing
1.3.3 (c)	Develop study design and protocol to determine the booster requirements of arboviral vaccines used by the ADF (JE and potentially dengue)	CSS AV	• Awaiting results from dengue vaccine trial with Sanofi-Pasteur	Aug 12
1.3.4	**Greater understanding of the epidemiology of arboviruses**			
1.3.4	Population dynamics of arboviruses (partially funded by US DOD GEIS program)	AV	• Genetic diversity in dengue viruses identified and quantified • Genetic diversity in Ross River virus identified. • Publication of results and presentation of data at international meetings.	Ongoing Ongoing Ongoing

38

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
1.3.5	**Improve knowledge and understanding of antimalarial drug resistance mechanisms to standard and new drugs against both falciparum and vivax malaria in areas of interest to the ADF**			
1.3.5 (a)	Chloroquine resistance in *P. falciparum*: monitor chloroquine resistance and investigate the evolution of chloroquine resistance in Asia-Pacific Region and other regions of interest (partially funded by AusAID and GEIS).	DRD WRAIR GEIS	• Investigate the distribution and evolution of chloroquine resistant *P. falciparum* parasites in Philippines • Investigate the global evolution of chloroquine resistance with a particular focus in the South Pacific	Complete Ongoing
1.3.5 (b)	Chloroquine resistance in *P. vivax*: search for molecular marker for chloroquine resistance in P. vivax and its correlation with in vivo and in vitro susceptibility to chloroquine. Partially funded by NIH, USA.	DRD MSHR USF DE	• Determination genotypes of *P. vivax* isolates collected in Timika, Indonesia, and in Thailand • Investigate correlations of 3 potential molecular markers with in vitro susceptibility to chloroquine and in vivo response to chloroquine • Investigate the stage specificity of *P. vivax* response to chloroquine and parasite growth rates in vitro • Prepare data for publication • Submit a research proposal to NIH for funding • Collect and enriching chloroquine resistant parasites in patients and in primates • Isolate total RNA, reverse transcribe to cDNA and construct cDNA libraries • Transfect resistant genomes (cDNA libraries) into *P. falciparum* • Large scale screening for *P. vivax* chloroquine resistant markers using chloroquine • Investigate correlation of further potential molecular markers with in vitro susceptibility to chloroquine • Evaluate the correlation of molecular markers with chloroquine resistance in other countries	Complete Complete Complete Complete Ongoing Commence July 2012 Commence 2012 Commence Jan 2013 Jun 2013 Dec 2013

39

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
1.3.5 (c)	Antifolate (pyrimethamine, cycloguanil and WR99210) resistance in *P. vivax* by transfecting *P. vivax* DHFR wild type and mutant alleles into *P. falciparum* and test their effect on parasite susceptibility to antifolate and sulfa drugs	DRD WRAIR USF	• Cloning wild type and mutant *P. vivax* dhfr alleles into transfection vectors • Transfect these constructs into *P. falciparum*, express episomally and test parasite susceptibility to a panel of antifolate drugs • Clone wild type and mutant *P. vivax* dhfr alleles into pigybac transfection vectors • Collaborate with Prof. John Adams, University of South Florida and transfer pigybac transfection Transfect these constructs into *P. falciparum* and test parasite susceptibility to a panel of antifolate drugs. • Testing the effect of 3rd generation antifolate drugs on the transfected parasites • Investigate role of pvgch1 copy number and antifolate resistance in P. vivax • Publish the findings	Complete Complete Complete Complete Ongoing Ongoing Ongoing

40

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
1.3.5 (d)	Investigate artemisinin induced dormancy and artemisinin resistance as causes of treatment failures. (partially funded by NIH, USA and NHMRC, Australia)	DRD WRAIR USF DE	• Investigate the rate of parasites dormancy and recover following exposure to artemisinin derivatives	Complete
			• Investigate the duration that parasites remain dormant following exposure to artemisinin	Complete
			• Investigate the role of mdr1 in artemisinin resistance and the stability of mdr1 amplification	Complete
			• Investigate the relationship between artemisinin induced dormancy and artemisinin resistance	Ongoing
			• Investigate the role of amplification and stability of a chromosome region different to mdr1 in artemisinin resistance	Complete
			• Investigate metabolic activities of artemisinin induced dormant parasites to ascertain possibilities of using antimalarial drug combinations or novel compounds to reduce the rate of dormancy	Ongoing
			• Investigate molecules involved in artemisinin resistance and identify molecular markers for artemisinin resistance through whole genome sequencing and quantitative RNA sequencing	Ongoing
			• Submit a research proposal to NHMRC to investigate control mechanisms of artemisinin induced dormancy by studying the parasite cell cycle control and regulations	Complete
			• Characterise the cell cycle engine in normal, arteimisinin induced dormant and recovering parasites	On going
			• Investigate the role of a G1 cell cycle checkpoint in the induction of artemisinin induced dormancy	Ongoing
			• Investigate the role of cell cycle regulators in the recovery from artemisinin induced dormancy	Ongoing
			• Investigate drugs and compounds that interfere with dormancy recovery	Ongoing
			• Present data at ASTMH conference	

41

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
1.3.5 (e)	Sulfa Resistance: investigate mechanisms of sulfa drug resistance in *P. vivax*	DRD	• Investigate the differences in drug binding sites between *P. falciparum* and *P. vivax* • Investigate sequence polymorphisms in *P. vivax* DHPS in isolates from different countries in the Asian-Pacific region • Predict the effect of various sequence polymorphisms on parasite's ability to bind sulfa drugs using the DHPS 3D models • Experimentally study the effect of amino acid changes in *P. vivax* DHPS that were predicted to associate with sulfadoxine resistance using P. falciparum expression system • Evaluate sulfones and sulfonamides for their efficacy against *P.vivax* in the P. falciparum expression system.	Complete Complete Complete Ongoing Ongoing

42

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
1.3.6	**Improve malaria diagnostics**			

1.3.6 (a)	Investigate factors influencing the performance of HRP2 based malaria Rapid Diagnostic Tests (RDTs), and to improve detection sensitivity and stability for HRP2 antigen based RDTs for *P. falciparum*
	(partially funded by WHO and FIND).
		DRD
		WHO
		QIMR
		FIND
		CDC
			• Investigate factors influencing the performance of malaria Rapid Diagnostic Tests (RDTs)
			  • Characterise the structure of PfHRP2 from parasites with diverse background and from parasites constituting the WHO/FIND RDT Specimen Bank
			  • Characterise the structure of PfHRP3 genes from parasites with diverse background and its role in the performance of RDTs
			  • Investigate the level of PfHRP2 and PfHRP3 expression in parasites from different genetic background
			  • Investigate the presence and level of anti-PfHRP2 antibodies in P.f patients and their effect on RDT sensitivity
			  • Investigate the possible antigen overload on the sensitivity of RDTs – the "prozone" effect
			  • Investigate the presence and spread of parasites lack HRP2 and HRP3
			• Participate as a key institution and provide support for WHO quality assurance program testing malaria rapid diagnostic tests
			• Evaluate RDT sensitivites in detecting low parasitemia infections
			• Present findings at conferences
			• Develop new reagents for the next generation of RDTs
			  • Immunise a shark with malaria antigens
			  • Establish a phage display library expressing shark antibodies (IgNARs) using genetic material isolated from shark blood
			  • Screen the library for IgNARs that bind malarial antigens
			  • Characterise the specificity, affinity and heat stability of IgNARs
				Ongoing
				Complete
				Complete
				Complete
				Ongoing
				Complete
				Ongoing
				Ongoing
				Ongoing
				Complete
				Ongoing
				Complete
				Ongoing
				Commence Jun 12

43

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
1.3.6 (b)	Establish or modify a multiplex PCR or real time PCR based malaria detection assay, and establish and evaluate a novel DNA based diagnostic method LAMP	DRD AusAID FIND QIMR	• Adapted a multiplex PCR detection assay for detecting 4 human *Plasmodium* species simultaneously • Optimising the conditions of the multiplex PCR to enhance sensitivity • Establish the prototype LAMP assay in the lab • Optimising the LAMP assay • Evaluate LAMP in field samples and for ease of use in the field	Complete Complete Ongoing Ongoing Commence 13
1.3.6 (c)	Investigate the role of Histidine Rich Protein 2 (HRP-2) in regulating parasite growth and pathogenesis.	DRD Director	• Investigate the role of HRP2 in regulating parasite growth in HRP2 positive and negative parasite lines, and further define the role of HRP2 by depleting or adding recombinant HRP2. • Investigate the mechanism by which HRP2 regulate parasite growth. • Investigate the role of HRP2 in pathogenesis	Ongoing Commence Dec 2012
1.3.6 (d)	Establish PCR-based method to detect *P. knowlesi* infection and investigate the frequency of *P. knowlesi* infecting human population	DRD MSHR	○ Establish a PCR-based method to detect *P. knowlesi* infection in humans; ○ Analyse the diversity and relationship of *P. knowlesi* isolates infecting humans in Sabah, Malaysia and establish how frequently and readily *P. knowlesi* infecting humans	Complete Ongoing
1.3.6 (d)	Improve malaria diagnostics by developing new techniques for malaria microscopic diagnosis and parasite quantitation.	CSS	• Develop novel techniques and produce SOPs • SOPs accepted by ADF as ADF-authorised for clinical laboratories • SOPs accepted by WHO as WHO-authorised	Ongoing Ongoing
1.3.6 (e)	Improve malaria diagnostics by implementing and conducting malaria microscopy training and competency assessment courses, in conjunction with WHO/WPRO	CSS	• Develop and conduct training/competency based assessment courses – domestic and international	Ongoing
1.3.7	**Evaluate personal protection measures used by ADF personnel under field conditions**			

44

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
1.3.7 (a)	Evaluation of 40% deet formulated by North Queensland laboratories as a liquid aerosol in alcohol as an alternative to ADF deet (35% deet in a gel)	VSC	• Efficacy in laboratory and field experiments • Conduct user acceptability of formulation in a group of soldiers • Analysis of data • Preparation of report to DCOH Expert panel and JHC, and for publication • DMO test of Bushman 40% • Obtain approval to replace ADF deet formulation with Bushman 40%deet	Complete Complete Complete Ongoing Ongoing Ongoing
1.3.7 (b)	Evaluation of the efficacy of commercial repellents commonly used by ADF personnel when on deployment	VSC	• Laboratory and field evaluation of new active ingredients present in commercial formulations • Prepare reports for JHC as required	Ongoing
1.3.7 (c)	Conduct comparative evaluation of the application of permethrin to DPCU fabric using ADF "dipping" method and commercial factory treatment methods	VSC DSTO	• Treat DPCU with permethrin using ADF and Buzz Off and Utexbel application methods • Evaluate persistence of permethrin in DPCU following washing in domestic washing machine • Investigate effect of washing on contact toxicity and prevention of mosquito biting • Conduct chemical assays of treated cloth (to be conducted by DSTO) • Conduct field assessment • Prepare recommendations for JHC	Complete Complete Complete Complete Complete Ongoing
1.3.7 (d)	Conduct assessment of insecticide susceptibility of *Culex annulirostris* and *Anopheles farauti* and *Aedes aegypti* adults collected in Queensland and the SW Pacific region	VSC	• Collection and establishment of colony material • Determine presence of enzyme associated with resistance • Determine molecular basis for resistance	Ongoing Dec 12 Dec 13
1.3.7 (e)	Conduct field and laboratory evaluation of insect behaviour modifying chemicals provided by Unites States Department of Agriculture, Gainesville, Florida , USA	VSC	• Efficacy in lab and field experiments • Prepare report and publication	Mar 13 Dec 13
1.3.7(f)	Conduct assessment and evaluation of Durable Insecticide treatment of DPCU in collaboration with DSTO and Bruck Group as part of Project 7.3.2 (Partially funded by DSTO)	VSC	• Obtain test fabrics from DSTO and determine protection from mosquito biting • Conduct field evaluation of selected fabric type	Apr 2013 Ongoing

45

AMI 2 - Implement training and educational programs on minimising VBDs in ADF personnel
Performance Indicator: Provide training through lectures and courses on VBD of importance to the ADF

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
2.1	Conduct health education and training in VBDs for personnel deploying overseas. General VBD education for all ranks; advanced training in VBDs for technical and professional personnel	CSS	• Provide lectures/demonstrations to notified Service Units deploying to VBD risk areas	Ongoing
2.2	With the CMVH, develop a two week course on tropical medicine with an emphasis on VBD for junior MOs, prior to their deployment postings	CSS VSC	• Consult with CMVH	Ongoing
2.3	Provide training and education in VBDs: Vector Borne Disease Surveillance and Control Course	VSC AV	• Conduct Vector Borne Disease Surveillance and Control Course for Preventive Medicine personnel - next course set for Nov 2012	Nov 12
2.4	Provide short course in malaria microscopy for deploying ADF scientists	AMI	• As required	Ongoing
2.5	Provide lectures on VBD of importance to the ADF to health workers	AMI VSC	• Occupation & Environmental Health Course • Tropical Medicine Lecture for incoming Medical Officers	Ongoing Ongoing

46

AMI 3 - Develop collaboration, networking and promote engagement with military and civilian medical organisations, both in Australia and overseas, to develop and evaluation effective measures to control malaria and other VBDs
Performance Indicator: Develop bilateral partnerships with key organisations

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
3.1.1	Implement and further develop antimalarial drug and entomological studies between the Vietnam People's Army, US Naval Medical Research Unit No. 2-Pacific and the ADF (partially funded by US Department of Defense Global Emergence Infectious Surveillance – GEIS)	VSC DE DRD NAMRU2	• Train Vietnamese military clinicians/scientists in malaria epidemiology in Australia and Vietnam • Collaborate with Vietnamese counterparts in carrying out epidemiological surveys and antimalarial drug trials in Vietnam • Clinical trial period (Jun 12 to Dec14) for the in vivo efficacy of Coartem versus artesunate alone for the treatment of uncomplicated falciparum malaria and in vivo efficacy assessment of chloroquine for the treatment of vivax malaria in south-central Vietnam • Clinical trial period (Jun 12 to Oct 12) for the pharmacokinetic-ex vivo assessment of Coarsucam plus methylene blue in healthy subjects) at Central Military Hospital 108 in Hanoi, Vietnam • Develop proposal to GEIS for the evaluation of antimalarial drugs for the treatment of falciparum and vivax malaria in south-central Vietnam as a defence initiative between VPA, ADF and US NAMRU2 • Present in vivo efficacy and tolerability data at ASTMH in Atlanta, USA	Ongoing Ongoing Ongoing Ongoing Completed Ongoing
3.1.2	Further develop the dengue research project between the Vietnam People's Army and the ADF (partially funded by US DOD GEIS program and QUT)	AV VSC	• Dengue prevalence and diagnosis • Train Vietnamese military clinicians/scientists in dengue epidemiology in Australia and Vietnam • Identify the cause of dengue-like non-dengue infections in Vietnam • Presentation of results at international meetings	Ongoing Ongoing Ongoing Ongoing

47

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
3.1.3	Pandemic Influenza during World War I in Australian, New Zealand, UK and USA military populations and its relationship to future pandemics of lethal respiratory disease in military populations (partially funded by GEIS)	Director CMVH	• Further development of database including WW I deaths and mortality risk factors • Development of control populations from historical military and civilian populations • Investigation of swine influenza interaction with other respiratory pathogens • Investigate epidemiological inter-relatedness of historical extreme mortality events caused by respiratory viruses on isolated island populations	Ongoing Ongoing Ongoing Ongoing
3.1.4	Collaborate with member countries of the Asia Pacific Malaria Elimination Network (APMEN) to develop strategies and technologies for malaria elimination (funded by AusAID through School of Public Health, UQ)	Director DRD WHO APMEN	• To share experiences, identify best practices, priorities operational projects and research priorities. • Host APMEN country delegates • Present at and contribute to APMEN meetings and workshops	Ongoing Ongoing Ongoing
3.1.5	Collaboration with the tripartite Pacific Malaria Initiative Support Centre (AMI, SPH UQ, QIMR) to characterize malaria in Solomon Islands and Vanuatu as well as develop protocols to test the feasibility of malaria elimination on small islands (partially funded by AusAID)	AusAID Director DRD VSC WHO CSS	• Conduct malaria surveys in Tafea, Vanuatu and Temotu, Solomon Islands in support of the AusAID Pacific malaria initiative. • Investigate the feasibility of malaria elimination on Melanesian islands. • Support National Malaria Incidence Surveys (MIS) in Vanuatu and Solomon Islands	Ongoing Ongoing Ongoing
3.1.6	Collaboration with US NIH, SPH, WEHI, Case Western Reserve University USA in longitudinal monitoring of malaria elimination efforts in PNG and Solomon Islands (US NIH funding)	SPH QIMR WEHI NIH VBDCP	• Assist with malaria survey in Tulagi, Central Province Solomon Islands • Conduct longitudinal malaria epidemiology in Central Province, Solomon Islands in conjunction with Solomon Islands Ministry of Health	May 2012 From 2013
3.1.7	Collaboration with international resource and construction companies with large work forces in Melanesia to assist their efforts to control malaria and other vector borne diseases in their populations (funded by companies involved)	Esso Leighton Morobe	• Provide advice and support to companies in PNG with malaria control and elimination issues • Design and assist with clinical trials to determine better malaria chemoprophylaxis regimens	Ongoing 2013
3.1.8	Collaboration with Civilian Health Agencies and Universities on VBDs, including presentations at civilian national and international conferences. Liaise and collaborate, with civilian institutions such as universities and other research organisations on malaria and other VBDs of mutual interest to the ADF.	AMI	• Provide support to the CMVH in its activities particularly malaria, influenza and tuberculosis epidemiology studies • Sanofi Pasteur: dengue vaccine development • QPharm: collaboration on clinical trials models particularly human malaria infection models	Ongoing

48

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
			• University of Queensland: Molecular configuration studies with the Centre for Drug Design and Development and Population Kinetic studies with the School of Pharmacy in continuing studies on antimalarial drug regimes • University of Queensland: School of Chemistry & Molecular Biosciences in the preclinical development of purine inhibitors of malaria parasites • University of Queensland: PacMISC, malaria control and elimination in the Pacific region particularly Solomon Islands and Vanuatu • Queensland University of Technology: Arboviral studies with the WHO Collaborating Centre for Arbovirology • Griffith University: Eskitis Institute for Cell and Molecular Therapies for high throughput drug screening and evaluation of new antimalarial compounds in animal models and the Institute for Glycomics in antimalarial vaccine development • Queensland Institute of Medical Research: Studies of molecular mechanisms of antimalarial drug resistance in malaria parasites and improved rapid diagnostic tests. • University of Queensland collaborating on vector borne diseases and climate change • Menzies School of Health Research, Darwin: Studies of molecular characterization of multiply resistant parasites , chloroquine resistant markers, *P. knowlesi* infections in humans and plasma chloroquine analysis • World Health Organization: Studies of dengue epidemiology, malaria rapid diagnostic tests, malaria drug resistance monitoring and continuation of AMI's status as WHO Collaborating Centre for Malaria • University of South Florida (USF): Screening P. vivax genome for chloroquine resistance determinants and artemisinin induced dormancy and	

49

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
			resistance mechanisms. • Jiangsu Institute of Parasitic Diseases, China: Studies of molecular characterization of malaria parasites, P. vivax relapse patterns, parasite dynamics and antimalarial drug resistance • Baxter pharmaceuticals : Ross River vaccine development • Australian Defence Force Academy, University of New South Wales, and James Cook University: Assessment of ruthenium complexes for antimalarial activity • Malaria Elimination Group (MEG) of the University of California San Francisco supported by BMGF for global malaria elimination epidemiology • Malaria Reference Group (MRG) of AusAID with advise on malaria control and elimination in the Asia Pacific Region	

50

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ END DATE
3.1.9	Collaboration with military organisations on VBDs, including presentations at military conferences. Maintain collaboration on malaria and other VBDs with foreign military organisations, such as the US, NZ, Thai, Indonesian, Philippines, Malaysian, Singaporeans Vietnamese and Papua New Guinean Defence Forces	AMI	Maintain collaboration on malaria and other VBDs with foreign military organisations, such as the US, NZ, Thai, PNG, Vietnamese, and Indonesian Defence Forces, in particular: • The Vietnam Australia Defence malaria and dengue projects: funded by IPDiv • US Naval Medical Research Unit 2 (NAMRU2)-Pacific: malaria and dengue collaboration with AMI in Vietnam • US Army Medical Materiel Agency: promote the further development of tafenoquine prophylaxis • Walter Reed Army Institute of Research: for studies on, drug resistance, JE vaccines and novel mosquito repellents and other personnel protection measures. • US Armed Forces Pest Management Board, for studies of evaluation of effects of permethrin treated clothing on mosquito biting, through the Defense War fighters Program. • Attend the Defence Health Symposium to present research findings on VBD's of military importance to the ADF • Attend the Defence Centre for occupational Health expert panel on Pesticides Meeting • Attend the Asia-Pacific Military Medicine Conference to maintain collaborations and seek out opportunities with other medical defence force organisations in the combat against VBDs of military importance • Human Protection & Performance Division, Defence Science & Technology Organisation (DSTO) • Attend Military Medicine Conference	Ongoing

51

AMI 4 - To provide quality health care management

Performance Indicator: To ensure that AMI has the appropriate policies and procedures in place to conduct its activities to the highest possible standards

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ ENDDATE
4.1	Maintenance of AMI to ISO 9001:2008 level of quality assurance (QA).	AMI	• Internal Audit Training • Internal Audits of all AMI Departments • Maintain all standards of ISO 9001:2008 QA	Ongoing Ongoing Ongoing
4.2.	Maintenance of accreditation of AMI to ISO/IEC 15189 -NATA (Internal Audits, Management Review, Non Conformance System)	AMI	• Ongoing maintenance of NATA Quality Management System • Next NATA re-accreditation audit	Ongoing May 2014
4.2.1	Seek NATA accreditation in CSS for malaria microscopic diagnosis	CSS	• Satisfy all requirements for next NATA audit	May 2014
4.3	Maintain Australian Quarantine Inspection Service (AQIS) accreditation (malaria, arboviruses, insectaries and animal facilities)	AMI	• Maintain AMI as a quarantine approved facility	Ongoing
4.4	Accredit AMI with the Office of the Gene Technology Regulator under the "Gene Technology Act 2000"	AMI	• Maintain the IBC and accreditation with OGTR • Develop internal management practises and training applicable to genetic research • Modification of Laboratories to PC level 2 (AS/NZS 2243.3: 2002) • Ensure PC 3 laboratory conforms to requirements	Ongoing Ongoing Ongoing Ongoing
4.5	Compliance with the Australian Code of Practise for the Care and use of Animals for Scientific Purposes (AS/NZS 2243.3)	AMI	• Maintain AMI's Animal Ethics Committee	Ongoing
4.6	Maintain compliance with the Therapeutic Goods Administration (TGA) guidelines on GCP and regulations on Clinical Trials in Australia	AMI	• Develop training and monitoring competency for compliance with TGA and GCP regulations	Ongoing
4.7	Comply with DHHPRC and ADHREC guidelines	AMI	• Maintain an AMI Scientific Review Committee • Protocols, reports and publications to DHHPRC and ADHREC for review	Ongoing Ongoing
4.8	Maintain ARCS (Australian Regulatory and Clinical Scientists) registration and monitoring capability within CSS	CSS	• Maintain Registration • Attend Annual conference • Maintain and upgrade monitoring accreditation	Ongoing Ongoing Ongoing

52

SERIAL	INITIATIVE	LEAD[1]	MILESTONES	STATUS/ ENDDATE
4.9	Attendance at the Australian Institute of Medical Science conference for external training in quality aspects of serology laboratory accreditation	AV QM GR	• AIMS Conference	Sep 12
4.10	Participate in the Worldwide Antimalarial Resistance Network (WWARN)	DE	• Participant in the WWARN Pharmacology Module QA/QC program for the measurement of antimalarial drugs to support clinical trials	Ongoing
4.11	Perform malaria microscopy QA for collaborative partners	CSS	• Link in with DRD for QA using molecular methods	Ongoing
4.12	Conduct External Quality Assurance Program on malaria microscopy for AMI staff, Army clinical laboratory and RAAF clinical laboratory	CSS	• Slides every two months to AMI, 2 GHB and 3 EHS	Ongoing

[1]Acronyms/Abreviations

1 PMC	1st Preventive Medicine Company, Enoggera, Qld
APMEN	Asia Pacific Malaria Elimination Network
AV	Department of Arbovirology – AMI
ACITH	Australian Centre for International and Tropical Health
AusAID	Australian Government aid organisation
BMGF	Bill and Melinda Gates Foundation
CMR	Central Malaria Register
CMVH	Centre for Military and Veterans Health
CSS	Department of Clinical Studies and Surveillance – US DoD
DE	Department of Drug Evaluation - AMI
DRD	Department of Drug Resistance and Diagnosis – AMI
DSTO	Defence Science and Technology Organisation
EQAP	External Quality Assurance Program
Esso	Esso Highlands, PNG
FIND	Foundation for Innovative and New Diagnostics
GEIS	Global Emerging Infectious Systems US DoD
GTRAP	Gene and related Therapies Research Advisory Panel
IBC	Institute Biosafety Committee - AMI
ICOPA	International Congress of Parasitology

53

IPDiv	International Policy Division
LC-MS	Liquid Chromatography - Mass Spectrometry
Leighton	Leighton Contractors Ltd, PNG
Menzies	Menzies School of Health Research - Darwin
MIDRP	Military Infectious Disease Research Program US DoD
MIHE	Military Institute of Hygiene and Epidemiology (Vietnam)
Morobe	Morobe Mining Joint Venture, PNG
NAMRU2	Naval Medical Research Unit No. 2 (US Navy – Pacific)
NHMRC	National Health and Medical Research Council of the Australian Government
NIH	National Institutes of Health - USA
OGTR	Office of Gene Technology Regulator
PC2	Physical Containment level 2
PC3	Physical Containment level 3
QA	Quality Assurance
QC2	Quarantine Containment level 2
QIMR	Queensland Institute of Medical Research
QUT	Queensland University of Technology
SPH	School of Population Health, University of Queensland
TIGR	*P. falciparum* Genomic Research Group
UQ	University of Queensland
USF	University of South Florida
VBDCP SI	Solomon Islands Vector Borne Disease Control Program
VSC	Department of Vector Surveillance and Control - AMI
VADMP	Vietnam Australia Defence Malaria Project
WHO	World Health Organization
WPRO	Western Pacific Regional Office
WEHI	Walter and Elisa Hall Institute, Melbourne VIC
WRAIR	Walter Reed Army Institute of Research
WWARN	Worldwide Antimalarial Resistance Network

54

Publications from the Army Malaria Institute since moving to Brisbane in 1997 (1-232)(233-286)

On request AMI will be pleased to provide Endnote file if you wish to examine references on line; alternatively AMI can provide hard copies of those papers of interest to the reviewers.

For those with an historical interest AMI can provide publications describing our work during the following periods:

First World War: Shanks GD. Simultaneous epidemics of influenza and malaria in the Australian Army in Palestine in 1918. Med J Aust. 2009;191(11-12):654-7. Epub 2009/12/24

Second World War: Sweeney T. Malaria Frontline: Australian Army Research During World War II. Melbourne University Press, 2003.

Vietnam War: Black RH. Malaria in the Australian army in South Vietnam: successful use of a proguanil-dapsone combination for chemoprophylaxis of chloroquine-resistant falciparum malaria. Med J Aust 1973 Jun 30;1(26):1265-70.

Current series of papers now appearing in *Journal of Military and Veteran's Health*:
Rieckmann KH, Sweeney AW. Army Malaria Institute: its evolution and achievements. First Decade: 1965-1975 J Mil Vet Hlth 2012; 20 (2): 17-24

1. Zhang VM, Chavchich M, Waters NC. Targeting protein kinases in the malaria parasite: update of an antimalarial drug target. Current topics in medicinal chemistry. 2012;12(5):456-72. Epub 2012/01/17.

2. Wilson N, Barnard LT, Summers JA, Shanks GD, Baker MG. Differential mortality rates by ethnicity in 3 influenza pandemics over a century, New Zealand. Emerg Infect Dis. 2012;18(1):71-7. Epub 2012/01/20.

3. Teuscher F, Chen N, Kyle DE, Gatton ML, Cheng Q. Phenotypic changes in artemisinin-resistant Plasmodium falciparum lines in vitro: evidence for decreased sensitivity to dormancy and growth inhibition. Antimicrob Agents Chemother. 2012;56(1):428-31. Epub 2011/10/12.

4. Shanks GD, Mackenzie A, Waller M, Brundage JF. Relationship between "purulent bronchitis" in military populations in Europe prior to 1918 and the 1918-1919 influenza pandemic. Influenza Other Respi Viruses. 2012.

5. Shanks GD, MacKenzie A, Waller M, Brundage JF. Low but highly variable mortality among nurses and physicians during the influenza pandemic of 1918-1919. Influenza Other Respi Viruses. 2012;5(3):213-9.

6. Shanks GD, Hussell T, Brundage JF. Epidemiological isolation causing variable mortality in Island populations during the 1918-1920 influenza pandemic. Influenza Other Respi Viruses. 2012. Epub 2012/01/10.

7. Shanks GD, Brundage JF. Pathogenic responses among young adults during the 1918 influenza pandemic. Emerg Infect Dis. 2012;18(2):201-7. Epub 2012/02/07.

8. Shanks GD, Brundage JF. Pacific islands which escaped the 1918-1919 influenza pandemic and their subsequent mortality experiences. Epidemiol Infect. 2012:1-4. Epub 2012/05/09.

9. Schuck-Paim C, Shanks GD, Almeida FE, Alonso WJ. Exceptionally high mortality rate of the 1918 influenza pandemic in the Brazilian naval fleet. Influenza Other Respi Viruses. 2012. Epub 2012/02/18.

10. Lee N, Gatton ML, Pelecanos A, Bubb M, Gonzalez I, Bell D, et al. Identification of optimal epitopes for Plasmodium falciparum rapid diagnostic tests that target histidine-rich proteins 2 and 3. J Clin Microbiol. 2012;50(4):1397-405. Epub 2012/01/20.

11. Kerlin DH, Marfurt J, Kenangalem E, Cheng Q, Price RN, Gatton M. Stage specific drug activity of chloroquine in Plasmodium vivax malaria: implications for ex vivo drug resistance testing. . Antimicrob Agents Chemother. 2012;In press.

12. Kerenaftali K, Aarons L, Ter Kuile F, Nosten F, White NJ, Edstein M, et al. Populations pharmacokinetics of halofantrine in healthy volunteers and patients with symptomatic falciparum malaria. Journal of Pharmacy and Pharmacology. 2012.

13. Davis RA, Buchanan MS, Duffy S, Avery VM, Charman SA, Charman WN, et al. Antimalarial Activity of Pyrroloiminoquinones from the Australian Marine Sponge Zyzzya sp. J Med Chem. 2012. Epub 2012/06/13.

14. Cheng Q, Kyle DE, Gatton M. Artemisinin resistance in Plasmodium falciparum: a process linked to dormancy? Int J Parasitol Drugs and Drug Resistance. 2012;In press.

15. Auliff A, Balu B, Chen N, O'Neil MT, Cheng Q, Adams JH. Functional analysis of Plasmodium vivax dihydrofolate reductase-thymidylate synthase genes through stable transformation of P. falciparum. . PLoS One. 2012;In press.

16. Atkinson JA, Johnson ML, Wijesinghe R, Bobogare A, Losi L, O'Sullivan M, et al. Operational research to inform a sub-national surveillance intervention for malaria elimination in Solomon Islands. Malar J. 2012;11:101. Epub 2012/04/03.

17. Wang C, Tsai WT, Cooper R, White J. Effectiveness of bed bug monitors for detecting and trapping bed bugs in apartments. Journal of economic entomology. 2011;104(1):274-8. Epub 2011/03/17.

18. Teuscher F, Gatton ML, Chen N, Peters J, Kyle DE, Cheng Q. Artemisinin-induced dormancy in plasmodium falciparum: duration, recovery rates, and implications in treatment failure. J Infect Dis. 2011;202(9):1362-8.

19. Stern DI, Gething PW, Kabaria CW, Temperley WH, Noor AM, Okiro EA, et al. Temperature and malaria trends in highland East Africa. PLoS One. 2011;6(9):e24524. Epub 2011/09/22.

20. Shanks GD, Waller M, Mackenzie A, Brundage JF. Determinants of mortality in naval units during the 1918-19 influenza pandemic. Lancet Infect Dis. 2011;11(10):793-9. Epub 2011/10/01.

21. Shanks GD, MacKenzie A, Waller M, Brundage JF. Low but highly variable mortality among nurses and physicians during the influenza pandemic of 1918-1919. Influenza Other Respi Viruses. 2011;5(3):213-9. Epub 2011/04/12.

22. Paynter S, Ware RS, Shanks GD. Host and environmental factors reducing mortality during the 1918-1919 influenza pandemic. Epidemiol Infect. 2011;139(9):1425-30. Epub 2011/03/23.

23. Ovenden SP, Cobbe M, Kissell R, Birrell GW, Chavchich M, Edstein MD. Phenolic glycosides with antimalarial activity from Grevillea "Poorinda Queen". Journal of natural products. 2011;74(1):74-8. Epub 2010/12/16.

24. Nasveld PE, Edstein MD, Reid M, Brennan L, Harris IE, Kitchener SJ, et al. Randomized, double-blind study of the safety, tolerability, and efficacy of tafenoquine versus mefloquine for malaria prophylaxis in nonimmune subjects. Antimicrob Agents Chemother. 2011;54(2):792-8.

25. Masurkar V, Edstein M, Gorton C, Anstey NM. Acute dapsone overdose: the effects of continuous veno-venous haemofiltration on the elimination of dapsone. Anaesth Intensive Care. 2011;39.

26. Luchavez J, Baker J, Alcantara S, Belizario V, Jr., Cheng Q, McCarthy JS, et al. Laboratory demonstration of a prozone-like effect in HRP2-detecting malaria rapid diagnostic tests: implications for clinical management. Malar J. 2011;10:286. Epub 2011/10/01.

27. Liu WJ, Rourke MF, Holmes EC, Aaskov JG. Persistence of multiple genetic lineages within intrahost populations of Ross River virus. J Virol. 2011;85(11):5674-8.

28. Li D, Lott WB, Lowry K, Jones A, Thu HM, Aaskov J. Defective interfering viral particles in acute dengue infections. PLoS One. 2011;6(4):e19447.

29. Li D, Aaskov J, Lott WB. Identification of a cryptic prokaryotic promoter within the cDNA encoding the 5' end of dengue virus RNA genome. PLoS One. 2011;6(3):e18197.

30. Holzer GW, Coulibaly S, Aichinger G, Savidis-Dacho H, Mayrhofer J, Brunner S, et al. Evaluation of an inactivated Ross River virus vaccine in active and passive mouse immunization models and establishment of a correlate of protection. Vaccine. 2011;29(24):4132-41.

31. Fukuda MM, Klein TA, Kochel T, Quandelacy TM, Smith BL, Villinski J, et al. Malaria and other vector-borne infection surveillance in the U.S. Department of Defense Armed Forces Health Surveillance Center-Global Emerging Infections Surveillance program: review of 2009 accomplishments. BMC Public Health. 2011;11 Suppl 2:S9. Epub 2011/03/17.

32. Frances SP, Sithiprasana R, Linthicum KJ. Response of Aedes aegypti and Aedes albopictus uninfected and infected with dengue virus to deet in the laboratory. J Med Entomol. 2011;48:334-6.

33. Frances SP. Rickettsial diseases of military importance: An Australian Perspective. J Mil Vet Hlth. 2011;19:25-30.

34. Ebringer A, Heathcote G, Baker J, Waller M, Shanks GD, Edstein MD. Evaluation of the safety and tolerability of a short higher-dose primaquine regimen for presumptive anti-relapse therapy in healthy subjects. Trans R Soc Trop Med Hyg. 2011;105(10):568-73. Epub 2011/09/06.

35. Codd A, Teuscher F, Kyle DE, Cheng Q, Gatton ML. Artemisinin-induced parasite dormancy: a plausible mechanism for treatment failure. Malar J. 2011;10:56. Epub 2011/03/10.

36. Chinh NT, Quang NN, Anh CX, Thanh NX, Dai B, Birrell GW, et al. Pharmacokinetics and ex vivo antimalarial activity of artesunate-azithromycin in healthy volunteers. Antimicrob Agents Chemother. 2011;55(9):4412-5. Epub 2011/07/07.

37. Cao-Lormeau VM, Roche C, Aubry M, Teissier A, Lastere S, Daudens E, et al. Recent emergence of dengue virus serotype 4 in French polynesia results from multiple introductions from other South pacific islands. PLoS One. 2011;6(12):e29555.

38. Bugoro H, Iro'ofa C, Mackenzie DO, Apairamo A, Hevalao W, Corcoran S, et al. Changes in vector species composition and current vector biology and behaviour will favour malaria elimination in Santa Isabel Province, Solomon Islands. Malar J. 2011;10:287. Epub 2011/10/04.

39. Bugoro H, Cooper RD, Butafa C, Iro'ofa C, Mackenzie DO, Chen CC, et al. Bionomics of the malaria vector Anopheles farauti in Temotu Province, Solomon Islands: issues for malaria elimination. Malar J. 2011;10:133.

40. Brundage JF, Shanks GD. Sequential infections with influenza and novel respiratory bacteria. J Infect Dis. 2011;203(7):1034-5. Epub 2011/03/16.

41. Brumpton B, McPherson B, Frances SP, Inglis T, McCall B. Townsville field training area health assessment. ADF Health. 2011(12):45-50.

42. Baker J, Gatton ML, Peters J, Ho MF, McCarthy JS, Cheng Q. Transcription and expression of Plasmodium falciparum histidine-rich proteins in different stages and strains: implications for rapid diagnostic tests. PLoS One. 2011;6(7):e22593. Epub 2011/07/30.

43. Auliff AM, Adams JH, O'Neil MT, Cheng Q. Defining the role of mutations in Plasmodium vivax dihydrofolate reductase-thymidylate synthase gene using an episomal Plasmodium falciparum transfection system. Antimicrob Agents Chemother. 2011;54(9):3927-32.

44. Aichinger G, Ehrlich HJ, Aaskov JG, Fritsch S, Thomasser C, Draxler W, et al. Safety and immunogenicity of an inactivated whole virus Vero cell-derived Ross River virus vaccine: a randomized trial. Vaccine. 2011;29(50):9376-84.

45. Aaskov J, Jones A, Choi W, Lowry K, Stewart E. Lineage replacement accompanying duplication and rapid fixation of an RNA element in the nsP3 gene in a species of alphavirus. Virology. 2011;410(2):353-9.

46. Whitman TJ, Coyne PE, Magill AJ, Blazes DL, Green MD, Milhous WK, et al. An outbreak of Plasmodium falciparum malaria in U.S. Marines deployed to Liberia. Am J Trop Med Hyg. 2010;83(2):258-65. Epub 2010/08/05.

47. Teuscher F, Gatton ML, Chen N, Peters J, Kyle DE, Cheng Q. Artemisinin-induced dormancy in plasmodium falciparum: duration, recovery rates, and implications in treatment failure. J Infect Dis. 2010;202(9):1362-8. Epub 2010/09/25.

48. Summers JA, Wilson N, Baker MG, Shanks GD. Mortality risk factors for pandemic influenza on New Zealand troop ship, 1918. Emerg Infect Dis. 2010;16(12):1931-7. Epub 2010/12/03.

49. Shanks GD, Mackenzie A, McLaughlin R, Waller M, Dennis P, Lee SE, et al. Mortality risk factors during the 1918-1919 influenza pandemic in the Australian army. J Infect Dis. 2010;201(12):1880-9. Epub 2010/05/11.

50. Shanks GD, Bradley DJ. Island fever: the historical determinants of malaria in the Andaman Islands. Trans R Soc Trop Med Hyg. 2010;104(3):185-90. Epub 2009/09/08.

51. Shanks GD. For severe malaria, artesunate is the answer. Lancet. 2010;376(9753):1621-2. Epub 2010/11/11.

52. Paynter S, Ware RS, Shanks GD. Host and environmental factors reducing mortality during the 1918-1919 influenza pandemic. Epidemiol Infect. 2010;139(9):1425-30.

53. Nasveld PE, Marjason J, Bennett S, Aaskov J, Elliott S, McCarthy K, et al. Concomitant or sequential administration of live attenuated Japanese encephalitis chimeric virus vaccine and yellow fever 17D vaccine: randomized double-blind phase II evaluation of safety and immunogenicity. Hum Vaccin. 2010;6(11):906-14.

54. Nasveld PE, Ebringer A, Elmes N, Bennett S, Yoksan S, Aaskov J, et al. Long term immunity to live attenuated Japanese encephalitis chimeric virus vaccine: randomized, double-blind, 5-year phase II study in healthy adults. Hum Vaccin. 2010;6(12):1038-46.

55. Manh CD, Beebe NW, Van VN, Quang TL, Lein CT, Nguyen DV, et al. Vectors and malaria transmission in deforested, rural communities in north-central Vietnam. Malar J. 2010;9:259. Epub 2010/09/18.

56. Li DS, Liu W, Guigon A, Mostyn C, Grant R, Aaskov J. Rapid displacement of dengue virus type 1 by type 4, Pacific region, 2007-2009. Emerg Infect Dis. 2010;16(1):123-5.

57. Kozlov S, Waters NC, Chavchich M. Leveraging cell cycle analysis in anticancer drug discovery to identify novel plasmodial drug targets. Infect Disord Drug Targets. 2010;10(3):165-90. Epub 2010/03/26.

58. Jones A, Lowry K, Aaskov J, Holmes EC, Kitchen A. Molecular evolutionary dynamics of Ross River virus and implications for vaccine efficacy. J Gen Virol. 2010;91(Pt 1):182-8.

59. Islands. TPMISGobotMoHoVatS. Malaria on Isolated Melanesian Islands Prior to the Initiation of Malaria Elimination Activities. . Malar J. 2010;9:218.

60. Harris I, Sharrock WW, Bain LM, Gray KA, Bobogare A, Boaz L, et al. A large proportion of asymptomatic Plasmodium infections with low and sub-microscopic parasite densities in the low transmission setting of Temotu Province, Solomon Islands: challenges for malaria diagnostics in an elimination setting. Malar J. 2010;9:254. Epub 2010/09/09.

61. Goodyer L, Croft A, Frances SP, Hill N, Moore S, Onyango S, et al. Expert Review of the Evidence Base for Arthropod Bite Avoidance. J Travel Med. 2010;17:182-92.

62. Gatton ML, Cheng Q. Interrupting malaria transmission: quantifying the impact of interventions in regions of low to moderate transmission. PLoS One. 2010;5(12):e15149. Epub 2010/12/15.

63. Gamboa D, Ho MF, Bendezu J, Torres K, Chiodini PL, Barnwell JW, et al. A large proportion of P. falciparum isolates in the Amazon region of Peru lack pfhrp2 and pfhrp3: implications for malaria rapid diagnostic tests. PLoS One. 2010;5(1):e8091. Epub 2010/01/30.

64. Frances SP, Bugoro H, Butafa C, Cooper RD. Field evaluation of deet against Anopheles farauti at Ndendo (Santa Cruz) Island, Solomon Islands. J Med Entomol. 2010;47(5):851-4.

65. Figtree M, Lee R, Bain L, Kennedy T, Mackertich S, Urban M, et al. Plasmodium knowlesi in human, Indonesian Borneo. Emerg Infect Dis. 2010;16(4):672-4. Epub 2010/03/31.

66. Elmes N. Malaria notifications in the Australian Defence Force from 1998 to 2007. International Health. 2010;2(2):130-5.

67. Cooper RD, Edstein MD, Frances SP, Beebe NW. Malaria vectors of Timor-Leste. Malar J. 2010;9:40. Epub 2010/02/04.

68. Chen N, Chavchich M, Peters JM, Kyle DE, Gatton ML, Cheng Q. Deamplification of pfmdr1-containing amplicon on chromosome 5 in Plasmodium falciparum is associated with reduced resistance to artelinic acid in vitro. Antimicrob Agents Chemother. 2010;54(8):3395-401. Epub 2010/04/28.

69. Chavchich M, Gerena L, Peters J, Chen N, Cheng Q, Kyle DE. Role of pfmdr1 amplification and expression in induction of resistance to artemisinin derivatives in Plasmodium falciparum. Antimicrob Agents Chemother. 2010;54(6):2455-64. Epub 2010/03/31.

70. Baker J, Ho MF, Pelecanos A, Gatton M, Chen N, Abdullah S, et al. Global sequence variation in the histidine-rich proteins 2 and 3 of Plasmodium falciparum: implications for the performance of malaria rapid diagnostic tests. Malar J. 2010;9:129. Epub 2010/05/18.

71. Alquezar DE, Hemmerter S, Cooper RD, Beebe NW. Incomplete concerted evolution and reproductive isolation at the rDNA locus uncovers nine cryptic species within Anopheles longirostris from Papua New Guinea. BMC Evol Biol. 2010;10:392. Epub 2010/12/28.

72. Thanh NX, Trung TN, Phong NC, Thien NX, Dai B, Shanks GD, et al. Open label randomized comparison of dihydroartemisinin-piperaquine and artesunate-amodiaquine for the treatment of uncomplicated Plasmodium falciparum malaria in central Vietnam. Trop Med Int Health. 2009;14(5):504-11. Epub 2009/03/27.

73. Strickman D, Frances SP, Debboun M. Prevention of Bug Bites, Stings, and Disease: Oxford University Press; 2009. 323 p.

74. Siriporn P, Panita T, Supaporn R, Pochaman W, Duangporn P, Frances SP, et al. Transstadial and transovarial transmission of Orientia tsutsugamushi in Leptotrombidium imphalum and Leptotrombidium chiangraiensis (Acari: Trombiculidae). J Med Entomol. 2009;46:1442-5.

75. Shanks GD. Are studies on severe malaria still possible? Clin Infect Dis. 2009;49(6):850-1. Epub 2009/08/14.

76. Shanks GD. Simultaneous epidemics of influenza and malaria in the Australian Army in Palestine in 1918. Med J Aust. 2009;191(11-12):654-7. Epub 2009/12/24.

77. Obaldia N, 3rd, Kotecka BM, Edstein MD, Haynes RK, Fugmann B, Kyle DE, et al. Evaluation of artemisone combinations in Aotus monkeys infected with Plasmodium falciparum. Antimicrob Agents Chemother. 2009;53(8):3592-4.

78. Nguyen DV, Nguyen QP, Nguyen ND, Le TT, Nguyen TD, Dinh DN, et al. Pharmacokinetics and ex vivo pharmacodynamic antimalarial activity of dihydroartemisinin-piperaquine in patients with uncomplicated falciparum malaria in Vietnam. Antimicrob Agents Chemother. 2009;53(8):3534-7.

79. Lilley K. Malaria Microscopy Quality Assurance Manual. 1 ed. Geneva: World Health Organisation; 2009.

80. Johnson P, Hall-Mendelin S, Whelan P, Frances SP, Jansen D, Mackenzie A, et al. Vector competence of Australian Culex gelidus Theobald for endemic and exotic arboviruses. Aust J Entomol. 2009;48:234-40.

81. Frances SP, MacKenzie DO, Rowcliffe KL, Corcoran SK. Comparative field evaluation of repellent formulations containing deet and IR3535 against mosquitoes in Queensland, Australia. J Am Mosq Control Assoc. 2009;25(4):511-3.

82. Frances SP, Mackenzie DO, Klun JA, Debboun M. Laboratory and field evaluation of SS220 and deet against mosquitoes in Queensland, Australia. J Am Mosq Control Assoc. 2009;25(2):174-8.

83. Cooper RD, Waterson DG, Frances SP, Beebe NW, Pluess B, Sweeney AW. Malaria vectors of Papua New Guinea. Int J Parasitol. 2009;39(13):1495-501. Epub 2009/06/10.

84. Bower JE, Cooper RD, Beebe NW. Internal repetition and intraindividual variation in the rDNA ITS1 of the anopheles punctulatus group (Diptera: Culicidae): multiple units and rates of turnover. J Mol Evol. 2009;68(1):66-79. Epub 2009/01/06.

85. Beebe NW, Cooper RD, Mottram P, Sweeney AW. Australia's dengue risk driven by human adaptation to climate change. PLoS Negl Trop Dis. 2009;3(5):e429. Epub 2009/05/06.

86. Suwanarusk R, Chavchich M, Russell B, Jaidee A, Chalfein F, Barends M, et al. Amplification of pvmdr1 associated with multidrug-resistant Plasmodium vivax. J Infect Dis. 2008;198(10):1558-64. Epub 2008/09/24.

87. Sharrock WW, Suwanarusk R, Lek-Uthai U, Edstein MD, Kosaisavee V, Travers T, et al. Plasmodium vivax trophozoites insensitive to chloroquine. Malar J. 2008;7:94.

88. Shanks GD, Hay SI, Bradley DJ. Malaria's indirect contribution to all-cause mortality in the Andaman Islands during the colonial era. Lancet Infect Dis. 2008;8(9):564-70. Epub 2008/07/05.

89. Sanh NH, Van Dung N, Thanh NX, Trung TN, Van Co T, Cooper RD. Forest malaria in central Vietnam. Am J Trop Med Hyg. 2008;79(5):652-4.

90. Sangiambut S, Keelapang P, Aaskov J, Puttikhunt C, Kasinrerk W, Malasit P, et al. Multiple regions in dengue virus capsid protein contribute to nuclear localization during virus infection. J Gen Virol. 2008;89(Pt 5):1254-64.

91. Russell B, Chalfein F, Prasetyorini B, Kenangalem E, Piera K, Suwanarusk R, et al. Determinants of in vitro drug susceptibility testing of Plasmodium vivax. Antimicrob Agents Chemother. 2008;52(3):1040-5. Epub 2008/01/09.

92. Nagelschmitz J, Voith B, Wensing G, Roemer A, Fugmann B, Haynes RK, et al. First assessment in humans of the safety, tolerability, pharmacokinetics, and ex vivo pharmacodynamic antimalarial activity of the new artemisinin derivative artemisone. Antimicrob Agents Chemother. 2008;52(9):3085-91.

93. McGinn D, Frances SP, Sweeney AW, Brown M, Cooper R. Evaluation of Bistar 80SC (Bifenthrin) as a tent treatment for protection against mosquitoes in Northern Territory, Australia. J Med Entomol. 2008;45:1087-91.

94. Hawkins VN, Auliff A, Prajapati SK, Rungsihirunrat K, Hapuarachchi HC, Maestre A, et al. Multiple origins of resistance-conferring mutations in Plasmodium vivax dihydrofolate reductase. Malar J. 2008;7:72. Epub 2008/04/30.

95. Gatton ML, Cheng Q. Can estimates of antimalarial efficacy from field studies be improved? Trends Parasitol. 2008;24(2):68-73. Epub 2008/01/10.

96. Frances SP, Huggins RL, Cooper RD. Evaluation of the inhibition of egg laying, larvicidal effects, and bloodfeeding success of Aedes aegypti exposed to permethrin- and bifenthrin-treated military tent fabric. J Am Mosq Control Assoc. 2008;24(4):598-600.

97. Frances SP, Baade LM, Kubofcik J, Nutman TB, Melrose WD, McCarthy JS, et al. Seroconversion to filarial antigens in Australian defence force personnel in Timor-Leste. Am J Trop Med Hyg. 2008;78(4):560-3.

98. Elmes NJ, Nasveld PE, Kitchener SJ, Kocisko DA, Edstein MD. The efficacy and tolerability of three different regimens of tafenoquine versus primaquine for post-exposure prophylaxis of Plasmodium vivax malaria in the Southwest Pacific. Trans R Soc Trop Med Hyg. 2008;102(11):1095-101.

99. Chen N, Gao Q, Wang S, Wang G, Gatton M, Cheng Q. No genetic bottleneck in Plasmodium falciparum wild-type Pfcrt alleles reemerging in Hainan Island, China, following high-level chloroquine resistance. Antimicrob Agents Chemother. 2008;52(1):345-7. Epub 2007/10/24.

100. Carlton JM, Adams JH, Silva JC, Bidwell SL, Lorenzi H, Caler E, et al. Comparative genomics of the neglected human malaria parasite Plasmodium vivax. Nature. 2008;455(7214):757-63. Epub 2008/10/10.

101. Brundage JF, Shanks GD. Deaths from bacterial pneumonia during 1918-19 influenza pandemic. Emerg Infect Dis. 2008;14(8):1193-9. Epub 2008/08/06.

102. Bower JE, Dowton M, Cooper RD, Beebe NW. Intraspecific concerted evolution of the rDNA ITS1 in Anopheles farauti sensu stricto (Diptera: Culicidae) reveals recent patterns of population structure. J Mol Evol. 2008;67(4):397-411. Epub 2008/09/27.

103. Appleyard B, Tuni M, Cheng Q, Chen N, Bryan J, McCarthy JS. Malaria in pregnancy in the Solomon islands: barriers to prevention and control. Am J Trop Med Hyg. 2008;78(3):449-54. Epub 2008/03/14.

104. Van den Hurk A, Johnson P, Hall-Mendelin S, Northill J, Simmons R, Jansen C, et al. Expectoration of flaviviruses during sugar feeding by mosquitoes (Diptera: Culicidae). J Med Entomol. 2007;44:845-50.

105. Suwanarusk R, Russell B, Chavchich M, Chalfein F, Kenangalem E, Kosaisavee V, et al. Chloroquine resistant Plasmodium vivax: in vitro characterisation and association with molecular polymorphisms. PLoS One. 2007;2(10):e1089. Epub 2007/11/01.

106. Strickman D, Frances SP, Debboun M. Epilogue: Prospects for the future. Debboun M, Frances SP, Strickman D, editors. Boca Raton: CRC Press; 2007.

107. Shanks GD, Magill AJ, Freedman DO, Keystone JS, Bradley DJ, Steffen R. Drug-free holidays: pre-travel versus during travel malaria chemoprophylaxis. Am J Trop Med Hyg. 2007;77(1):1-2. Epub 2007/07/11.

108. Ratcliff A, Siswantoro H, Kenangalem E, Wuwung M, Brockman A, Edstein MD, et al. Therapeutic response of multidrug-resistant Plasmodium falciparum and P. vivax to chloroquine and sulfadoxine-pyrimethamine in southern Papua, Indonesia. Trans R Soc Trop Med Hyg. 2007;101(4):351-9.

109. Peters JM, Fowler EV, Krause DR, Cheng Q, Gatton ML. Differential changes in Plasmodium falciparum var transcription during adaptation to culture. J Infect Dis. 2007;195(5):748-55. Epub 2007/01/31.

110. O'Neil MT, Korsinczky ML, Gresty KJ, Auliff A, Cheng Q. A novel Plasmodium falciparum expression system for assessing antifolate resistance caused by mutant P. vivax dihydrofolate reductase-thymidylate synthase. J Infect Dis. 2007;196(3):467-74. Epub 2007/06/29.

111. Krause DR, Gatton ML, Frankland S, Eisen DP, Good MF, Tilley L, et al. Characterization of the antibody response against Plasmodium falciparum erythrocyte membrane protein 1 in human volunteers. Infect Immun. 2007;75(12):5967-73. Epub 2007/10/10.

112. Kitchener S, Nasveld P, Edstein MD. Tafenoquine for the treatment of recurrent Plasmodium vivax malaria. Am J Trop Med Hyg. 2007;76(3):494-6.

113. Kistner O, Barrett N, Bruhmann A, Reiter M, Mundt W, Savidis-Dacho H, et al. The preclinical testing of a formaldehyde inactivated Ross River virus vaccine designed for use in humans. Vaccine. 2007;25(25):4845-52.

114. Hemmerter S, Slapeta J, van den Hurk AF, Cooper RD, Whelan PI, Russell RC, et al. A curious coincidence: mosquito biodiversity and the limits of the Japanese encephalitis virus in Australasia. BMC Evol Biol. 2007;7:100. Epub 2007/06/30.

115. Frances SP, Debboun M. User acceptability: public perceptions of insect repellents. Debboun M, Frances SP, Strickman D, editors. Boca Raton: CRC Press; 2007.

116. Frances SP. Picaridin. Debboun M, Frances SP, Strickman D, editors. Boca Raton: CRC Press; 2007.

117. Frances SP. Efficacy and safety of repellents containing deet. Debboun M, Frances SP, Strickman D, editors. Boca Raton: CRC Press; 2007.

118. Frances SP. Evaluation of bifenthrin and permethrin as barrier treatments for military tents against mosquitoes in Queensland, Australia. J Am Mosq Control Assoc. 2007;23(2):208-12.

119. Foley DH, Wilkerson RC, Cooper RD, Volovsek ME, Bryan JH. A molecular phylogeny of Anopheles annulipes (Diptera: Culicidae) sensu lato: the most species-rich anopheline complex. Mol Phylogenet Evol. 2007;43(1):283-97.

120. Edstein MD, Nasveld PE, Kocisko DA, Kitchener SJ, Gatton ML, Rieckmann KH. Gender differences in gastrointestinal disturbances and plasma concentrations of tafenoquine in healthy volunteers after tafenoquine administration for post-exposure vivax malaria prophylaxis. Trans R Soc Trop Med Hyg. 2007;101(3):226-30.

121. Edstein MD, Kotecka BM, Ager AL, Smith KS, DiTusa CA, Diaz DS, et al. Antimalarial pharmacodynamics and pharmacokinetics of a third-generation antifolate--JPC2056--in cynomolgus monkeys using an in vivo in vitro model. J Antimicrob Chemother. 2007;60(4):811-8.

122. Dao NV, Cuong BT, Ngoa ND, Thuy le TT, The ND, Duy DN, et al. Vivax malaria: preliminary observations following a shorter course of treatment with artesunate plus primaquine. Trans R Soc Trop Med Hyg. 2007;101(6):534-9. Epub 2007/03/21.

123. Chen N, Auliff A, Rieckmann K, Gatton M, Cheng Q. Relapses of Plasmodium vivax infection result from clonal hypnozoites activated at predetermined intervals. J Infect Dis. 2007;195(7):934-41. Epub 2007/03/03.

124. Charles BG, Miller AK, Nasveld PE, Reid MG, Harris IE, Edstein MD. Population pharmacokinetics of tafenoquine during malaria prophylaxis in healthy subjects. Antimicrob Agents Chemother. 2007;51(8):2709-15.

125. Charles BG, Blomgren A, Nasveld PE, Kitchener SJ, Jensen A, Gregory RM, et al. Population pharmacokinetics of mefloquine in military personnel for prophylaxis against malaria infection during field deployment. Eur J Clin Pharmacol. 2007;63(3):271-8.

126. Brundage JF, Shanks GD. What really happened during the 1918 influenza pandemic? The importance of bacterial secondary infections. J Infect Dis. 2007;196(11):1717-8; author reply 8-9. Epub 2007/11/17.

127. Beebe NW, Whelan PI, Van den Hurk AF, Ritchie SA, Corcoran S, Cooper RD. A polymerase chain reaction-based diagnostic to identify larvae and eggs of container mosquito species from the Australian region. J Med Entomol. 2007;44(2):376-80. Epub 2007/04/13.

128. Baker J, McCarthy J, Gatton M, Lee N, Bell D, Peters J, et al. Rapid diagnostic tests for malaria: are they sufficiently reliable? ADF Health 2007;8(12-17.).

129. Aaskov J, Buzacott K, Field E, Lowry K, Berlioz-Arthaud A, Holmes EC. Multiple recombinant dengue type 1 viruses in an isolate from a dengue patient. J Gen Virol. 2007;88(Pt 12):3334-40.

130. van den Hurk AE, Montgomery BL, Zborowski P, Beebe NW, Cooper RD, Ritchie SA. Does 1-octen-3-ol enhance trap collections of Japanese encephalitis virus mosquito vectors in northern Australia? J Am Mosq Control Assoc. 2006;22(1):15-21. Epub 2006/05/02.

131. Sweeney AW, Beebe NW, Cooper RD, Bauer JT, Peterson AT. Environmental factors associated with distribution and range limits of malaria vector Anopheles farauti in Australia. J Med Entomol. 2006;43(5):1068-75. Epub 2006/10/05.

132. Shanks GD. Treatment of falciparum malaria in the age of drug resistance. J Postgrad Med. 2006;52(4):277-80. Epub 2006/11/15.

133. Reid M, Mackenzie D, Baron A, Lehmann N, Lowry K, Aaskov J, et al. Experimental infection of Culex annulirostris, Culex gelidus, and Aedes vigilax with a yellow fever/Japanese encephalitis virus vaccine chimera (ChimeriVax-JE). Am J Trop Med Hyg. 2006;75(4):659-63.

134. Podder G, Breiman RF, Azim T, Thu HM, Velathanthiri N, Mai le Q, et al. Origin of dengue type 3 viruses associated with the dengue outbreak in Dhaka, Bangladesh, in 2000 and 2001. Am J Trop Med Hyg. 2006;74(2):263-5.

135. Lee N, Baker J, Bell D, McCarthy J, Cheng Q. Assessing the genetic diversity of the aldolase genes of Plasmodium falciparum and Plasmodium vivax and its potential effect on performance of aldolase-detecting rapid diagnostic tests. J Clin Microbiol. 2006;44(12):4547-9. Epub 2006/10/06.

136. Lee N, Baker J, Andrews KT, Gatton ML, Bell D, Cheng Q, et al. Effect of sequence variation in Plasmodium falciparum histidine- rich protein 2 on binding of specific monoclonal antibodies: Implications for rapid diagnostic tests for malaria. J Clin Microbiol. 2006;44(8):2773-8. Epub 2006/08/08.

137. Kitchener S, Nissen M, Nasveld P, Forrat R, Yoksan S, Lang J, et al. Immunogenicity and safety of two live-attenuated tetravalent dengue vaccine formulations in healthy Australian adults. Vaccine. 2006;24(9):1238-41.

138. Kitchener S, Nasveld P, Brennan L, Ward D. Comparative safety and efficacy of subcutaneous and intradermal administration of inactivated Japanese encephalitis vaccine during predeployment preparations in the Australian Defence Force. Mil Med. 2006;171(12):1190-5.

139. Haynes RK, Fugmann B, Stetter J, Rieckmann K, Heilmann HD, Chan HW, et al. Artemisone--a highly active antimalarial drug of the artemisinin class. Angew Chem Int Ed Engl. 2006;45(13):2082-8.

140. Gatton ML, Peters JM, Gresty K, Fowler EV, Chen N, Cheng Q. Detection sensitivity and quantitation of Plasmodium falciparum var gene transcripts by real-time RT-PCR in comparison with conventional RT-PCR. Am J Trop Med Hyg. 2006;75(2):212-8. Epub 2006/08/10.

141. Gatton ML, Cheng Q. Plasmodium falciparum infection dynamics and transmission potential following treatment with sulfadoxine-pyrimethamine. J Antimicrob Chemother. 2006;58(1):47-51. Epub 2006/04/28.

142. Fowler EV, Chavchich M, Chen N, Peters JM, Kyle DE, Gatton ML, et al. Physical linkage to drug resistance genes results in conservation of var genes among West Pacific Plasmodium falciparum isolates. J Infect Dis. 2006;194(7):939-48. Epub 2006/09/09.

143. Elmes NJ, Bennett SM, Abdalla H, Carthew TL, Edstein MD. Lack of sex effect on the pharmacokinetics of primaquine. Am J Trop Med Hyg. 2006;74(6):951-2.

144. Cooper RD, Waterson DG, Frances SP, Beebe NW, Sweeney AW. The anopheline fauna of Papua New Guinea. J Am Mosq Control Assoc. 2006;22(2):213-21. Epub 2006/10/06.

145. Burns M, Baker J, Auliff AM, Gatton ML, Edstein MD, Cheng Q. Efficacy of sulfadoxine-pyrimethamine in the treatment of uncomplicated Plasmodium falciparum malaria in East Timor. Am J Trop Med Hyg. 2006;74(3):361-6. Epub 2006/03/10.

146. Auliff A, Wilson DW, Russell B, Gao Q, Chen N, Anh le N, et al. Amino acid mutations in Plasmodium vivax DHFR and DHPS from several geographical regions and susceptibility to antifolate drugs. Am J Trop Med Hyg. 2006;75(4):617-21. Epub 2006/10/14.

147. Aaskov J, Buzacott K, Thu HM, Lowry K, Holmes EC. Long-term transmission of defective RNA viruses in humans and Aedes mosquitoes. Science. 2006;311(5758):236-8.

148. Vu SN, Nguyen TY, Tran VP, Truong UN, Le QM, Le VL, et al. Elimination of dengue by community programs using Mesocyclops(Copepoda) against Aedes aegypti in central Vietnam. Am J Trop Med Hyg. 2005;72(1):67-73.

149. Shanks GD, Hay SI, Omumbo JA, Snow RW. Malaria in Kenya's western highlands. Emerg Infect Dis. 2005;11(9):1425-32. Epub 2005/10/19.

150. Shanks GD, Edstein MD. Modern malaria chemoprophylaxis. Drugs. 2005;65(15):2091-110. Epub 2005/10/18.

151. Shanks GD, Biomndo K, Guyatt HL, Snow RW. Travel as a risk factor for uncomplicated Plasmodium falciparum malaria in the highlands of western Kenya. Trans R Soc Trop Med Hyg. 2005;99(1):71-4. Epub 2004/11/20.

152. Nasveld P, Kitchener S. Treatment of acute vivax malaria with tafenoquine. Trans R Soc Trop Med Hyg. 2005;99(1):2-5.

153. Myat Thu H, Lowry K, Jiang L, Hlaing T, Holmes EC, Aaskov J. Lineage extinction and replacement in dengue type 1 virus populations are due to stochastic events rather than to natural selection. Virology. 2005;336(2):163-72.

154. Kitchener SJ, Nasveld PE, Gregory RM, Edstein MD. Mefloquine and doxycycline malaria prophylaxis in Australian soldiers in East Timor. Med J Aust. 2005;182(4):168-71.

155. Kitchener S, Nasveld P, Bennett S, Torresi J. Adequate primaquine for vivax malaria. J Travel Med. 2005;12(3):133-5.

156. Imwong M, Pukrittayakamee S, Cheng Q, Moore C, Looareesuwan S, Snounou G, et al. Limited polymorphism in the dihydropteroate synthetase gene (dhps) of Plasmodium vivax isolates from Thailand. Antimicrob Agents Chemother. 2005;49(10):4393-5. Epub 2005/09/29.

157. Hay SI, Shanks GD, Stern DI, Snow RW, Randolph SE, Rogers DJ. Climate variability and malaria epidemics in the highlands of East Africa. Trends Parasitol. 2005;21(2):52-3. Epub 2005/01/25.

158. Frances SP, Wirtz RA. Repellents: past, present, and future. J Am Mosq Control Assoc. 2005;21(4 Suppl):1-3.

159. Frances SP, Waterson DG, Beebe NW, Cooper RD. Field evaluation of commercial repellent formulations against mosquitoes (Diptera: Culicidae) in Northern Territory, Australia. J Am Mosq Control Assoc. 2005;21(4):480-2. Epub 2006/03/02.

160. Frances SP, Marlow R, Jansen R, Huggins RL, Cooper R. Laboratory and field evaluation of commercial repellent formulations against mosquitoes (Diptera: Culicidae) in Queensland, Australia. Aust J Entomol. 2005;44:431-6.

161. Frances SP. Potential for horizontal transmission of Orientia tsutsugamushi by chigger mites (Acari: Trombiculidae). Internat J Acarol. 2005;31:75-82.

162. Foley DH, Frances SP. Laboratory evaluation of methylated coconut oil as a larvicide for Anopheles farauti and Culex annulirostris. J Am Mosq Control Assoc. 2005;21(4):477-9. Epub 2006/03/02.

163. Edstein MD, Kotecka BM, Anderson KL, Pombo DJ, Kyle DE, Rieckmann KH, et al. Lengthy antimalarial activity of atovaquone in human plasma following atovaquone-proguanil administration. Antimicrob Agents Chemother. 2005;49(10):4421-2.

164. Dao NV, Quoc NP, Ngoa ND, Thuy le T, The ND, Dai B, et al. Fatty food does not alter blood mefloquine concentrations in the treatment of falciparum malaria. Trans R Soc Trop Med Hyg. 2005;99(12):927-31.

165. Chen N, Wilson DW, Pasay C, Bell D, Martin LB, Kyle D, et al. Origin and dissemination of chloroquine-resistant Plasmodium falciparum with mutant pfcrt alleles in the Philippines. Antimicrob Agents Chemother. 2005;49(5):2102-5. Epub 2005/04/28.

166. Beebe NW, Whelan PI, van den Hurk A, Ritchie S, Cooper RD. Genetic diversity of the dengue vector Aedes aegypti in Australia and implications for future surveillance and mainland incursion monitoring. Communicable diseases intelligence. 2005;29(3):299-304. Epub 2005/10/14.

167. Baker J, McCarthy J, Gatton M, Kyle DE, Belizario V, Luchavez J, et al. Genetic diversity of Plasmodium falciparum histidine-rich protein 2 (PfHRP2) and its effect on the performance of PfHRP2-based rapid diagnostic tests. J Infect Dis. 2005;192(5):870-7. Epub 2005/08/10.

168. Wongsrichanalai C, Prajakwong S, Meshnick SR, Shanks GD, Thimasarn K. Mefloquine--its 20 years in the Thai Malaria Control Program. Southeast Asian J Trop Med Public Health. 2004;35(2):300-8. Epub 2005/02/05.

169. Walsh DS, Eamsila C, Sasiprapha T, Sangkharomya S, Khaewsathien P, Supakalin P, et al. Efficacy of monthly tafenoquine for prophylaxis of Plasmodium vivax and multidrug-resistant P. falciparum malaria. J Infect Dis. 2004;190(8):1456-63.

170. Thu HM, Lowry K, Myint TT, Shwe TN, Han AM, Khin KK, et al. Myanmar dengue outbreak associated with displacement of serotypes 2, 3, and 4 by dengue 1. Emerg Infect Dis. 2004;10(4):593-7.

171. Sweeney AW, Blackburn CR, Rieckmann KH. Short report: the activity of pamaquine, an 8-aminoquinoline drug, against sporozoite-induced infections of Plasmodium vivax (New Guinea strains). Am J Trop Med Hyg. 2004;71(2):187-9.

172. Shanks GD, Biomndo K, Maguire J. Travel as a risk factor for malaria requiring hospitalization on a highland tea plantation in western Kenya. J Travel Med. 2004;11(6):354-7. Epub 2004/12/01.

173. Reitera P, Thomas CJ, Atkinson PM, Hay SI, Randolph SE, Rogers DJ, et al. Global warming and malaria: a call for accuracy. Lancet Infect Dis. 2004;4(6):323-4. Epub 2004/06/03.

174. Pichyangkul S, Yongvanitchit K, Kum-arb U, Hemmi H, Akira S, Krieg AM, et al. Malaria blood stage parasites activate human plasmacytoid dendritic cells and murine dendritic cells through a Toll-like receptor 9-dependent pathway. J Immunol. 2004;172(8):4926-33. Epub 2004/04/07.

175. Nuegoonpipat A, Berlioz-Arthaud A, Chow V, Endy T, Lowry K, Mai le Q, et al. Sustained transmission of dengue virus type 1 in the Pacific due to repeated introductions of different Asian strains. Virology. 2004;329(2):505-12.

176. Korsinczky M, Fischer K, Chen N, Baker J, Rieckmann K, Cheng Q. Sulfadoxine resistance in Plasmodium vivax is associated with a specific amino acid in dihydropteroate synthase at the putative sulfadoxine-binding site. Antimicrob Agents Chemother. 2004;48(6):2214-22. Epub 2004/05/25.

177. Kitchener S, Baade L, Brennan L, Nasveld P. Intradermal boosting of Japanese encephalitis vaccination. J Travel Med. 2004;11(3):182-3.

178. Hanna JN, Ritchie SA, Eisen DP, Cooper RD, Brookes DL, Montgomery BL. An outbreak of Plasmodium vivax malaria in Far North Queensland, 2002. Med J Aust. 2004;180(1):24-8.

179. Gatton ML, Martin LB, Cheng Q. Evolution of resistance to sulfadoxine-pyrimethamine in Plasmodium falciparum. Antimicrob Agents Chemother. 2004;48(6):2116-23. Epub 2004/05/25.

180. Gatton ML, Cheng Q. Modeling the development of acquired clinical immunity to Plasmodium falciparum malaria. Infect Immun. 2004;72(11):6538-45. Epub 2004/10/27.

181. Gatton ML, Cheng Q. Investigating antigenic variation and other parasite-host interactions in Plasmodium falciparum infections in naive hosts. Parasitology. 2004;128(Pt 4):367-76. Epub 2004/05/21.

182. Gao Q, Beebe NW, Cooper RD. Molecular identification of the malaria vectors Anopheles anthropophagus and Anopheles sinensis (Diptera: Culicidae) in central China using polymerase chain reaction and appraisal of their position within the Hyrcanus group. J Med Entomol. 2004;41(1):5-11. Epub 2004/03/03.

183. Frances SP, Waterson DG, Beebe NW, Cooper RD. Field evaluation of repellent formulations containing deet and picaridin against mosquitoes in Northern Territory, Australia. J Med Entomol. 2004;41(3):414-7. Epub 2004/06/10.

184. Frances SP, Cooper RD, Rowcliffe KL, Chen N, Cheng Q. Occurrence of Ross River virus and Barmah Forest virus in mosquitoes at Shoalwater Bay military training area, Queensland, Australia. J Med Entomol. 2004;41(1):115-20. Epub 2004/03/03.

185. Cooper RD, Frances SP, Popat S, Waterson DG. The effectiveness of light, 1-octen-3-ol, and carbon dioxide as attractants for anopheline mosquitoes in Madang Province, Papua New Guinea. J Am Mosq Control Assoc. 2004;20(3):239-42. Epub 2004/11/10.

186. Boutlis CS, Weinberg JB, Baker J, Bockarie MJ, Mgone CS, Cheng Q, et al. Nitric oxide production and nitric oxide synthase activity in malaria-exposed Papua New Guinean children and adults show longitudinal stability and no association with parasitemia. Infect Immun. 2004;72(12):6932-8. Epub 2004/11/24.

187. Sweeney AW. Malaria Frontline: Australian Army research during World War II. Carlton: Melbourne University Press; 2003. 354 p.

188. Russell BM, Udomsangpetch R, Rieckmann KH, Kotecka BM, Coleman RE, Sattabongkot J. Simple in vitro assay for determining the sensitivity of Plasmodium vivax isolates from fresh human blood to antimalarials in areas where P. vivax is endemic. Antimicrob Agents Chemother. 2003;47(1):170-3.

189. Nasveld P, Russell B, Kotecka B, Rieckmann K. Lack of in vitro effect of ivermectin on Plasmodium falciparum. Southeast Asian J Trop Med Public Health. 2003;34(3):552-3.

190. McGready R, Stepniewska K, Seaton E, Cho T, Cho D, Ginsberg A, et al. Pregnancy and use of oral contraceptives reduces the biotransformation of proguanil to cycloguanil. Eur J Clin Pharmacol. 2003;59(7):553-7.

191. McGready R, Stepniewska K, Edstein MD, Cho T, Gilveray G, Looareesuwan S, et al. The pharmacokinetics of atovaquone and proguanil in pregnant women with acute falciparum malaria. Eur J Clin Pharmacol. 2003;59(7):545-52.

192. Kotecka BM, Rieckmann KH, Davis TM, Batty KT, Ilett KF. Comparison of bioassay and high performance liquid chromatographic assay of artesunate and dihydroartemisinin in plasma. Acta Trop. 2003;87(3):371-5.

193. Kitchener S, Nasveld P, Russell B, Elmes N. An outbreak of malaria in a forward battalion on active service in East Timor. Mil Med. 2003;168(6):457-9.

194. Kitchener S, Baade L, Brennan L. When should travelers from nonendemic areas for flaviviruses receive booster vaccination for Japanese encephalitis? J Travel Med. 2003;10(1):50-1.

195. Gatton ML, Peters JM, Fowler EV, Cheng Q. Switching rates of Plasmodium falciparum var genes: faster than we thought? Trends Parasitol. 2003;19(5):202-8. Epub 2003/05/24.

196. Frances SP, Watson K, Constable BG. Comparative toxicity of permethrin- and bifenthrin-treated cloth fabric for Anopheles farauti and Aedes aegypti. J Am Mosq Control Assoc. 2003;19(3):275-8.

197. Frances SP, Cooper RD, Gupta RK, Debboun M. Efficacy of a new self-supporting low-profile bednet for personal protection against Anopheles farauti (Diptera: Culicidae) in a village in Papua New Guinea. J Med Entomol. 2003;40(1):68-72.

198. Frances SP, Auliff AM, Edstein MD, Cooper RD. Survey of personal protection measures against mosquitoes among Australian defense force personnel deployed to East Timor. Mil Med. 2003;168(3):227-30.

199. Ezard N, Burns M, Lynch C, Cheng Q, Edstein MD. Efficacy of chloroquine in the treatment of uncomplicated Plasmodium falciparum infection in East Timor, 2000. Acta Trop. 2003;88(1):87-90. Epub 2003/08/29.

200. Edstein MD, Kocisko DA, Walsh DS, Eamsila C, Charles BG, Rieckmann KH. Plasma concentrations of tafenoquine, a new long-acting antimalarial agent, in thai soldiers receiving monthly prophylaxis. Clin Infect Dis. 2003;37(12):1654-8.

201. Craig S, Thu HM, Lowry K, Wang XF, Holmes EC, Aaskov J. Diverse dengue type 2 virus populations contain recombinant and both parental viruses in a single mosquito host. J Virol. 2003;77(7):4463-7.

202. Coleman RE, Monkanna T, Linthicum KJ, Strickman DA, Frances SP, Tanskul P, et al. Occurrence of Orientia tsutsugamushi in small mammals from Thailand. Am J Trop Med Hyg. 2003;69(5):519-24. Epub 2003/12/26.

203. Chen N, Kyle DE, Pasay C, Fowler EV, Baker J, Peters JM, et al. pfcrt Allelic types with two novel amino acid mutations in chloroquine-resistant Plasmodium falciparum isolates from the Philippines. Antimicrob Agents Chemother. 2003;47(11):3500-5. Epub 2003/10/25.

204. Arness MK, Bradshaw RD, Biomndo K, Shanks GD. Epidemiology of highland malaria in western Kenya. East African medical journal. 2003;80(5):253-9. Epub 2005/09/20.

205. Wittke V, Robb TE, Thu HM, Nisalak A, Nimmannitya S, Kalayanrooj S, et al. Extinction and rapid emergence of strains of dengue 3 virus during an interepidemic period. Virology. 2002;301(1):148-56.

206. Tjitra E, Baker J, Suprianto S, Cheng Q, Anstey NM. Therapeutic efficacies of artesunate-sulfadoxine-pyrimethamine and chloroquine-sulfadoxine-pyrimethamine in vivax malaria pilot studies: relationship to Plasmodium vivax dhfr mutations. Antimicrob Agents Chemother. 2002;46(12):3947-53. Epub 2002/11/19.

207. Shanks GD, Hay SI, Stern DI, Biomndo K, Snow RW. Meteorologic influences on Plasmodium falciparum malaria in the Highland Tea Estates of Kericho, Western Kenya. Emerg Infect Dis. 2002;8(12):1404-8. Epub 2002/12/25.

208. Ryan JR, Dave K, Collins KM, Hochberg L, Sattabongkot J, Coleman RE, et al. Extensive multiple test centre evaluation of the VecTest malaria antigen panel assay. Med Vet Entomol. 2002;16(3):321-7.

209. Rieckmann K, Cheng Q. Pyrimethamine-sulfadoxine resistance in Plasmodium falciparum must be delayed in Africa. Trends Parasitol. 2002;18(7):293-4; author reply 4. Epub 2002/10/17.

210. Peters JM, Chen N, Gatton M, Korsinczky M, Fowler EV, Manzetti S, et al. Mutations in cytochrome b resulting in atovaquone resistance are associated with loss of fitness in Plasmodium falciparum. Antimicrob Agents Chemother. 2002;46(8):2435-41. Epub 2002/07/18.

211. Peters J, Fowler E, Gatton M, Chen N, Saul A, Cheng Q. High diversity and rapid changeover of expressed var genes during the acute phase of Plasmodium falciparum infections in human volunteers. Proc Natl Acad Sci U S A. 2002;99(16):10689-94. Epub 2002/07/27.

212. Nasveld P, Kitchener S, Edstein M, Rieckmann K. Comparison of tafenoquine (WR238605) and primaquine in the post-exposure (terminal) prophylaxis of vivax malaria in Australian Defence Force personnel. Trans R Soc Trop Med Hyg. 2002;96(6):683-4.

213. Maguire JD, Lacy MD, Sururi, Sismadi P, Krisin, Wiady I, et al. Chloroquine or sulfadoxine-pyrimethamine for the treatment of uncomplicated, Plasmodium falciparum malaria during an epidemic in Central Java, Indonesia. Ann Trop Med Parasitol. 2002;96(7):655-68.

214. Lerdthusnee K, Khlaimanee N, Monkanna T, Sangjun N, Mungviriya S, Linthicum KJ, et al. Efficiency of Leptotrombidium chiggers (Acari: Trombiculidae) at transmitting Orientia tsutsugamushi to laboratory mice. J Med Entomol. 2002;39(3):521-5. Epub 2002/06/14.

215. Kitchener S, Leggat PA, Brennan L, McCall B. Importation of dengue by soldiers returning from East Timor to north Queensland, Australia. J Travel Med. 2002;9(4):180-3.

216. Kitchener S. Epidemiology of malaria from East Timor among Australian Defence Force personnel. Trans R Soc Trop Med Hyg. 2002;96(4):376-7.

217. Kay BH, Nam VS, Tien TV, Yen NT, Phong TV, Diep VT, et al. Control of aedes vectors of dengue in three provinces of Vietnam by use of Mesocyclops (Copepoda) and community-based methods validated by entomologic, clinical, and serological surveillance. Am J Trop Med Hyg. 2002;66(1):40-8.

218. Hii J, Frances SP, Canyon D, Covere J. Personal protective measures against disease vectors. Leggat PA, Goldsmid J, editors. Brisbane: ACTM Publications; 2002.

219. Hay SI, Rogers DJ, Randolph SE, Stern DI, Cox J, Shanks GD, et al. Hot topic or hot air? Climate change and malaria resurgence in East African highlands. Trends Parasitol. 2002;18(12):530-4. Epub 2002/12/17.

220. Hay SI, Cox J, Rogers DJ, Randolph SE, Stern DI, Shanks GD, et al. Climate change and the resurgence of malaria in the East African highlands. Nature. 2002;415(6874):905-9. Epub 2002/02/23.

221. Gatton ML, Cheng Q. Evaluation of the pyrogenic threshold for Plasmodium falciparum malaria in naive individuals. Am J Trop Med Hyg. 2002;66(5):467-73. Epub 2002/08/31.

222. Frances SP, Van Dung N, Beebe NW, Debboun M. Field evaluation of repellent formulations against daytime and nighttime biting mosquitoes in a tropical rainforest in northern Australia. J Med Entomol. 2002;39(3):541-4.

223. Frances SP, Cooper R. Personal protection measures against mosquitoes – a brief history and current usage of repellents by the Australian Defence Force. J ADHS. 2002;3:58-63.

224. Fowler EV, Peters JM, Gatton ML, Chen N, Cheng Q. Genetic diversity of the DBLalpha region in Plasmodium falciparum var genes among Asia-Pacific isolates. Mol Biochem Parasitol. 2002;120(1):117-26. Epub 2002/02/19.

225. Cooper RD, Waterson DG, Frances SP, Beebe NW, Sweeney AW. Speciation and distribution of the members of the Anopheles punctulatus (Diptera: Culicidae) group in Papua New Guinea. J Med Entomol. 2002;39(1):16-27. Epub 2002/04/05.

226. Cooper RD, Frances SP. Malaria vectors on Buka and Bougainville Islands, Papua New Guinea. J Am Mosq Control Assoc. 2002;18(2):100-6.

227. Chen N, Russell B, Fowler E, Peters J, Cheng Q. Levels of chloroquine resistance in Plasmodium falciparum are determined by loci other than pfcrt and pfmdr1. J Infect Dis. 2002;185(3):405-7. Epub 2002/01/25.

228. Chen N, Baker J, Ezard N, Burns M, Edstein MD, Cheng Q. Short report: Molecular evaluation of the efficacy of chloroquine treatment of uncomplicated Plasmodium falciparum malaria in East Timor. Am J Trop Med Hyg. 2002;67(1):64-6. Epub 2002/10/05.

229. Bragonier R, Reyburn H, Nasveld P, Edstein M, Auliffe A. Rainy-season prevalence of malaria in Bobonaro district, East Timor. Ann Trop Med Parasitol. 2002;96(7):739-43. Epub 2003/01/23.

230. Bragonier R, Nasveld P, Auliffe A. Plasmodium malariae in East Timor. Southeast Asian J Trop Med Public Health. 2002;33(4):689-90. Epub 2003/05/22.

231. Beebe NW, van den Hurk AF, Chapman HF, Frances SP, Williams CR, Cooper RD. Development and evaluation of a species diagnostic polymerase chain reaction-restriction fragment-

length polymorphism procedure for cryptic members of the Culex sitiens (Diptera: Culicidae) subgroup in Australia and the southwest Pacific. J Med Entomol. 2002;39(2):362-9. Epub 2002/04/05.

232. Beebe NW, Cooper RD. Distribution and evolution of the Anopheles punctulatus group (Diptera: Culicidae) in Australia and Papua New Guinea. Int J Parasitol. 2002;32(5):563-74. Epub 2002/04/12.

233. Shanks GD, Oloo AJ, Aleman GM, Ohrt C, Klotz FW, Braitman D, et al. A new primaquine analogue, tafenoquine (WR 238605), for prophylaxis against Plasmodium falciparum malaria. Clin Infect Dis. 2001;33(12):1968-74. Epub 2001/11/09.

234. Shanks GD, Kain KC, Keystone JS. Malaria chemoprophylaxis in the age of drug resistance. II. Drugs that may be available in the future. Clin Infect Dis. 2001;33(3):381-5. Epub 2001/07/05.

235. Serafin IL, Aaskov JG. Identification of epitopes on the envelope (E) protein of dengue 2 and dengue 3 viruses using monoclonal antibodies. Arch Virol. 2001;146(12):2469-79.

236. Lok SM, Ng ML, Aaskov J. Amino acid and phenotypic changes in dengue 2 virus associated with escape from neutralisation by IgM antibody. J Med Virol. 2001;65(2):315-23.

237. Kain KC, Shanks GD, Keystone JS. Malaria chemoprophylaxis in the age of drug resistance. I. Currently recommended drug regimens. Clin Infect Dis. 2001;33(2):226-34. Epub 2001/06/22.

238. Jensen NP, Ager AL, Bliss RA, Canfield CJ, Kotecka BM, Rieckmann KH, et al. Phenoxypropoxybiguanides, prodrugs of DHFR-inhibiting diaminotriazine antimalarials. J Med Chem. 2001;44(23):3925-31.

239. Hay SI, Rogers DJ, Shanks GD, Myers MF, Snow RW. Malaria early warning in Kenya. Trends Parasitol. 2001;17(2):95-9. Epub 2001/03/03.

240. Hammond RB, Bierman P, Levine E, Cooper RL. Field resistance of two soybean germplasm lines, HC95-15MB and HC95-24MB, against bean leaf beetle (Coleoptera: Chrysomelidae), western corn rootworm (Coleoptera: Chrysomelidae), and Japanese beetles (Coleoptera: Scarabaidae). Journal of economic entomology. 2001;94(6):1594-601. Epub 2002/01/05.

241. Frances SP, Watcharapichat P, Phulsuksombati D, Tanskul P. Investigation of the role of Blankaartia acuscutellaris (Acari: Trombiculidae) as a vector of scrub typhus in central Thailand. Southeast Asian J Trop Med Public Health. 2001;32(4):863-6.

242. Frances SP, Watcharapichat P, Phulsuksombati D. Vertical transmission of Orientia tsutsugamushi in two lines of naturally infected Leptotrombidium deliense (Acari: Trombiculidae). J Med Entomol. 2001;38(1):17-21.

243. Frances SP, Cooper RD, Popat S, Beebe NW. Field evaluation of repellents containing deet and AI3-37220 against Anopheles koliensis in Papua New Guinea. J Am Mosq Control Assoc. 2001;17(1):42-4. Epub 2001/05/10.

244. Frances SP, Cooper RD, Chen N, Cheng Q. Surveillance of potential arbovirus vectors at Shoal Water Bay military training area, Queensland. Arbovirus Research in Australia. 2001;8:160-3.

245. Edstein MD, Walsh DS, Eamsila C, Sasiprapha T, Nasveld PE, Kitchener S, et al. Malaria prophylaxis/radical cure: recent experiences of the Australian Defence Force. Med Trop (Mars). 2001;61(1):56-8.

246. Edstein MD, Kocisko DA, Brewer TG, Walsh DS, Eamsila C, Charles BG. Population pharmacokinetics of the new antimalarial agent tafenoquine in Thai soldiers. Br J Clin Pharmacol. 2001;52(6):663-70.

247. Cloonan N, Fischer K, Cheng Q, Saul A. Aldolase genes of Plasmodium species. Mol Biochem Parasitol. 2001;113(2):327-30. Epub 2001/04/11.

248. Chen N, Russell B, Staley J, Kotecka B, Nasveld P, Cheng Q. Sequence polymorphisms in pfcrt are strongly associated with chloroquine resistance in Plasmodium falciparum. J Infect Dis. 2001;183(10):1543-5. Epub 2001/04/25.

249. Beebe NW, Maung J, van den Hurk AF, Ellis JT, Cooper RD. Ribosomal DNA spacer genotypes of the Anopheles bancroftii group (Diptera: Culicidae) from Australia and Papua New Guinea. Insect Mol Biol. 2001;10(5):407-13. Epub 2002/03/08.

250. Beasley DW, Aaskov JG. Epitopes on the dengue 1 virus envelope protein recognized by neutralizing IgM monoclonal antibodies. Virology. 2001;279(2):447-58.

251. van den Hurk AF, Cooper RD, Beebe NW, Williams GM, Bryan JH, Ritchie SA. Seasonal abundance of Anopheles farauti (Diptera: Culicidae) sibling species in far north Queensland, Australia. J Med Entomol. 2000;37(1):153-61. Epub 2004/06/29.

252. Taylor D, Cloonan N, Mann V, Cheng Q, Saul A. Sequence diversity in rodent malaria of the Pfs28 ookinete surface antigen homologs. Mol Biochem Parasitol. 2000;110(2):429-34. Epub 2000/11/09.

253. Sweeney AW. Wartime research on malaria chemotherapy. Parassitologia. 2000;42(1-2):33-45.

254. Shanks GD, Biomndo K, Hay SI, Snow RW. Changing patterns of clinical malaria since 1965 among a tea estate population located in the Kenyan highlands. Trans R Soc Trop Med Hyg. 2000;94(3):253-5. Epub 2000/09/07.

255. Ogutu BR, Smoak BL, Nduati RW, Mbori-Ngacha DA, Mwathe F, Shanks GD. The efficacy of pyrimethamine-sulfadoxine (Fansidar) in the treatment of uncomplicated Plasmodium falciparum malaria in Kenyan children. Trans R Soc Trop Med Hyg. 2000;94(1):83-4. Epub 2000/04/05.

256. Lawrence G, Cheng QQ, Reed C, Taylor D, Stowers A, Cloonan N, et al. Effect of vaccination with 3 recombinant asexual-stage malaria antigens on initial growth rates of Plasmodium falciparum in non-immune volunteers. Vaccine. 2000;18(18):1925-31. Epub 2000/03/04.

257. Korsinczky M, Chen N, Kotecka B, Saul A, Rieckmann K, Cheng Q. Mutations in Plasmodium falciparum cytochrome b that are associated with atovaquone resistance are located at a putative drug-binding site. Antimicrob Agents Chemother. 2000;44(8):2100-8. Epub 2000/07/18.

258. Kitchener SJ, Auliff AM, Rieckmann KH. Malaria in the Australian Defence Force during and after participation in the International Force in East Timor (INTERFET). Med J Aust. 2000;173(11-12):583-5. Epub 2001/05/31.

259. Hay SI, Myers MF, Burke DS, Vaughn DW, Endy T, Ananda N, et al. Etiology of interepidemic periods of mosquito-borne disease. Proc Natl Acad Sci U S A. 2000;97(16):9335-9. Epub 2000/08/02.

260. Frances SP, Watcharapichat P, Phulsuksombati D, Tanskul P. Transmission of Orientia tsutsugamushi, the aetiological agent for scrub typhus, to co-feeding mites. Parasitology. 2000;120 (Pt 6):601-7.

261. Frances SP, Watcharapichat P, Phulsuksombati D. Development and persistence of antibodies to Orientia tsutsugamushi in the roof rat, Rattus rattus and laboratory mice following attachment of naturally infected Leptotrombidium deliense. Acta Trop. 2000;77(3):279-85.

262. Figtree M, Pasay CJ, Slade R, Cheng Q, Cloonan N, Walker J, et al. Plasmodium vivax synonymous substitution frequencies, evolution and population structure deduced from diversity in AMA 1 and MSP 1 genes. Mol Biochem Parasitol. 2000;108(1):53-66. Epub 2000/05/10.

263. Cooper RD, Waterson DG, Bangs MJ, Beebe NW. Rediscovery of Anopheles (Cellia) clowi (Diptera: Culicidae), a rarely recorded member of the Anopheles punctulatus group. J Med Entomol. 2000;37(6):840-5. Epub 2000/12/29.

264. Cooper R, Frances SP. Biting sites of Anopheles koliensis on human collectors in Papua New Guinea. J Am Mosq Control Assoc. 2000;16:266-7.

265. Beebe NW, Cooper RD, Morrison DA, Ellis JT. Subset partitioning of the ribosomal DNA small subunit and its effects on the phylogeny of the Anopheles punctulatus group. Insect Mol Biol. 2000;9(5):515-20. Epub 2000/10/13.

266. Beebe NW, Cooper RD, Morrison DA, Ellis JT. A phylogenetic study of the Anopheles punctulatus group of malaria vectors comparing rDNA sequence alignments derived from the mitochondrial and nuclear small ribosomal subunits. Mol Phylogenet Evol. 2000;17(3):430-6. Epub 2001/01/03.

267. Beebe NW, Cooper RD, Foley DH, Ellis JT. Populations of the south-west Pacific malaria vector Anopheles farauti s.s. revealed by ribosomal DNA transcribed spacer polymorphisms. Heredity (Edinb). 2000;84 (Pt 2):244-53. Epub 2000/04/13.

268. Beebe NW, Cooper RD. Systematics of malaria vectors with particular reference to the Anopheles punctulatus group. Int J Parasitol. 2000;30(1):1-17. Epub 2000/02/17.

269. Beebe NW, Bakote'e B, Ellis JT, Cooper RD. Differential ecology of Anopheles punctulatus and three members of the Anopheles farauti complex of mosquitoes on Guadalcanal, Solomon

Islands, identified by PCR-RFLP analysis. Med Vet Entomol. 2000;14(3):308-12. Epub 2000/10/04.

270. van Vugt M, Edstein MD, Proux S, Lay K, Ooh M, Looareesuwan S, et al. Absence of an interaction between artesunate and atovaquone--proguanil. Eur J Clin Pharmacol. 1999;55(6):469-74.

271. Sweeney AW. Prospects for control of mosquito-borne diseases. J Med Microbiol. 1999;48(10):879-81.

272. Shanks GD, Smoak BL, Aleman GM, Oundo J, Waiyaki PG, Dunne MW, et al. Single dose of azithromycin or three-day course of ciprofloxacin as therapy for epidemic dysentery in Kenya. Acute Dysentery Study Group. Clin Infect Dis. 1999;29(4):942-3. Epub 1999/12/10.

273. Shanks GD, Ragama BO, Oloo AJ. Time to reappearance of malaria parasites following various drug treatment regimens in a holoendemic area of western Kenya. Trans R Soc Trop Med Hyg. 1999;93(3):304-5. Epub 1999/09/24.

274. Frances SP, Watcharapichat P, Phulsuksombati D, Tanskul P, Linthicum KJ. Seasonal occurrence of Leptotrombidium deliense (Acari: Trombiculidae) attached to sentinel rodents in an orchard near Bangkok, Thailand. J Med Entomol. 1999;36(6):869-74.

275. Frances SP, Watcharapichat P, Phulsuksombati D, Tanskul P. Occurrence of Orientia tsutsugamushi in chiggers (Acari: Trombiculidae) and small animals in an orchard near Bangkok, Thailand. J Med Entomol. 1999;36(4):449-53.

276. Frances SP, Cooper RD, Popat S, Sweeney AW. Field evaluation of the repellents deet, CIC-4, and AI3-37220 against Anopheles in Lae, Papua New Guinea. J Am Mosq Control Assoc. 1999;15(3):339-41.

277. Clifford K, Frances SP, Nasveld P, Russell B. Preventive health advice to deploying units. Aust Military Med. 1999;8(3):7-12.

278. Chen N, Cheng Q. Codon usage in Plasmodium vivax nuclear genes. Int J Parasitol. 1999;29(3):445-9. Epub 1999/05/20.

279. Beebe NW, Ellis JT, Cooper RD, Saul A. DNA sequence analysis of the ribosomal DNA ITS2 region for the Anopheles punctulatus group of mosquitoes. Insect Mol Biol. 1999;8(3):381-90. Epub 1999/09/01.

280. van den Hurk AF, Ritchie SA, Ingram A, Cooper RD. The first report of Anopheles farauti sensu stricto below the nineteenth parallel at Mackay, Queensland. Med J Aust. 1998;169(2):89-90.

281. Shanks GD, Gordon DM, Klotz FW, Aleman GM, Oloo AJ, Sadie D, et al. Efficacy and safety of atovaquone/proguanil as suppressive prophylaxis for Plasmodium falciparum malaria. Clin Infect Dis. 1998;27(3):494-9. Epub 1998/10/14.

282. Malakooti MA, Biomndo K, Shanks GD. Reemergence of epidemic malaria in the highlands of western Kenya. Emerg Infect Dis. 1998;4(4):671-6. Epub 1998/12/29.

283. Frances SP, Cooper RD, Sweeney AW. Laboratory and field evaluation of the repellents deet, CIC-4, and AI3-37220 against Anopheles farauti (Diptera: Culicidae) in Australia. J Med Entomol. 1998;35(5):690-3.

284. Fenner F, Sweeney AW. Malaria in New Guinea during the Second World War: the Land Headquarters Medical Research Unit. Parassitologia. 1998;40(1-2):65-8.

285. Cooper RD. Preservation of anopheline mosquitoes for DNA probe analysis. J Am Mosq Control Assoc. 1998;14(1):58-60.

286. Cheng Q, Cloonan N, Fischer K, Thompson J, Waine G, Lanzer M, et al. stevor and rif are Plasmodium falciparum multicopy gene families which potentially encode variant antigens. Mol Biochem Parasitol. 1998;97(1-2):161-76. Epub 1999/01/08.

Science and Technology Support Request (STSR)

Client Requirement Code (CRC):	SA-A use only	Band:	SA-A use only

Short Title[i]:	*Prevention of vector borne disease (VBD)*

Client Research Request:

Develop measures to prevent Vector Borne Diseases (VBD) including drugs, personal protection, vaccines and diagnostic techniques.

Background:

VBD (particularly malaria and arbovirus diseases such as dengue fever) represent one of the main causes of non-battle casualties during deployed ADF operations, particularly in the geographic area of Australia's regional interest. Prevention of VBD is the most effective force protection measure. The constantly changing clinical environment requires continual and collaborative research to ensure ADF maintains leading-edge capability in disease prevention as a force multiplier.

Span of the Issue:	***Measures such as chemoprophylaxis, personal protection, vaccination and surveillance-related diagnostic techniques are at the core of maintaining VBD prevention capability.***

Purpose:

The results of the S&T research is to provide ADF personnel with the best possible protection against VBD enabling health planning policy and procedural doctrine to be based on sound clinical evidence.

Consequence:

Failure to address this CRC will:

a. Reduce the ADF capability to retain a force protection edge.
b. Increase the risk of VBD illness to members of the ADF members deployed to areas where these diseases are endemic.
c. Result in lack of suitably trained staff available for deployment into tropical areas of high disease threat.

Links to other CRCs (if applicable)[ii]:

TBA

Capability Life Cycle Adviser[iii]:	Client Requirement Owner (Sponsor)[iv]:	Capability Timeframe[v]	Client Requirement Desk Officer[vi]:	Date Raised:
DGPPA	DGSHPP	AIB (&ongoing)	DCP	Mar 06

Contact Officer: **Normally the Requirement Desk Officer**	
Appointment:	SO1 HHPR, DHCD
Name:	WGCDR John Hatfield
Telephone:	
Email address:	

This section should be completed in close consultation with an S&T provider (eg: SO(Sc), DSTO SME or STCC/Mission Head, non-DSTO S&T SME etc), and should describe how the S&T provider could meet the client requirement.

R&D Approach[vii]:

The task will be to find and develop new and improved means of protecting Australian soldiers from the infectious disease threat inherent in deployment to tropical areas in the geographic area of Australia's regional interest. Protection will focus on the following major intervention categories:
A. development and testing of new drugs capable of treating and/or preventing tropical infectious diseases such as malaria
B. development and testing of new personal protective measures such as insect insecticides and repellents to prevent insect bites and disease
C. development and testing of new vaccines capable of preventing tropical viral infections such as Japanese encephalitis
D. development and testing of new diagnostic techniques that in conjunction with field surveillance will allow better risk estimates of tropical infectious diseases in the region

[viii]R&D Objective: A

Drugs

Medications taken by mouth are and probably will remain the primary means of protecting soldiers in the tropics from malaria. Malaria parasites constantly evolve new forms of drug resistance requiring on-going efforts to develop new and better medications. Drugs that require fewer doses and less supervision are of particular interest as their field effectiveness increases when less effort is required of the soldier. Tafenoquine is a new antimalarial in advanced clinical testing that shows great promise for malaria prevention particularly against relapsing malaria strains common on the island of New Guinea. The objective, by 2010, is to have field tested tafenoquine in patients infected in New Guinea and be ready to submit a drug registration package to the Therapeutic Goods Administration such that the drug can be used by Australian soldiers on tropical deployments.

R&D Objective: B

Insecticides and Personal protective measures
Preventing mosquito bites is the first line of defence against VBD, and in the case of many of the arboviruses it is the only defence. Insecticides and repellents are the most commonly used products to reduce mosquito bites. With insecticides the challenge is to design the best method of delivery to maximise the effect of the product. The synthetic pyrethroid Bifenthrin is currently being developed as a barrier spray for use on tentage and other surfaces, the suitability of this product for the ADF will be determined by 2008. With repellents, the challenge is to develop a product readily accepted by soldiers. By 2008, formulations, concentrations and delivery methods will have been evaluated to provide a better service product that will be acceptable to ADF soldiers.

R&D Objective: C

Vaccines

Genetically engineered (GE) vaccines are now available that use established vaccine strains adapted to display the protective antigens of other viral pathogens, thus allowing protection to develop against the new virus using the base from older known viral vaccines. This has been particularly important in developing replacement products for first-generation vaccines that have now ceased production, as is the case with the current in-service Biken vaccine. Chimerivax JE (Japanese encephalitis) is a GE product using a yellow fever vaccine base to protect against Japanese encephalitis, this vaccine is currently being developed and appears to have a number of distinct advantages over the Biken vaccine. This GE technology also has direct application to dengue, which is a much greater threat to Australian soldiers and a much more difficult vaccine target as there are four separate viruses involved. The objective, by 2009, is to have a licensed viral vaccine for Japanese encephalitis to replace the current product, which has ceased production and to have initiated testing of a dengue virus vaccine.

R&D Objective: D

Diagnostic techniques

Fevers are common in the tropics and are caused by a multitude of infectious agents that require separate and distinct diagnosis and treatment. The ability to quickly access a febrile soldier, determine the cause of the fever and provide appropriate treatment

79

is a non-trivial issue especially given the logistical limitations of any deployed medical support unit. Biotechnology has made a new generation of diagnostic devices possible using a variety of monoclonal antibody or nucleic acid techniques. The objective, by 2011 is to have field tested and be ready to submit for regulatory approval an improved rapid diagnostic test for falciparum malaria that is also capable of detecting the presence of other relapsing forms of malaria.

[redacted]

Security Classification: Unclassified

None known

Requirement Owner Endorsement[ix]*:*

(Signature) (Date)

R.M. Walker
CMDR, RAN
DGSHPP

[i] Aim for 6 words or less. Make it a descriptive as possible, avoiding acronyms and project numbers. The title must not have a higher classification than RESTRICTED. Subsequent section may have a higher classification if necessary

[ii] Advice on any related CRCs can be obtained from SO(Sc), FRAC Coordinator or DRR-A

[iii] The capability lifecycle advisers (CLA) are responsible for advising DCA on the suitability and balance of research applied to their section of the capability lifecycle, as described in the Army's S&T Model (see ASTRAP Annex H). The CLAs are CLL/DGFLW – Key technologies & Concepts, DGLD – DCP Pre-approval, DGLCCS – DCP Post-approval, DGPPA – Army in Being

[iv] One star sponsor

[v] AIB (Army in Being), HNA (Hardened & Networked Army, or OF (Objective Force)

[vi] Originator of STSR and officer responsible for maintaining the CRC and tracking research conducted to support it.

[vii] The research request describes the top level issue. This will be addressed by one or more objectives that can be completed by one or more discrete tasks within DSTO (or other S&T providers). The scoping of these objectives should be done in conjunction with the DSTO Subject Matter Expert. DRR-A can assist in identifying the appropriate DSTO POC. Where appropriate, objectives should be set out in the order in which they should be undertaken.

[viii] Due to the nature of research, it is appreciated that milestones may not be known in the early part of a task's life. It is therefore acceptable to detail the first year's products and subsequent years' broad objectives

[ix] The STSR must be signed and dated by the one-star sponsor. Notwithstanding the need for appropriate endorsement, there will be circumstances when one-star authorisation is not appropriate (eg submission by an individual of a requirement which does not relate to the responsibilities of the Defence Group to which the individual is posted). In such cases, the STSR should be sent directly to SA-A

Science and Technology Support Request (STSR)

Section One

Client Requirement Code (CRC):	*SA-A use only*	Band:	*SA-A use only*

DCA S&T Priority[1] :	

Short Title[2]:	***Factory Treatment of Polymer Coated Permethrin Uniforms***

Client Research Request:

Assess the insect repellent performance of factory polymer coated permethrin treated ADF uniforms for insect repellence in support of current and future operations in areas where vector-borne disease (VBD) is prevalent.

Background:

1. Permethrin is the ADF uniform treatment of choice in prevention of arthropod or insect transmitted diseases during operations. Traditionally, manual application treatment by units or individuals has been performed in accordance with ADFP 705 *Pesticides Manual,* Chapter 2 Insect and Mite Repellents, Table 2-13 Re-treatment Schedule which indicates re-treatment every 3-5 washes. Field trials may be required involving collaboration between AMI and HPPD.

2. Polymer coated permethrin factory treatment of military uniforms is now available by several manufacturers (Ref A). Procurement of ADF uniforms that are factory treated with permethrin would significantly enhance uniform treatment compliance thus enhancing individual soldier protection from disease transmitting insects. It is claimed that the polymer treated permethrin uniforms provide effective protection for the life of the uniform or 100 washes. The effects of this claim need to be substantiated.

Span of the Issue:	*Band 2*

Purpose:

The purpose of this request is for the improvement of Force Protection during current operations. The implementation of factory treated permethrin uniforms will greatly assist commanders in reducing Disease and Non-Battle Injuries within their commands. Category Band 2

Consequence:

Consequence to provide proper testing and evaluation of factory treated uniforms will directly impact soldier health during future operations.

a. This research will increase the ADF capability now and in the future.
b. This research will have an impact upon Defence's Capability Plan with greater force protection.
c. Without the use of permethrin polymer coated uniforms the risk of illness may be greater, leading to greater potential morbidity and mortality for ADF Members

Links to other CRCs (if applicable)[3]:

Any links to other requirements should be identified here.

Capability Life Cycle Adviser[4]:	Client Requirement Owner (Sponsor)[5]:	Capability Timeframe[6]	Client Requirement Desk Officer[7]:	Date Raised:
H, DHSD	DGSHPP	AIB, HNA	DOPH, DHS	

Contact Officer: *Normally the Requirement Desk Officer*	
Appointment:	S01 Preventive Health
Name:	LTC Shawn Boos
Telephone:	
Email address:	

Section Two:

R&D Approach[8]:

Acquire and evaluate permethrin treated products; compare and test the products for:
1. Manual application of spray or soak applications
2. Polymer coated permethrin factory treatment

HPPD is to lead the evaluation and study regarding:

Durability of permethrin treated uniform (i.e. number of washes) and its effect on functional and appearance i.e signature management.

AMI is to lead the evaluation and study on:

Efficacy and safety of treated uniform through both Lab scale assessment and field trial. (HPPD to provide washed samples).

[9]R&D Objective: A

Required research objectives include:

1. Research findings for efficacy of various insect repellence for both types of products (spray or soaked uniforms vs polymer coated permethrin treated uniforms).

2. Research recommendations regarding the use of polymer coated permethrin uniforms.

Section Three:

Security Classification: Unclassified

No security implications are anticipated.

Requirement Owner Endorsement[10]:

ORIGINAL SIGNED 15 AUG 2006
R.M. Walker
CDRE, RAN
DGSHPP

[1] DCA S&T Priorities: see SA-A webpage at http://web-vic.dsto.defence.gov.au/workareas/SA_A/index.shtml

[2] Aim for 6 words or less. Make it a descriptive as possible, avoiding acronyms and project numbers. The title must not have a higher classification than RESTRICTED. Subsequent section may have a higher classification if necessary

[3] Advice on any related CRCs can be obtained from SO(Sc), FRAC Coordinator or DRR-A

[4] The capability lifecycle advisers (CLA) are responsible for advising DCA on the suitability and balance of research applied to their section of the capability lifecycle, as described in the Army's S&T Model. The CLAs are CLL/DGFLW – Key technologies & Concepts, DGLD – DCP Pre-approval, DGLCS – DCP Post-approval, DGPPA – Army in Being

[5] One star sponsor

[6] AIB (Army in Being), HNA (Hardened & Networked Army, or OF (Objective Force)

[7] Originator of STSR and officer responsible for maintaining the CRC and tracking research conducted to support it.

[8] The research request describes the top level issue. This will be addressed by one or more objectives that can be completed by one or more discrete tasks within DSTO (or other S&T providers). The scoping of these objectives should be done in conjunction with the DSTO Subject Matter Expert. DRR-A can assist in identifying the appropriate DSTO POC. Where appropriate, objectives should be set out in the order in which they should be undertaken.

[9] Due to the nature of research, it is appreciated that milestones may not be known in the early part of a task's life. It is therefore acceptable to detail the first year's products and subsequent years' broad objectives

[10] The STSR must be signed and dated by the one-star sponsor. Notwithstanding the need for appropriate endorsement, there will be circumstances when one-star authorisation is not appropriate (eg submission by an individual of a requirement which does not relate to the responsibilities of the Defence Group to which the individual is posted). In such cases, the STSR should be sent directly to SA-A

STAFF ACTION SUMMARY SHEET For use of this form, see MEDCOM Reg 25-51 and OTSG Reg 25-51; the proponent agency is MEDCOM/OTSG	1. TRACKING NUMBER:	2. TODAY'S DATE YYYYMMDD: 20121015
4. OFFICE SYMBOL: MCMR-UMZ	5. SUBJECT Letter of support to the Australian Army Malaria Institute	3. SUSPENSE DATE

6. KEY POINTS:

- USAMMDA has been asked to provide a letter of support to the Australian Army Malaria Institute (AMI).
- This letter will be used to support the AMI as they enter into an internal Australian Defense Force review that may determine their institutional survival.
-

7. EXECUTIVE SUMMARY:

REFERENCE(S): N/A

ENCLOSURE(S): N/A

1. PURPOSE:

The purpose of this letter is to provide support to the Australian Army Malaria Institute as they enter into an internal Australian Defense Force review that may determine their institutional survival.

2. DISCUSSION:

COL Bryan L. Smith, Product Manager & IPT Chair, IV Artesunate for Severe Malaria & Tafenoquine Antimalarial Prophylaxis, United States Army Medical Materiel Development Activity has been asked by the Director of the Australia Malaria Institute for a letter detailing our past and anticipated future interactions with them that can be used in their support as they enter into an internal Australian Defense Force review that may determine their institutional survival.

Enclosed is a letter of support which has been staffed with the Australian Army Malaria Institute and USAMMDA.

3. RECOMMENDATION:

Recommend the CG sign the enclosed letter.

For pick up please contact

8. ACTION OFFICER: COL Bryan L. Smith / 301-619-7853	SIGNATURE

9. COMMAND GROUP ROUTING:

OFFICE	CONCUR	NON-CONCUR	NAME	DATE	RE
DIR					
AXO					
CSM					
CoS					
DSG					
XO					
TSG					
SACO					

10. STAFF COORDINATION:

OFFICE	CONCUR	NON-CONCUR	NAME	DATE	REMARKS
MCMR-UMZ			Ms. Benson	15Oct12	
MCMR-UMZ			LTC Kopydlowski	15OCT12	
MCMR-UMZ			COL Coleman	15 Oct 12	
MCMR-SGS			LTC Fobbs	17Oct12	
MCMR-ZC			COL Starrs	19Oct12	
MCMR-ZB			CAPT Syring	18Oct12	
MCMR-ZA			MG Gilman	23Oct12	

INSTRUCTIONS:

PARENTHESIS AT TOP OF FORM:
Fill in classification (UNCLASSIFIED, FOUO, etc).

Block 1. TRACKING NUMBER
If the action has been assigned a tracking number by the XOs Office, enter number.

Block 2. TODAY'S DAY
Will auto populate and can be changed.

Block 3. SUSPENSE DATE - Click on Calendar Icon
a. If the action is responding to an external suspense, enter the date of the assigned suspense.
b. If the suspense date is established internally, enter that date.

Block 4. OFFICE SYMBOL
Enter the office symbol of the directorate responsible for action. Example: DASG-HCZ.

Block 5. SUBJECT
Enter the primary subject line of action.

Block 6. KEY POINTS
a. The key points are the salient information that the TSG needs to take away from the action and highlight the strategic impact of the action.
b. Each key point should not exceed two lines. Maximum of three key points.

Block 7. EXECUTIVE SUMMARY
a. References: List all references, i.e., DA tasker, meeting, e-mails, etc. If none, state N/A.
b. Enclosures: List all enclosures and tabs. Explain what is included within the packet. If none, state N/A. (For example, Enclosures: TAB A: MEMO for TSG Signature, TAB B: Information Paper, TAB C: EXSUM).

Block 8. ACTION OFFICER/SIGNATURE
Under action officer block, enter the AOs Rank, Name, Phone Number, E-mail Address.

Block 9. COMMAND GROUP ROUTING
These blocks are completed by the HQs staff and are designed for routing the action within the OneStaff HQs.

Block 10. STAFF COORDINATION
These blocks are designed to show the internal routing of the document within the Staff before it is submitted to the XOs office.

DEPARTMENT OF DEFENCE
AUSTRALIAN EMBASSY HANOI

Office of the Australian Defence Attaché,
Australian Embassy Hanoi, 8 Dao Tan Street, HANOI, VIETNAM

11 July 2012

Professor Dennis Shanks
Director
Australian Army Malaria Institute

LETTER OF APPRECIATION - AUSTRALIAN ARMY MALARIA INSTITUTE CONTRIBUTION TO AUSTRALIAN-VIETNAM DEFENCE ENGAGEMENT

Dear Professor Shanks,

This letter is to express my appreciation for the contribution made by the Australian Army Malaria Institute (AMI) to the development of defence relations between Australia and Vietnam. While July 2012 marks the conclusion of International Policy (IP) Division's funding for the projects undertaken by AMI in Vietnam, AMI's work in Vietnam over a twelve year period will have an enduring legacy.

The bilateral defence relationship with Vietnam has progressed strongly since the establishment of the Defence Attaché's office in Hanoi in 1999. The projects run by AMI in cooperation with the Vietnam People's Army (VPA) were pivotal in initiating and developing our defence engagement and taking us to where we are now. The two projects; the Vietnam Australian Defence Malaria Project from 2000 to 2012, and the Vietnam Australian Dengue Project from 2004 to 2012, have achieved their objectives from both the defence engagement perspective, as well as delivering substantive results in the field of medical research, capacity building, training and technology transfer.

AMI's success in establishing a close working relationship with the VPA Military Medicine Department and associated hospitals and units is clearly evident in my daily dealings with the VPA. The value of AMI's work has been commented upon by the Vietnamese Defence Minister in discussion with our Ambassador, and by Vice Defence Ministers and other senior officials. Through training, sponsorship and mentoring, AMI has also created a community of VPA medical officers who value their association with Australia and Defence.

Although IP Division funding for AMI's projects ceased in mid 2012, this is by no means a reflection on the continued relevance of these projects. Defence engagement with Vietnam is evolving to meet new challenges and priorities in a time of funding constraint. Core Defence engagement priorities are now focused on preparing the VPA for future UN peace keeping operations, and on cooperation on maritime security and countering non-traditional threats.

I have been advised that IP Division has no objections to AMI continuing its work in Vietnam, albeit with other sources of funding. I also understand that AMI's work in Vietnam may continue under a new cooperative arrangement with the US Navy Medical research Unit No 2

(NMRU2). The VPA have indicated their strong preference that AMI be involved in any NMRU2 continuance of AMI programs and I sincerely hope that this proves to be the case.

Matthew Dudley, CSC
Group Captain
Defence Attaché
Australian Embassy Hanoi

EIJKMAN INSTITUTE
for molecular biology

Eijkman-Oxford Clinical Research Unit

Ref. No.: EOCRU/200/210/Vol.1/050

7 August 2012

COL Craig Schramm
Director Future Health Capability
Joint Health Command CP2-6-011
Campbell Park Offices
PO Box 7911
Canberra BC ACT 2610
AUSTRALIA

Dear COL Schramm:

This unsolicited letter communicates my considered views regarding the tremendous value of the Australian Army Malaria Institute. The actual costs of running the Institute are of course unknown to me, and shrewd application of precious dollars and cents is not what I have in mind in expressing "*tremendous value*".

A warship afloat near potentially hostile shores is indeed a very expensive venture. It is also a tremendous value. It demonstrates military capacity and political will, and thereby discourages bellicose actions. Its value in preventing confrontation is priceless, even more so in the event of confrontation. AMI may be compared to such a warship at patrol along the shores of a threat, and a very serious one - malaria. This infection has slain more soldiers at war than the combined bullets and bombs of the enemy. Malaria is not in retreat in the face of modern medicine, but is resurgent, and it comes equipped with resistance to our best weapons.

Only the Australian Defense Forces can assess the likelihood and extent of their exposure to this threat, but this letter implores not underestimating that threat or the value of AMI as a strategic asset in dealing with it. AMI can prevent confrontation with that enemy, and strike decisively when it does occur. The necessary expertise with malaria as a problem of military medicine does not come incidentally. It cannot be garnered from the civilian workforce any more than a freighter can be made into an effective combatant warship. When the ADF need expertise in malaria, it cannot be drafted, hired, or otherwise conjured – it is absent, and the forces exposed to malaria will be vulnerable. AMI is a *tremendous value* in ensuring that never materializes.

Setting aside the proud traditions of the ADF in being a significant contributor to the march of progress against malaria, disengagement from that march, plainly speaking, is a poor value for Australian soldiers and Australia.

Sincerely yours,

J. Kevin Baird, Ph.D.
Captain, Medical Service Corps, United States Navy (ret)
Director

EOCRU
Gedung Lembaga Eijkman,
Jl. Diponegoro 69, Jakarta 10430
INDONESIA

Website: www.eocru.org

UNIVERSITY OF WASHINGTON SCHOOL OF MEDICINE

Carol Hopkins Sibley
Professor of Genome Sciences
Department of Genome Sciences
Box 355065
University of Washington
2012
Seattle, WA 98195-5065

12 December

COL Craig Schramm, Chair of AMI Review
Director Future Health Capability, Joint Health Command CP2-6-0 1 1
Campbell Park Offices, PO Box 79 1 1
Canberra BC ACT 2610, Australia

Dear COL Schramm,

It is my pleasure to support the Army Medical Institute as you undertake a review of their accomplishments and importance in the context of military preparedness. I am a scientist who studies malaria, and my comments will focus on the key roles that my colleagues have played and should continue to play in that area.

I am the scientific Director of the WorldWide Antimalarial Resistance Network (WWARN), a Gates Foundation funded international effort to track antimalarial resistance. The scientists of AMI have worked collaboratively with WWARN, and Drs. Edstein, Cheng and Shenks have been active participants, a reflection of their strong involvement and many contributions to the malaria community.

The most important assets of the AMI are the intellectual quality, high motivation and impressive productivity of the scientists who work there. They are major "players" in the malaria community. Their work is highly regarded and frequently forms the basis for policy decisions on antimalarial use in the region. The proximity of Australia to malarious regions allows them to work directly in the field, and they have made major contributions to my particular area of study, resistance to antimalarial drugs. This has been particularly true of the decades-long work in the development and testing of new antimalarials, a collaboration with the US Walter Reed Army Institute of Research that has included long term posting of US personnel to AMI.

In short, AMI is a world-class scientific institution. Its scientists have made major contributions to basic science and malaria control, and continue to have a central place in the very strong Australian scientific community.

Due to the strategic importance of Australia in Asia-Pacific region, Australian troops have been deployed repeatedly in areas endemic for malaria, even in recent years. Malaria will remain a threat in Asia for many years to come and this reality has kept tropical diseases high on the agenda of troop readiness and protection. AMI has the expertise and breadth to support the practical needs for protection of Australian personnel when deployed in malaria endemic regions. It is a key component of future health capability and the combination of high quality science and practical utility is a win for both the Australian Army and malaria research.

Please feel free to contact me if further information would be helpful in your assessment of the AMI.

Sincerely,

Carol Hopkins Sibley
Professor of Genome Sciences
Scientific Director, WWARN

S243C, Foege Building, 1795 NE Pacific Ave

UNSW@ADFA
CANBERRA • AUSTRALIA
School of Physical, Environmental and Mathematical Sciences

COL Craig Schramm
AMI Review Chair
Joint Health Command
Campbell Park Offices
Canberra, ACT, 2610

14 August, 2012

Dear COL Schramm,

I am writing in support of the Australian Army Malaria Institute (AMI). I am an academic at the Australian Defence Force Academy (ADFA) in Canberra. Over the last few years my collaborators and I have been developing a family of novel metal-based compounds, called dinuclear ruthenium complexes, as antimicrobial agents. As we believed that these compounds might possess antimalarial activity, we contacted the Department of Drug Evaluation at AMI to see whether they could assist us in assessing the complexes as potential antimalarial agents. We are now actively collaborating with AMI, and believe that one of the ruthenium complexes shows a great deal of promise, as it exhibits very good *in vitro* activity against the malaria parasites, with low toxicity towards liver and kidney human cell lines. The ruthenium compounds are also active against both drug-sensitive and drug-resistant malaria strains, *in vitro*.

I would particularly like to stress, that without the Department of Drug Evaluation expertise in this project (that is, in addition to carrying out the necessary *in vitro* biological assays) we would not have a potential new antimalarial compound worthy of further investigations in animal models. As an indication of the importance of the collaborative project, ADFA provided funding for one of my PhD students to spend several weeks working at the Department of Drug Evaluation in 2011, where she gained valuable insight into the various strategies used in antimalarial drug discovery. Furthermore, if we can succeed in demonstrating good *in vivo* potency against rodent malaria, we plan to apply to ADFA to obtain defence related research funding and funds from external agencies, such as the Medicines for Malaria Venture, to further this work.

As you no doubt know, malaria is a significant health problem for the ADF and the wider world community. Given the increasing incidence and spread of drug-resistant malaria strains in operational areas of interest to the ADF, such as the Asia-Pacific region, it is important that new antimalarial drugs be developed. I have read that one of the problems with R&D for malaria is the potential low economic return on the investment – malaria is considered a poor country disease. However, for the ADF it is essential that we have the best and safest chemotherapeutic agents available to ensure that our military personnel are fully operational to carry out their mission without the adverse impact of malaria. I believe that it is highly appropriate that the

ADO funds an institute, such as the AMI, to enable the development of new medicines for a disease that is a significant issue for ADF personnel and the worldwide community. The existence of AMI, a centre of excellence in vector-borne diseases of military importance, allows academics like myself to access experts in the field of malaria chemotherapy and drug evaluation. This adds considerably to our research efforts, but also allows the ADO to utilise the expertise, personnel and infrastructure within Australian universities and research centres to help develop measures to protect and treat military personnel from malaria.

In summary, I strongly believe that AMI is extremely relevant and with the continuing spread of antimalarial drug resistant strains of malaria the institute will become more relevant to the ADO and the broader Australian community.

Yours sincerely,

A/Prof Grant Collins
School of PEMS
ADFA

Dr Ian Howie-Willis Consultant Historian
49 Gaunson Crescent Wanniassa ACT 2903 AUSTRALIA

16 August 2012

The Chair of the Army Malaria Institute Review
c/o Colonel Craig Schramm
Director of Future Health Capability
Joint Health Command
CP2-6-011
Campbell Park Offices
PO Box 7911
Canberra BC
ACT 2610

Dear Sir

Re: Review of the Army Malaria Institute

I write to make comment on the Army Malaria Institute (AMI) in relation to the AMI review which you are to conduct.

My reason for doing so is that I am an interested but independent observer of the AMI in my capacity as an historian with a particular interest in the history of the Australian Army's long experience with malaria.

This interest arises from my current historical research project, which is being supported by funding awarded to me in 2011 under the Army History Research Grants scheme. This project requires me to write a book on the history of the Army's protracted struggle to reduce the impact of malaria on its personnel and in particular on its front-line combat troops.

The book, which I hope to have completed and published by 2014, will have the title ***An Unending War: The Australian Army's Continuing Struggle Against Malaria***. The book stems from, and will be an extension of, the research I carried out for my most recent book of military history — *A Medical Emergency: Major General 'Ginger' Burston and the Army Medical Service in World War II* (Big Sky Publishing, Sydney, 2012), which was also supported by an Army History Research Grant..

The Australian Army's on-going struggle against malaria may be summarized as follows:

- Australia's military experience of malaria predates the establishment of the Australian Army. It began with the NSW Sudan Contingent in 1885, many members of which suffered fevers, the symptoms of which indicate that it was certainly a form of malaria endemic in northern Africa. (At that stage the causes of malaria were still unknown.)

- Troops of the Australian colonial and subsequent Commonwealth contingents sent to the Boer War 1899–1902 also contracted malaria.

- During World War I malaria infected the ANZAC force on Gallipoli; however, it was during the desert campaigns of the Desert Mounted Corps that malarial infection rose to catastrophically epidemic proportions, causing the campaign against the Turks in Syria and Lebanon to have ground to a halt by the time of the Armistice.

- Malaria was the almost ubiquitous deadly enemy of Australian military personnel in World War II, a menace to troops fighting the campaigns in Egypt-Libya, Greece, Palestine, Syria, Malaya, New Guinea and Borneo. Malaria infection rates during the critical Papuan campaigns of 1942 rose to alarmingly high levels, with 12% of the fighting force hospitalized with malaria in any week of the war. Such extraordinarily high infection rates, which threatened to nullify the Allied effort, led to the establishment of the Land Headquarters Medical Research Unit (LHQ MRU) at Cairns in 1943. The LHQ MRU then undertook pioneering malaria research, the application of which succeeded in reducing the hospitalisation rate to below 1%, thus helping make the Allied victory possible.

- Malaria was again an issue of concern during the military involvements of the immediate post-war decades, for the British Commonwealth Occupation Force in Japan 1945–47 then in the Korean War 1950–53, the Malayan Emergency 1950–60 and Indonesia-Malaysia Confrontation 1962–66.

- During the Australian involvement in the Vietnam War 1962–73, malaria once more became such a major threat that in 1967 the 1 Malaria Research Laboratory (1MRL) was established to conduct research into the disease to minimize its adverse impact on Australia's military capability. (The name of the 1MRL changed to Army Malaria Research Unit in 1973 and then to Australian Army Malaria Institute (AMI) when relocated to Brisbane in 1996.)

- Malaria has subsequently been a concern in all the post-Vietnam involvements — the Gulf War (1991), East Timor (from 1999), Afghanistan (from 2001), Iraq (2003–11) and the lesser peace-keeping commitments in Cambodia, Rwanda, Somalia and the Solomons.

In short, in virtually all of Australia's military involvements since 1885, with the possible exception of the Western Front in World War I, malaria has always been a problem for the nation's Defence Forces. In at least three campaigns — Syria in World War I, Papua New Guinea in World War II and Vietnam in the 1960s–70s — malaria proved disastrous.

In view of this historical experience, I submit that the continued support of the Australian Defence Force (ADF) for the AMI and its programs is vital.

My strong belief here, however, arises not so much from the ADF's historical experience of malaria but from certain present-time realities which are elaborated in the following numbered points:

1. There might be no present threat of major overseas wars involving Australia as a combatant, nor any need for Australia to commit its military personnel to new peace-keeping operations abroad in the near future. Historical experience, however, suggests that this will not always be the case. Thus, in the past decade Australian troops have been committed to wars and peace-keeping operations in at least four nations — East Timor, Afghanistan, Iraq and the Solomons — all of which are highly malarious and have therefore hazarded the health and military effectiveness of the forces sent there. Two of these commitments have proved long-term and on-going.

2. When next the Australian Defence Force (ADF) is deployed to malarious regions overseas, as seems likely if post-World War II Australian military history is any guide, some specialised agency must be standing by already equipped to ensure that ADF personnel are protected against malaria. The AMI, which now has 45 years' experience in military-oriented malaria research and is at the forefront of this field, is the sole agency capable of fulfilling that expectation.

3. A highly pertinent consideration in relation to point 2 is the question of which agency might be entrusted with the heavy responsibility of keeping Australian military personnel malaria-

free if the AMI could no longer play its appointed role through having been down-sized, scaled back, denied the necessary resources and/or otherwise impeded in fulfilling its historic mission.

4. The obvious answer to the question just posed in point 3 is one or more of the civilian medical research institutes interested in malaria. These include the Walter and Eliza Hall Institute in Melbourne, the Queensland Institute of Medical Eesearch in Brisbane and university-based tropical medicine centres such as the Australian Institute of Tropical Health and Medicine at James Cook University in Townsville and the School of Public Health and Tropical Medicine at the University of Sydney. The difficulty with the civilian and university-based research centres, however, is that:

   (a) their programs of research do not necessarily relate to specific Army need;

   (b) they do not necessarily focus, as AMI research must perforce do, on prophylaxis for and the treatment of troops deployed to exotic and often remote and malarious places overseas;

   (c) they are not under ADF control and need not therefore accept ADF research priorities;

   (d) if they were contracted to undertake the kind of ADF-oriented research presently the responsibility of the AMI, they would expect generous resourcing which could well exceed that of the AMI and would therefore be a heavier burden on the ADF, the government and taxpayers;

   (e) being civilian institutions, if they were contracted to undertake ADF-sponsored research they might reasonably expect to come under attack from various agitators — e.g. anti-war activists and animal liberationists — with radical, anti-military agenda to pursue.

5. The present global situation with malaria is that, in the wake of the World Health Organisation's failed Malaria Eradication Program of the 1950s and early 1960s, the disease is now resurgent worldwide. This situation has come about through a complex set of historical, political and socio-economic factors that render its control problematic. Such factors include:

   (a) the emergence of more virulent and drug-resistant strains of the *Plasmodium* parasites;

   (b) the evolutionary tendency of the anopheline mosquito vectors to acquire immunity to particular insecticides;

   (c) prohibitions on the use of the DDT-based insecticides that had been effective in eradicating the vectors but had unwanted environmental side-effects;

   (d) the inability of governments in many under-developed nations to mount and sustain effective anti-malaria programs and to fund prophylaxis for their citizens;

   (e) endemic poverty and malnutrition exacerbated by rapid population growth, which militates against people in poor regions of the world taking effective personal anti-malarial precautions;

   (f) migration patterns which have resulted in malaria gaining hold in previously malaria-free regions;

(g) environmental changes that have encouraged the spread of anopheline vectors, including dam-building, deforestation, siltation and altered stream flows resulting in increased flooding in low-lying areas.

6. In view of the factors enumerated in point 5 above, there is a strong probability that ADF personnel deployed overseas in future military operations, especially to under-developed, malarious nations and/or those with unstable political regimes, would be at increased risk of malaria.

7. Here it is worth remembering that, depending on the type of malaria contracted, the disease is often severely debilitating and potentially fatal. Controlling it requires increasingly sophisticated pharmacology and the continual development of new combinations of drugs to combat the parasites' evolutionary tendency to acquire resistance to drugs which formerly were toxic to it.

8. For ADF personnel on active service generally and for combat troops in war zones in particular, malaria and dengue fever are a threat at least as great as hostile armed opposition. One former ADF Surgeon-General* has stated the situation nicely by observing that *"troops shivering, sweating and shaking with malarial fever cannot shoot straight, let alone fight"*. A similar comment would apply to dengue fever as well.

9. The AMI's capacity to undertake the relevant parasitological, entomological, immunological and pharmacological investigation has lifted it to the forefront of research on malaria and other vector-borne diseases. If its activities were to be scaled back, that would inevitably impact adversely on the health and welfare of ADF personnel deployed overseas. The ADF management, the Defence Department and the Government would accordingly be obliged to find workable, effective and credible alternatives to the AMI research programs if these were to be curtailed.

10. There would, of course, be political ramifications for the ADF, Defence Department and Government in ADF personnel being deployed to malarious regions if inadequately protected against malaria through ignorance of the latest trends in effective prophylaxis. Few elected governments would wish to be seen to be placing ADF lives at risk by having disabled an effective agency such as the AMI. The AMI's achievement speaks for itself — an unparalleled record of safeguarding ADF personnel against tropical diseases across a continuous 45-year time-span.

I will conclude this submission with some pertinent observations on the Allied Armies' experience of malaria in Papua New Guinea in World War II. One significant factor in the eventual Allied victory was the successful application of the ground-breaking malaria research undertaken by the LHQ Medical Research Unit in Cairns 1943–46. By contrast, the Japanese, whose anti-malaria effort was at best haphazard, inconsistent and spasmodic, suffered huge mortality from malaria. For the Japanese, malaria perhaps proved a more lethal foe than the Allied armies, navies and air forces combined. Through the LHQ MRU, the Allies tackled malaria scientifically, systematically, thoroughly and effectively. The Japanese did not and in consequence lost the war.

The World War II strategic experience of successfully combating malaria is both instructive and relevant to ADF health planning seven decades later in the early 21st century. The AMI, a worthy successor to the LHQ MRU, still has a key role to play in protecting ADF personnel against vector-borne diseases. I submit that its ability to do so should not be constrained by short-sighted cost-cutting, expedient and ill-advised restructuring or internal and self-serving ADF politicking, none of which gives priority to soldiers serving on active duty.

* Major-General Professor John H. Pearn.

Finally, I submit that what one government or set of defence bureaucrats or senior ADF management team might choose to dismantle, later governments, bureaucrats and ADF managers will subsequently be obliged to re-erect when the need inevitably arises. Almost inevitably, too, the cost of re-erection, both in terms of finance and regaining lost expertise, will be appreciably higher than having maintained the amenity that was dismantled.

In conclusion, I would direct your attention to what might best be called "the verdict of history". Medical and military historians of the future may be relied on to take particular interest in the review you are conducting, the report that flows from the review, the action taken by the ADF and/or the government to implement the review recommendations and the impact of such action upon ADF capability. And here I would point out that the favourable verdict of history on the World War II Prime Minister, John Curtin, and his Army Commander-in-Chief, Field Marshal Sir Thomas Blamey, arises in part from their effective leadership in establishing the LHQ Medical Research Unit and then in providing it with the necessary resources to defeat malaria before it could defeat the Allied forces in Papua New Guinea.

Yours sincerely

Dr Ian Howie-Willis
Consultant Historian

Finally, I submit that what one government or set of defence bureaucrats or senior ADF management team might choose to dismantle, later governments, bureaucrats and ADF managers will subsequently be obliged to re-erect when the need inevitably arises. Almost inevitably, too, the cost of re-erection, both in terms of finance and regaining lost expertise, will be appreciably higher than having maintained the amenity that was dismantled.

In conclusion, I would direct your attention to what might best be called "the verdict of history". Medical and military historians of the future may be relied on to take particular interest in the review you are conducting, the report that flows from the review, the action taken by the ADF and/or the government to implement the review recommendations and the impact of such action upon ADF capability. And here I would urge you to be mindful of the favourable verdict of history on the action to curb malaria taken by the World War II Prime Minister, John Curtin, and his Army Commander-in-Chief, Field Marshal Sir Thomas Blamey. That verdict arises from their effective leadership in causing the LHQ Medical Research Unit to be established and then from having provided it with the necessary resources to overcome malaria before the disease could defeat the Allied forces in Papua New Guinea.

Yours sincerely,

Dr Ian Howie-Willis
Consultant Historian

WORLD HEALTH ORGANIZATION
REGIONAL OFFICE FOR THE WESTERN PACIFIC

ORGANISATION MONDIALE DE LA SANTE
BUREAU REGIONAL DU PACIFIQUE OCCIDENTAL

United Nations Avenue, P.O. Box 2932, 1000 Manila, Philippines

In reply please refer to:
Prière de rappeler la référence:

Col Craig Schramm
The Australian Army Malaria Institute
Review Chair
Director, Future Health Capability
Joint Health Command CP2-6-011
Campbell Park Offices, P.O. Box 7911
Canberra BC ACT 2610, Australia

17 August 2012

Dear Col Schramm,

The World Health Organization considers the Australian Army Malaria Institute a vital player in the field of malaria control in the Asia Pacific Region. The Institute has been a WHO Collaborating Centre for malaria since 1998, and, in a longstanding and fruitful relationship, has been an active partner in both training and research.

Over the years, the Institute has contributed substantially to improving malaria diagnosis in the Region, including the establishment of a product-testing programme and the lot testing of malaria rapid diagnostic tests. Through its involvement in malaria microscopy, the Institute has provided important support for the WHO external competency assessment scheme, which has been ongoing since 2002 throughout the Asia Pacific Region. The Institute's expertise is now an integral part of the WHO Quality Assurance Manual on Malaria Microscopy.

The Institute is also a key partner in the Pacific Malaria Initiative, focusing on intensified malaria control and elimination in Solomon Islands and Vanuatu, particularly in the fields of evaluation and research. This includes significant support in the development and conduct of malaria indicator surveys and entomological research. Importantly, the Institute is also a key partner in antimalarial drug issues, as well as in vivax malaria research.

The World Health Organization maintains that continued collaboration with high-capability partners such as the Australian Army Malaria Institute is critically important in WHO's fight against vectorborne diseases in the Asia Pacific Region.

Best regards,

Dr John Ehrenberg
Director
Combating Communicable Diseases

Colonel Leonard Brennan
Director Army Health

Army Headquarters
R1-3-A037
PO Box 7901
CANBERRA BC ACT 2600

DAH/OUT/2012/R12087052

SUBMISSION TO REVIEW OF ARMY MALARIA INSTITUTE

1. **Background.** As an Army medical officer with over 20 years experience including operational and non-operational service in Malaysia, Singapore, Papua New Guinea, East Timor, Vanatu, Solomon Islands and Afghanistan I am well place to highlight the significant contributions the Army Malaria Institute (AMI) has made to ADF military medicine and more broadly to tropical medicine knowledge in the region.

CURRENT AND PAST

2. **Scope of contribution.** Malaria remains endemic in most countries within Australia's region and a disease of great military importance. Military history, including Australia's is full of examples where military campaigns have been determined by the ability or inability to conduct operations in a malarious environment. AMI and its predecessors are testament to the ADF's foresight and recognition of the tactical advantage that effective anti-malaria prevention and treatment provided its forces.

3. AMI has matured into a world renouned centre of excellence and a World Health Organisation reference laboratory for malaria. Whilst the primary focus has been malaria, it has extended its expertise into other infectious tropical disease of military importance in our region. These includes the viral diseases; dengue fever, Japanese encephalitis, Ross river fever and other arboviruses.

4. **Military significance.** AMI pioneered the use of doxycyline as an antimalarial agent and has been instrumental in the development of newer agents such as Malarone and Tafenoquine. It discovered drug resistence in p.Vivax and has led the world in the management of p.Vivax in the region.

5. AMI has sponsored the ADF policy on malaria prevention and treatment for many decades. This policy has been one of the best and most current policies on malaria (or other infectious disease of military significance) that I have observed. My recent experiences in Afghanistan confirmed that the US was only just adopting a number of these policies as best practice 10-15 years after the ADF.

6. In addition to chemotherapy, AMI maintains an expertise in entomology that has informed the ADF's personnal and collective protective systems. Advice and trials of uniforms, bed netting and vector control agents and apparatus have significantly enhanced the protection of deployed soldiers.

7. **Regional engagement.** Malaria results in a large disease burden to the indigenous populations in our region both civilian and military. Defence's strategic interests have been advanced by AMI contribution to Defence's international engagement program. There are few countries in the region where AMI has not engaged. It is, however worth highlighting that AMI was instrumental in the ADF re-engagement with Vietnam and it has also developed significant relationships in the Indonesian military.

FUTURE

8. **Operational.** AMI provided an invaluable deployed response to malaria and dengue outbreaks during the initial ADF deployment into East Timor.

9. When operating on the higher end of the conflict spectrum in our region the ADF can assume that the combination of distrupted local infrastructure and servces, increase disease burden within indigenous and displaced peoples and the immature personnal and collective protective measures options for ADF personnel will result in a HIGH to EXTREME environmental risk, particularly from malaria and arbo-viral diseases.

10. There will therefore be an on-going requirement for a deployable specialist tropical medicine capability to augment Army's deployable preventive medicine capability.

11. **Centre of excellence.** The ADF will continue to be exposed to malaria and other infectious tropical diseases whilst conducting operations and exercises in our region (including northern Australia for some conditions).

12. AMI's provision of a WHO reference laboratory for malaria and a laboratory centre of excellence for other infectious tropical diseases provide timely, dedicated and discrete access. This capability is not duplicated within the Australian civilian sector. The maintenance of this capability would be very prudent of the ADF.

13. **Regional engagement.** AMI operations throughout the region would make an ongoing valuable, cost-effective and sustainable contribution to Defence's international engagement program. The contributions are usually tangeable and well received by both civilian and military authorities.

14. AMI has a proven capability to compete successfully, locally and internationally for research funding that more than offsets the costs associated with its broader international enegament. Whilst there are no doubt challenges associated with the governance of the arrangements, they are not unique to Defence nor insurmountable.

CONCLUSION

15. AMI has made a substantial contribution to the health and welfare of deployed ADF members, especially soldiers over many years. The ADF has a duty of care to ensure that its members have access to optimal preventive and clinical services in what ever environment it sends its members. Given the tropical nature of our region the maintenance of the AMI capabilities should be a high priority.

L.B. BRENNAN
Colonel
Director Army Health

17 August 2012

Schramm, Craig COL

From: Feachem, Richard
Sent: Saturday, 18 August 2012 9:16 AM
To: Schramm, Craig COL
Subject: The Army Malaria Institute
Attachments: Col Schramm re AMI Aug 2012.pdf

Dear Colonel Schramm,

The Army Malaria Institute

I write to convey my strongest support and appreciation for the exceptional work of the Army Malaria Institute in Brisbane.

I have worked on malaria in many different roles and capacities since 1965. I have long been aware of the exceptional role of the Army Malaria Institute in Brisbane. Over the past 6 years, I have chaired and guided, on behalf of AusAID and the Australian Government, the Pacific Malaria Initiative (PacMI) and the Asia Pacific Malaria Elimination Network (APMEN). Both of these Initiatives, mainly financed by Australia, have had rapid and exceptional impact in driving down malaria across the Asia Pacific region. A dozen countries in the region have now set their sights on the complete elimination of malaria and are making rapid progress in this direction. This would not have been possible without the many contributions of the Army Malaria Institute. The role of the Army Malaria Institute to both PacMI and APMEN has been second to none.

Australia's leadership in the fight against malaria in the Asia Pacific region is exceptional, highly appreciated in the region, and widely recognized worldwide. Symbolizing this leadership role, Senator Bob Carr is hosting a major international event in Sydney on October 31-November 2 under the banner Malaria 2012. The Army Malaria Institute will play a major role in this event.

From the global perspective, the country with the largest and most impactful malaria capacity within its military is the United States. In my estimation, Australia comes in clear second place. This is quite remarkable and means that Australia is punching well above its weight in malaria. This has big impact and is much appreciated internationally, especially in the Asia Pacific region.

Finally, as you will be well aware, Australia's role in fighting malaria in the Asia Pacific region is strongly in the interest of Australia. This is not only for reasons of regional politics and mutually beneficial relationships, but also because of Australia's self-interest in limiting the constant reintroduction of malaria into areas of northern Queensland which still have the potential for malaria transmission to be re-established. The Army Malaria Institute, with its strategic location in Brisbane, plays a major role in defending Australia from the re-establishment of endemic malaria.
I hope you will find these reflections and opinions of use as you take forward your review. Please do not hesitate to contact me if I can offer any further information or clarification.

With very best regards.

Yours sincerely,

Richard Feachem

Sir Richard Feachem, KBE, FREng, DSc(Med), PhD
Director, The Global Health Group
Professor of Global Health
50 Beale Street, suite 1200
San Francisco, CA 94105

http://globalhealthsciences.ucsf.edu/GHG

UCSF GLOBAL HEALTH SCIENCES
THE GLOBAL HEALTH GROUP
From evidence to action

Global Health Group

Richard Feachem
FREng, DSc(Med), PhD, HonDEng
tor

eale Street, Suite 1200
Francisco, CA 94105, USA

August 16, 2012

Colonel Craig Schramm
AMI Review Chair
Campbell Park Offices
PO Box 7911
Canberra BC ACT 2610
Australia

Dear Colonel Schramm,

The Army Malaria Institute

I write to convey my strongest support and appreciation for the exceptional work of the Army Malaria Institute in Brisbane.

I have worked on malaria in many different roles and capacities since 1965. I have long been aware of the exceptional role of the Army Malaria Institute in Brisbane. Over the past 6 years, I have chaired and guided, on behalf of AusAID and the Australian Government, the Pacific Malaria Initiative (PacMI) and the Asia Pacific Malaria Elimination Network (APMEN). Both of these Initiatives, mainly financed by Australia, have had rapid and exceptional impact in driving down malaria across the Asia Pacific region. A dozen countries in the region have now set their sights on the complete elimination of malaria and are making rapid progress in this direction. This would not have been possible without the many contributions of the Army Malaria Institute. The role of the Army Malaria Institute to both PacMI and APMEN has been second to none.

Australia's leadership in the fight against malaria in the Asia Pacific region is exceptional, highly appreciated in the region, and widely recognized worldwide. Symbolizing this leadership role, Senator Bob Carr is hosting a major international event in Sydney on October 31-November 2 under the banner Malaria 2012. The Army Malaria Institute will play a major role in this event.

From the global perspective, the country with the largest and most impactful malaria capacity within its military is the United States. In my estimation, Australia comes in clear second place. This is quite remarkable and means that Australia is punching well above its weight in malaria. This has big impact and is much appreciated internationally, especially in the Asia Pacific region.

UCSF
University of California
San Francisco

Finally, as you will be well aware, Australia's role in fighting malaria in the Asia Pacific region is strongly in the interest of Australia. This is not only for reasons of regional politics and mutually beneficial relationships, but also because of Australia's self-interest in limiting the constant reintroduction of malaria into areas of northern Queensland which still have the potential for malaria transmission to be re-established. The Army Malaria Institute, with its strategic location in Brisbane, plays a major role in defending Australia from the re-establishment of endemic malaria.

I hope you will find these reflections and opinions of use as you take forward your review. Please do not hesitate to contact me if I can offer any further information or clarification.

With very best regards.

Yours sincerely,

Sir Richard Feachem, KBE, FREng, DSc(Med), PhD
Director, The Global Health Group
Chair, Asia Pacific Malaria Elimination Network
Professor of Global Health

JACOBUS PHARMACEUTICAL COMPANY, INC.
37 CLEVELAND LANE
P.O. BOX 5290
PRINCETON, NEW JERSEY 08540

August 20, 2012

AMI Review Chair Col. Craig Schramm

Director Future Health Capability
Joint Health Command CP2-6-011
Campbell Park Offices
P.O. Box 7911
Canberra BC ACT2610
Australia

Dear Col. Schramm:

We are pleased to respond to the request from Professor Dennis Shanks with a letter of support for the Australian Army Malaria Institute (AMI).

The Army Malaria Institute is a first class institution. The central issue of the last five years in malaria is the development of resistance to the artemisinin class of medications to treat the erythrocytic phase responsible for clinical symptoms and death. Dr. Qin Cheng's discovery two years ago demonstrated that artemisinin creates dormant organisms resistant even to super clinical dose levels. This is of paramount importance. The studies required new methodology, marvelous technique and a broad range of supporting data to put the work in perspective. The work is widely discussed in view of the increasing parasite clearance times to various artemisinin combinations. All the partner drugs depend upon the artemisinins for a quick knockdown of the parasite load to reduce the mutation rates of the partner drugs. The prospect of failure is of global importance.

The contributions of the AMI in the field of Plasmodium vivax have been significant over the years. Dr. Shanks is recognized by the WHO for his interest and skills in disease control. The study of vivax in the laboratory has been difficult because vivax cannot be maintained in vitro. However Maj Alyson Auliff and Dr. Cheng have been able to substitute the DHFR system of vivax for the DHFR of falciparum. The methodology opens a path to the complex genetics of vivax and for the extension of the DHFR class of medications for vivax.

c:\ss\Jacobus.12\Schramm.812

Our support for AMI is tangible. We have brought to AMI (and only AMI) a novel series of schizonticide drugs aimed at the dormant organisms demonstrated by Cheng et al. The lead compound is preclinical. On many levels we are joint collaborators in the long and complex process that is modern drug development. We have done the lead development and support the testing facility under Dr. Arba Ager in Miami, Florida for both mice and monkeys. We support the bulk and dosage form production as well as the preclinical safety with US FDA registration. If arrangements can be made, performing the Phase 1 at the medical school in Brisbane would allow Dr. Edstein to conduct an in vivo/in vitro secondary study of central importance. If all goes well and the results look promising we will be pleased to support his leadership of a field study. Since 2011, we have contributed in US dollars $475,000 towards the current collaborative project with substantial in-kind support from AMI.

I would like to close with my personal support for research on vector transmitted disease in military facilities. The AMI is a military facility. When its members travel to the field they bring the presence of the nation to other people on the ground. The past Director of AMI, Dr. Karl Rieckmann, and the current Director, Dr. Dennis Shanks, have been successful in disease central as well as directing a first class research facility. I believe the Army Medical Institute projects should lead to a substantial improvement in disease control in the western Pacific and other regions with malaria. That improvement will contribute to the security of all of us.

Sincerely yours,

David P. Jacobus, M.D.

DPJ:ss

c:\ss\Jacobus.12\Schramm.812

Eskitis Institute
Nathan Campus, Griffith University,
Brisbane, Queensland 4111,
Australia

Dr. Rohan A. Davis
Group Leader
Natural Products Chemistry

23 August 2012

AM1 Review Chair
Colonel Craig Schramm (Director Future Health Capability
Joint Health Command CP2-6-0 11
Campbell Park Offices, PO Box 7911
Canberra BC ACT 2610 Australia

Dear Colonel Schramm.

I am writing this letter in support of the research being conducted at the Australian Army Malaria Research Institute in Brisbane, Queensland.

I have collaborated with Michael Edstein and his team at AAMI since 2007. Our research is focused on the identification of potent antimalarial small molecules from nature. To date we have successfully identified several potential lead candidates and are currently optimizing one lead series for pre-clinical drugs trials in the next 2 years. The grants that I have co-written with AAMI include:

1) Medicines for Malaria Venture – project grant ($282K **2007**, $539K **2008**, $716K **2009**)
Ronald J. Quinn, Rohan Davis, Vicky Avery, Susan Charman, William Charman, Michael Good, Katherine Andrews, Michael Edstein
Project title: "Lead generation *via* HTS of malaria targets against a large natural product extract library"

2) NHMRC project grant (APP1024314) ($156K **2012**, $221K **2013**, $216K **2014**)
Rohan Davis, Mark Coster, Kathy Andrews, Michael Edstein, Susan Charman
Project title: "Evaluation of novel pyrrolo/iminoquinone antimalarial compounds"

Without the intellectual input and on-going research support offered by the world-renowned malaria team at the AAMI there is no doubt in my mind that the above listed applications would not have been successful. My continued collaboration with the group is essential for the NHMRC project grant success.

I hope the up-coming review of the AAMI has positive outcomes, and that this world-class research institute can continue to contribute to the fight against malaria and other vector-borne diseases that are of both military and public health importance.

Yours sincerely,

Rohan A. Davis

MMV
Medicines for Malaria Venture

27 August 2012

Colonel Craig Schramm
Director Future Health Capability
Joint Health Command CP2-6-011
Campbell Park Offices
PO Box 7911
Canberra BC ACT 2610
Austral

Dear Colonel Schramm

Ref: Letter of support for Australian Army Malaria Institute

In light of the forthcoming review of the Army Malaria Institute (AMI) in Brisbane, Medicines for Malaria Venture (MMV) would like to express its full support for this institution and endorse the appropriateness of its mission and the quality and relevance of its research in combating vector-borne diseases of military importance.

The Institute is a highly valued collaborator with MMV's partners in both Australia and globally. Its focus on clinical and translational research fills a critical gap in the development of new drugs to protect against malaria and other vector-borne diseases.

In the past ten years there has been considerable progress made in the development of new anti-malarial medicines, but increasing drug resistance threatening public health in AsiaPacific amplifies the need to intensify research and development activities. This is increasingly being recognized by MMV's partners in AsiaPacific.

The institute provides important regional engagement with military organisations to control vector-borne diseases more effectively, therefore contributing to regional control efforts.

The focus of its research, particularly on areas such as malaria chemoprophylaxis, diagnosis, drug evaluation and resistance, personal protection, and elimination of the disease, has been central to global efforts to discover and develop new antimalarials. AMI's clinical evaluation of tafenoquine (a long-acting primaquine analogue), which is being co-developed with MMV and GlaxoSmithKline as the next generation drug for the radical cure of *P. vivax* malaria, has been instrumental in bringing the molecule closer to regulatory submission.

We believe the academic achievements of AMI are effectively measured through the publications of its staff, which currently stands at over 300 articles on infectious disease topics. Together with its extensive network of collaborators, national and international, AMI demonstrates its strong capability as a key player in the global move to combat vector-borne diseases that are of critical importance both to the military and wider public health community.

Sincerely,

Dr David Reddy, CEO

International Center Cointrin Entrance G, 3rd floor Route de Pré-Bois 20 PO Box 1826 CH-1215 Geneva 15 Switzerland

World Health Organization

20, AVENUE APPIA – CH-1211 GENEVA 27 – SWITZERLAND – TEL CENTRAL +41 22 791 2111 – FAX CENTRAL +41 22 791 3111 – WWW.WHO.INT

COL Schramm
Head, Review Committee
Australian Army Malaria Institute
Campbell Park Offices
P.O.Box 7811
Canberra BC ACT
Australie

In reply please refer to:

Your reference:

19 September 2012

Dear Colonel Schramm,

It is pleasure for me to refer to the very fruitful collaboration and support that the Australian Army Malaria Institute provides to the work of the World Health Organization (WHO), in relation to both global activities coordinated by WHO's Global Malaria Programme (GMP) as well as several important initiatives of the Regional Office for the Western Pacific. As you certainly know, the Australian Army Malaria Institute has been recently re-designated for four years as WHO Collaborating Center for Malaria on the basis of its excellent contributions to WHO's work in multiple technical areas.

This work spans over basic and applied research, focussing on multiple aspects of the malaria parasites and its vectors. This includes in particular, studies on mechanisms of artemisinin resistance; evaluation of new genotyping to distinguish recrudescence's from new infections; measurements of antimalarial drug concentrations from samples obtained from multiple groups, research on RDT diagnostic performance as part of WHO Product Testing of malaria RDTs, PCR validation of malaria species in samples collected, malaria surveys, and slide banks. The centre provides invaluable support to national health authorities in endemic countries in the development of quality management systems for malaria RDTs and the management of training and accreditation workshops for malaria microscopists in numerous countries, including accreditation workshops in 12 countries in the last year and courses on external competency assessment in eight countries in the same period. The microscopy accreditation approaches developed as part of these activities have become WHO global standards for quality assurance of malaria microscopy and have been also adopted and introduced in other regions, including the South East Asian and the African regions. The presence of senior malaria experts from the institute at multiple WHO expert consultations, is also an asset for the Organisation and a valid contribution that this WHOCC brings to global public health.

./...

Overall, the expertise, resources and services of the Australian Army Malaria Institute give invaluable support to WHO's work in the fight against malaria, with a key presence in several global and regional initiatives which have major public health relevance today and for the several years to come.

We sincerely appreciate the support that the Institute continues to provide in malaria research and training, and we hope this could be continued and even expanded in the near future.

Yours sincerely,

Dr Robert Newman
Director
Global Malaria Programme

INSTITUTE FOR GLYCOMICS

Prof. Michael F Good AO MD PhD FTSE
Australia Fellow

www.griffith.edu.au

G26/4.18 Gold Coast Campus,
Griffith University, QLD 4222, Australia

20 September 2012

Dr. Dennis Shanks
Professor and Director,
Australian Army Malaria Institute
Building K10
Weary Dunlop Drive
Gallipoli Barracks
ENOGGERA QLD 4051

Dear Dennis,

I understand that the Australian Army Malaria Institute is undergoing a formal review and if the opportunity arises I would like you to provide my thoughts to the committee of review.

My own association with AAMI goes back to when Dr. Karl Rieckmann was the Director. My own research in malaria at that time had a heavy focus on sporozoite immunity and vaccine research and I was very aware of Dr. Rieckmann's substantial contributions to the field, being one of the first to deliberately inoculate volunteers with irradiated sporozoites to measure immunity. Dr. Rieckmann provided me with good advice and encouragement after I returned from the USA.

After I became Director of QIMR, Dr. Qin Chen had moved from QIMR to AAMI and I again became associated with AAMI to help establish a QIMR Lab at AAMI. I believe that this was very beneficial to both QIMR and to AAMI. Other QIMR personnel have moved to AAMI since that time while maintaining close links with QIMR.

About 8 years ago, I had a direct collaboration with AAMI via Dr. Mike Edstein. We had previously published a paper in *The Lancet* demonstrating that exposure of humans to low doses of *P. falciparum*-infected red cells led to a strong T cell response and apparent protection from subsequent malaria. Mike Edstein subsequently demonstrated that the drug that we were using to treat malaria in the volunteers in our study had a slower metabolism than previously thought and this brought into consideration the possibility that the apparent protection that we had observed may have been mediated, at least in part, by residual drug. Mike and I subsequently wrote a paper on the topic and published it in *Antimicrobial Agents and Chemotherapy* in 2005.

More recently, I have re-established a very significant collaboration with Mike Edstein to test in *Aotus* monkeys a prototype malaria vaccine that we have developed. AAMI holds the only *Aotus* colony in Australia. Furthermore, after visiting a number of non-human primate colonies overseas I can attest that the AAMI facility is absolutely world class in terms of not just the scientific program but also in terms of animal welfare. We plan to use the facility within the next 6 months to test our vaccine. There are other primate colonies in Australia (including a Rhesus facility and a Baboon facility in Sydney), but these primates cannot be infected with the major human parasite, *P. falciparum*; thus AAMI has an incredibly valuable resource that is of enormous benefit to Australian research. While my own work is in the field of vaccines, the Army uses the facility for much drug development work for malaria. It goes without saying that as drug resistance of falciparum malaria parasites is increasing rapidly, the value of a facility to screen new drugs is very significant.

I know a number of the individuals who work at AAMI and I can personally attest to their very high international standing. As a result of their efforts and the efforts of those who have gone before them AAMI has a stellar international profile and is a facility of which Australia cannot only be proud, but of which Australia has a great need.

Yours sincerely

Prof. Michael F Good AO
Australia Fellow

JAMES COOK UNIVERSITY
AUSTRALIA

Townsville Campus
Townsville Qld 4811 Australia

www.jcu.edu.au
CRICOS Provider Code 00117J

Professor Peter A Leggat
MD, PhD, DrPH, FAFPHM, FFPH RCP(UK), FACAsM, FACTM, FACRRM, FFTM FFEWM ACTM, FFTM RCPSG, FACE, FSIA, FAICD, FRGS, ACPHM CMSA, Hon FACTM
Deputy Head of School (Campus Head)
School of Public Health, Tropical Medicine & Rehabilitation Sciences

26 September 2012

AMI Review Chair COL Craig Schramm
Director, Future Health Capability
Joint Health Command CP2-6-011
Campbell Park Offices
PO Box 7911
Canberra BC ACT 2610 Australia)

Dear COL Schramm,

Re: The Australian Army Malaria Institute

I write in my capacity as Director of the Anton Breinl Centre for Public Health and Tropical Medicine at James Cook University in response to a call for submissions concerning the review of the Australian Army Malaria Institute (AMI). Our Centre is one of the largest providers of postgraduate training in the Australasian region for public health and tropical medicine and we have maintained a close association with the AMI over many years.

The work of the AMI has been recognised internationally with conferral of World Health Organization Collaborating Centre status in the field of Malaria. This is noteworthy recognition for an organisation tackling a significant global health problem and a major problem for our region and for international deployments. The expertise of the Institute is broader than malaria however and there has been considerable involvement in translational research in other infectious disease areas with particular relevance to the tropics.

One of the reasons for the success of the AMI has been the strong multidisciplinary team operating out of the Institute that can, for example, examine issues relevant to vector biology, laboratory science or clinical practice. AMI has established strong links to relevant research groups working here and abroad. It has developed strong collaboration with universities supporting the Centre for Military and Veteran's Health, including the University of Queensland.

The record of the AMI is impeccable as are the credentials of its research leaders. I see considerable merit for the AMI in continuing to work with institutions such as the University of Queensland and ourselves, as this provides strong synergies in responding to issues arising from deployments.

Yours faithfully

Professor Peter A. Leggat
Director, Anton Breinl Centre
& Deputy Head (Campus Head)
School of Public Health, Tropical Medicine and Rehabilitation Sciences
Faculty of Medicine, Health and Molecular Sciences
James Cook University

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
F. EDWARD HEBERT SCHOOL OF MEDICINE
4301 JONES BRIDGE ROAD
BETHESDA, MARYLAND 20814-4799
http://www.usuhs.mil

October 4, 2012

Office of the Dean

COL Craig Schramm
Director, Future Health Capability
Joint Health Command CP2-6-011
Campbell Park Offices
P.O. Box 7911
Canberra BC ACT 2610
Australia

Ref: AMI Review

Dear COL Schramm:

I am writing to provide hopefully useful input into your review of the status of the Australian Army Malaria Institute (AMI). Over my more than 20-year US Army medical career, I've worked closely with the professionals assigned to the AMI and more recently, have had the opportunity to assign some of my own officers there for mutual benefit.

The US Army medical research mission, worldwide, is focused on the identification of new disease threats to our deployed forces and on the development of effective countermeasures (like drugs, vaccines, and diagnostic techniques) against these threats. In so many ways, this mission is very much aligned with that of the AMI. For much of my research career, I have worked in malaria vaccine development. To say that the AMI team has contributed in multiple important ways to the larger military malaria research mission—one of the top priorities for the US Army—would be an understatement. Further, AMI's expertise in the scientific assessment of vector-borne disease in general and the ability to properly frame these diseases in the proper public health and military context is incredibly remarkable. While many countries and their militaries are carefully considering how best to apply limited funds in support of the greatest good, one only needs to be reminded of potentially catastrophic outbreaks like that of SARS and the potential for more of the same in the future where the capability of an organization like the AMI is an important asset for both public/military health but also for national security.

When I commanded the Walter Reed Army Institute of Research (WRAIR), the US Department of Defense's largest and most diverse medical research laboratory, I witnessed first-hand the excellence and breadth of capabilities of the AMI staff, so much so that I continued to endorse the assignment of suitable exchange officers from my staff to the AMI where they had incredible opportunities to conduct militarily-relevant medical research responsive to the needs of both of our countries. The ties between the AMI, the WRAIR, and our research facility in Thailand, the

Armed Forces Research Institute for the Medical Sciences (AFRIMS) are extensive and AMI's status as the only WHO Collaborating Center in the entire South Pacific Region is a real enabler.

For its small size, the AMI is a powerhouse of military-focused medical/scientific knowledge and experience and is an important capability for the Australian Defense Organization. As a senior military clinician and as one who has worked closely with the AMI staff over the years, my hope is that your review will prove to be a positive one for the AMI. If you desire additional input from me or from others within the US Army's medical establishment, please let me know.

I look forward to a positive review.

Sincerely,

KESTER.KENT.EDWARD.1045853027

Digitally signed by KESTER.KENT.EDWARD.1045853027
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=KESTER.KENT.EDWARD.1045853027
Date: 2012.10.04 11:42:02 -04'00'

Kent E. Kester, MD, FACP, FIDSA
Colonel, US Army
Associate Dean for Clinical Research and
Consultant to the Army Surgeon General
in Infectious Diseases and in Medical Research
and Development

DEPARTMENT OF THE ARMY
U.S. ARMY MEDICAL RESEARCH AND MATERIEL COMMAND
504 SCOTT STREET
FORT DETRICK, MD 21702-5012

OCT 2 3 2012

Office of the Commanding General

Colonel Craig Schramm, AMI Review Chair
Director, Future Health Capability Joint Health Command CP2-6-011
Campbell Park Offices
PO Box 7911
Canberra BC ACT 2610, Australia

Dear Colonel Schramm:

It is my understanding that the Australian Army Malaria Institute (AMI) is in the process of undergoing a review of its mission, current capabilities, and future role within the Australian Defense Organization (ADO). The US Army Medical Research and Materiel Command, specifically the US Army Medical Materiel Development Activity (USAMMDA), Pharmaceutical Systems Project Management Office, fully recognizes the exceptional work that has been done by the AMI in research on vector-borne infectious diseases, and in the development of vaccines for Dengue and Japanese Encephalitis and drugs for malaria treatment and prophylaxis. The USAMMDA has heavily relied on the AMI studies in filings for licensing of products with the Food and Drug Administration (FDA) in the past, and expect to continue to do so in the future.

I would like to express to the review committee the importance of AMI's continued contribution in the coming years as the challenges from vector-borne diseases are unlikely to diminish given the increasing participation of developing economies ravaged by malaria and other vector-borne diseases in the global market place. The potential for vector-borne diseases to expand under such circumstances cannot be ignored as our world becomes smaller.

Without the effort of AMI in the past several years in designing and implementing field studies to test the efficacy of new candidate prophylactic drugs, it is doubtful that the next generation of prophylactic candidate drugs would have been available as viable products with reasonable prospects for licensing in the US and elsewhere.

There is a common interest between our organizations' missions in protecting active duty service members deployed to malaria endemic areas. Both of our respective organizations have contributed in the past to the monitoring and evaluation of emerging drug resistance, the testing of new candidate antimalarial drugs, and the development of new chemoprophylaxis, and we are counting on AMI to continue to do so in the future. The synergy accrued from our mutual and parallel efforts should continue, not only for the benefit of our service members, but to enhance stability in emerging

economies. Our work contributes in no small measure to the global political stability that is an integral part and an essential component of the security of both our nations, given the fact that we have been closely allied in international peacekeeping efforts and will undoubtedly continue to do so in the future.

Malaria will undoubtedly continue to develop resistance to the currently available drugs. The question that we in the US and you in Australia need to continue to address is whether we will give up on the efforts to keep ahead of the disease or whether we will be fully engaged in developing new products.

We sincerely believe that continued support by the ADO for the mission of AMI is essential for future development of new prophylactic antimalarial drugs and vaccines. In fact, without such continued effort, it is doubtful that new prophylactic antimalarial drugs, such as Tafenoquine, will ever be licensed in the US or anywhere else. In the pursuit of this effort, a team representing USAMMDA visited AMI in recent months to coordinate the development of Tafenoquine as we intend to facilitate the licensing of this drug in both places, Australia and the US, within the next five years. To this end, studies done by AMI in the past several years will be essential for USAMMDA's filing with the FDA, and studies funded by us will similarly be critical for the filing package, which will be submitted to the Therapeutic Goods Administration in Australia.

We urge the review board to continue to support AMI in the coming years and look forward to a closer collaboration between our organizations in the realization that, under a resource constraint environment, collaboration will become even more essential if we hope to achieve our common goals of protecting our service members from vector-borne diseases as we deploy them to endemic areas.

Sincerely,

James K. Gilman
Major General, Medical Corps
Commanding General

Annex D

version 27.2.98

AGREEMENT

BETWEEN

COMMONWEALTH OF AUSTRALIA

AND

THE UNIVERSITY OF QUEENSLAND

AND

THE COUNCIL OF THE QUEENSLAND INSTITUTE OF MEDICAL RESEARCH

IN RELATION TO

THE AUSTRALIAN ARMY MALARIA INSTITUTE

THIS AGREEMENT is made the day of 1998

BETWEEN

COMMONWEALTH OF AUSTRALIA ('the Commonwealth') acting through and represented by the Department of Defence's Army Malaria Institute (AMI)

AND

THE UNIVERSITY OF QUEENSLAND ('UQ') a body corporate constituted under the University of Queensland Act 1965

AND

THE COUNCIL OF THE QUEENSLAND INSTITUTE OF MEDICAL RESEARCH ('QIMR') a body corporate established pursuant to the Queensland Institute of Medical Research Act 1945 - 1948.

BACKGROUND

A. AMI was located at Liverpool New South Wales and affiliated with the University of Sydney;

B. AMI has recently moved to Brisbane and wishes to be affiliated with UQ, QIMR and the Australian Centre for International and Tropical Health and Nutrition;

C. the Australian Centre for International and Tropical Health and Nutrition is an unincorporated joint venture established by UQ and QIMR (and funded in part by the Commonwealth); and

D. the Commonwealth, UQ and QIMR agree that AMI's affiliation with UQ, QIMR and the Australian Centre for International Health and Nutrition shall be governed by the terms of this Agreement.

NOW IT IS HEREBY AGREED AS FOLLOWS:

1. INTERPRETATION

1.1 In this Agreement unless the contrary intention appears:

'Background Intellectual Property' means Intellectual property which is made available for use in the Centre by a party to this Agreement;

'Centre' means the Australian Centre for International and Tropical Health and Nutrition established by UQ and QIMR;

'Confidential Information' means information that:

(a) is by its nature confidential;

(b) is designated by a party as confidential; or

(c) the receiving party knows or ought to know is confidential;

but does not include information which:

(d) is or becomes public knowledge other than by a breach of this Agreement or by any other unlawful means; or

(e) is in the possession of the receiving party without restriction in relation to disclosure before the date of receipt from another party; or

(f) has been independently developed or acquired by the receiving party.

'Contribution' means monies, assets, personnel, facilities and services, but does not include Intellectual Property; and

'Intellectual Property' includes all copyright and neighbouring rights, all rights in relation to inventions (including patent rights), plant varieties, registered and unregistered trademarks (including service marks), registered designs, Confidential Information (including trade secrets and know how) and circuit layouts, and all other rights resulting from intellectual activity in the industrial, literary or artistic fields.

1.2 Words importing a gender include any other gender.

1.3 Words in the singular number include the plural and words in the plural number include the singular.

1.4 Clause headings in this Agreement are for convenient reference only and have no effect in limiting or extending the language of the provisions to which they refer.

2. AFFILIATION WITH UQ, QIMR AND THE CENTRE

2.1 AMI is affiliated with UQ and QIMR and the Centre on the terms set out in this Agreement.

3. PARTICIPATION OF AMI PERSONNEL AND PERSONNEL INVITED BY AMI IN CENTRE ACTIVITIES AND FACILITIES

3.1 AMI personnel (and persons invited by AMI and approved by the Centre's Director) may participate in the activities of the Centre and use the facilities of the Centre nominated by the Director for that purpose.

3.2 AMI shall provide such Contribution to the Centre as the parties agree is reasonably necessary to support the participation of AMI personnel, and persons invited by it, in the activities of the Centre.

4. STATUS OF AMI PERSONNEL IN UQ AND QIMR

4.1 AMI personnel who contribute some or all of their time to the activities of the Centre may be granted adjunct status in accordance with UQ and QIMR policies in relation to UQ and QIMR and the Centre; such personnel shall, however, remain officers/employees of the Commonwealth and the Commonwealth shall continue to meet their wages.

5. PARTICIPATION OF CENTRE STAFF AND PERSONNEL INVITED BY ACITHN IN AMI ACTIVITIES AND FACILITIES

5.1 Centre staff (and persons invited by the Centre and approved by AMI's Director) may participate in the activities of AMI and use the facilities of AMI nominated by the Director of AMI for that purpose.

5.2 The Centre shall provide such contributions to AMI as the parties agree is reasonably necessary to support the participation of Centre personnel, and persons invited by it, in the activities of AMI.

6. STATUS OF CENTRE STAFF IN AMI

6.1 Centre staff who contribute some or all of their time to AMI activities may be granted adjunct status in AMI in accordance with AMI policy; such personnel shall, however, remain officers/employees of UQ or QIMR and UQ or QIMR shall continue to meet their wages.

7. SEPARATE FUNDING ARRANGEMENTS

7.1 This Agreement shall not affect any separate funding arrangements between the Commonwealth and UQ and QIMR in relation to the Centre, including any duties, obligations or liabilities to the Commonwealth under such arrangements.

8. BOARD OF MANAGEMENT AND CONSULTATIVE COMMITTEE

8.1 Membership of the Centre's Board of Management and Consultative Committee shall include a nominee of AMI.

8.2 Notwithstanding the representation of AMI on the Centre's Board of Management and Consultative Committee, the Director of the Centre's Board of Management shall at all times remain accountable to the Commonwealth for the management of the financial,

academic and scientific activities of the Centre.

9. BACKGROUND INTELLECTUAL PROPERTY

9.1 From time to time during the term of the Centre, a party may make Background Intellectual Property available for the activities of the Centre.

9.2 Each of the parties represents and warrants to the other that:

(a) it is entitled to use and make available the Background Intellectual Property which it makes available for the activities of the Centre; and

(b) except to the extent disclosed at the time of making available such Background Intellectual Property, the Background Intellectual Property is free of any encumbrance known at that time.

9.3 The parties acknowledge and agree that in the absence of other agreement the Background Intellectual Property shall remain the property of the party which made the Background Intellectual Property available.

9.4 Subject to strict compliance with this Agreement, and the party not prejudicing the ability of the owner of Background Intellectual Property to seek appropriate protection for Background Intellectual Property, each party shall have a non-exclusive royalty free right to use - for the purposes of the activities of the Centre - the Background Intellectual Property made available by another party.

9.5 Nothing in this clause 9 restricts the ability of a party to use its Background Intellectual Property outside the Centre for any purpose whatsoever.

10. INTELLECTUAL PROPERTY

10.1 Subject to the following subclause, all Intellectual Property shall be owned by the party employing the personnel who created the Intellectual Property. In the case of Intellectual Property created by personnel from more than one party, the Intellectual Property shall be jointly owned by those parties.

10.2 In the event that a research activity undertaken by the personnel of more than one party is considered likely to produce Intellectual property with potential strategic or commercial significance, those parties agree to enter into a project agreement designed to deal with the research activity in question. Such a project agreement should deal with the following:

(a) project definition;

(b) contributions by the parties;

(c) ownership of intellectual property;

(d) control of commercialisation;

(e) confidentiality;

(f) rights of internal use;

(g) distribution of income;

(h) such other matters considered appropriate by the Centre's Board of Management.

11. CONFIDENTIALITY

11.1 Each party agrees to keep secret and confidential all Confidential Information supplied to it by another party.

12. NEGATION OF PARTNERSHIP OR AGENCY

12.1 Nothing in this Agreement constitutes any of the parties as agent or partner of any of the other parties.

13. TERMINATION

13.1 The Commonwealth may at any time by written notice terminate this Agreement; however, clauses 9,10,11,14 and 16 shall survive such termination.

14. DISPUTE RESOLUTION

14.1 Subject to clause 12.4, before resorting to external dispute resolution mechanisms, the parties shall attempt to settle by negotiation any dispute in relation to this Agreement including by referring the matter to personnel who may have authority to intervene and direct some form of resolution.

14.2 If a dispute is not settled by the parties within 10 working days of one party sending to the other party written notice that they are in dispute, the dispute may be the subject of court proceedings or may be submitted to some form of dispute resolution mechanism as may be agreed in writing between the parties.

14.3 Notwithstanding the existence of a dispute, each party shall continue to perform its obligations under this Agreement.

14.4 A party may commence court proceedings relating to any dispute arising from this Agreement at any time where that party seeks urgent interlocutory relief.

15. SEVERABILITY

15.1 Each provision of this Agreement and each part thereof shall, unless the context otherwise necessarily requires it, be read and construed as a separate and severable provision or part. If a provision or part thereof is void or otherwise unenforceable for any reason then that provision or part (as the case may be) shall be severed and the remainder shall be read and construed as if the severable provision or part had never existed.

16. APPLICABLE LAW

This Agreement shall be governed by and construed in accordance with the law for the time being in force in Queensland and the parties agree to submit to the non-exclusive jurisdiction of the Courts of that State.

(SIGNATURE BLOCK)

Version 27.2.98

Australian Centre for International and Tropical Health and Nutrition

Expression of Professional Opinions by Staff

In response to questions raised by academic staff and by the Board of Management about the right of members of staff to express publicly their professional opinions on contemporary issues related to their field of expertise (which may involve publicising their affiliation with ACITHN and with the University), Mika Hayward, Executive Officer of the Faculty of Health Sciences has provided further advice as follows:

the issue raised is not uncommon within the University and requires the exercise of judgment on a case-by-case basis;

the University has no written policy on the matter, possibly because the issues involved are difficult to codify, and there are no prescriptive answers which can be applied to all cases;

the principles are the same as those set out in the policy on "Letters to the Press", that is, that where staff are expressing opinions on a matter which is clearly within the range of their professional expertise, it is appropriate for their university position to be given. If, however, staff wish to express opinions on a matter (for example, political, religious or social) in which they have expertise no greater than that of a member of the general community, then it would not be appropriate to publicise an association with the University;

there is a line to be drawn between the expression of a genuinely objective academic opinion and personal crusades. In the latter case (which have been described as "personal frolics"), the University has been known to decline responsibility and to decline to provide support in subsequent litigation. Where there is doubt, the views of more senior staff, such as the Head of Department, should be sought;

in summary, public comment within one's field of professional expertise is considered to be a normal academic function. There is a line to be drawn when personal ideologies overtake academic objectivity and when staff have no special expertise in the subject matter. Caution is required where the name of the Department or the University is invoked, and the University has no universal obligation to support the opinions expressed nor their consequences. Staff should seek advice when in doubt.

bu 18.3.98

BUDGET VARIANCES 1997

	ACTUAL	VARIANCE %	VARIANCE	BUDGET
INCOME				
PHERP	1,868,498	0.5%	8,498	1,860,000
UQ ALLOCATIONS	1,109,799	-6.8%	(80,661)	1,190,460
OTHER GOVERNMENT	323,012	-23.7%	(100,129)	423,141
STUDENT FEES	345,079	13.4%	40,775	304,304
CONSULTANCIES/SEMINARS	127,146	-2.2%	(2,854)	130,000
OTHER	35,162	6.6%	2,162	33,000
TOTAL INCOME	$3,808,696	-3.4%	(132,209)	$3,940,905
1996 COMMITMENTS	108,060	18.7%	17,060	91,000
AVAILABLE BALANCE	$3,700,635	-3.9%	(149,270)	$3,849,905
EXPENDITURE				
SALARIES				
Academic/Scientific	1,870,390	-5.0%	(97,484)	1,967,874
Others	838,429	0.4%	3,142	835,287
TOTAL SALARIES	2,708,819	-3.4%	(94,342)	2,803,161
EXTERNAL ACADEMIC COSTS	104,162	14.2%	12,962	91,200
TRAVEL & SUBSISTENCE	109,319	3.1%	3,319	106,000
MAINTENANCE	265,074	-12.2%	(36,855)	301,929
TRAINING COSTS	220,003	-31.3%	(100,118)	320,121
FIELDWORK COSTS	43,400	-53.4%	(49,800)	93,200
EQUIPMENT & FURNITURE	72,223	9.4%	6,223	66,000
CENTRE COSTS	23,654	18.3%	3,654	20,000
OVERHEADS 1997	166,834	-8.3%	(15,053)	181,888
TOTAL EXPENDITURE	$3,713,489	-6.8%	($270,009)	$3,983,498
UNDER (OVER) EXPENDITURE	($12,854)	-90.4%	$120,740	($133,593)
CARRIED FORWARD FROM 1996	$396,273	3.4%	$13,207	$383,066
BALANCE END 1997	$383,419	53.7%	$133,947	$249,473

C:\A_ACITHN\ACITHN98\BOMY_98.wb3

ACITHN

PHERP BUDGET 1998

	THP - UQ	HP - QIMR	NP	IHP	TOTAL
INCOME					
PHERP	978,000	631,000	190,000	94,000	1,893,000
OTHER	1,000	1,811			2,811
TOTAL INCOME	$979,000	$632,811	$190,000	$94,000	$1,895,811
1997 COMMITMENTS	61,000		12,000		73,000
AVAILABLE BALANCE	$918,000	$632,811	$178,000	$94,000	$1,822,811
EXPENDITURE					
SALARIES					
Academic/Scientific	398,614	455,985	111,328	35,253	1001180.04
Others	374,174	40,787	34,083	51,586	500630.57
TOTAL SALARIES	772,788	496,772	145,411	86,839	1,501,811
EXTERNAL ACADEMIC COSTS	3,500	30,628	13,000		47128
TRAVEL & SUBSISTENCE	0	21,000	5,000		26000
MAINTENANCE	12,000	34,000	15,000		61000
TRAINING COSTS	0				0
FIELDWORK COSTS	30,000	40,000	27,000		97000
EQUIPMENT & FURNITURE	15,000	4,000	2,000		21000
CENTRE COSTS	20,800	5,000	3,150		28950
OVERHEADS 1997	66,776	90,000	16,733	6,947	180455.37
TOTAL EXPENDITURE	$920,864	$721,400	$227,294	$93,786	$1,963,344
UNDER (OVER) EXPENDITURE	($2,864)	($88,589)	($49,294)	$214	($140,533)
CARRIED FORWARD FROM 1997	($6,000)	$88,589	$43,500		$126,089
BALANCE END 1998	($8,864)	$0	($5,794)	$214	($14,444)

ACITHN

CONSOLIDATED BUDGET 1998

	THP-UQ	THP-QIMR	NP	IHP	CIHER	TOTAL
INCOME						
PHERP	978,000	631,000	190,000	94,000		1,893,000
UQ ALLOCATIONS	725,043		128,162	254,534	100,000	1,207,739
DEETYA					491,000	491,000
OTHER GOVERNMENT				113,141	150,000	263,141
STUDENT FEES	219,839		140,346			360,185
CONSULTANCIES/SEMINARS	125,000		25,000	60,880		210,880
OTHER	37,887	1,811	1,000	18,000	100,000	158,698
TOTAL INCOME	$2,085,769	$632,811	$484,508	$540,555	$841,000	$4,584,643
1997 COMMITMENTS	61,957		12,000			73,957
AVAILABLE BALANCE	$2,023,812	$632,811	$472,508	$540,555	$841,000	$4,510,686
EXPENDITURE						
SALARIES						
Academic/Scientific	884,137	455,985	228,976	408,655	365,564	2,343,317
Others	561,602	40,787	116,358	132,156	133,446	984,349
TOTAL SALARIES	1,445,739	496,772	345,334	540,811	499,010	3,327,666
EXTERNAL ACADEMIC COSTS	19,887	30,628	42,600	9,000		102,115
TRAVEL & SUBSISTENCE	48,000	21,000	28,000	16,000	60,000	173,000
MAINTENANCE	156,500	34,000	57,000	49,500	71,700	368,700
TRAINING COSTS	178,806		9,500	2,000		190,306
FIELDWORK COSTS	54,600	40,000	47,000	27,000		168,600
EQUIPMENT & FURNITURE	31,800	4,000	17,700	19,500	87,000	160,000
CENTRE COSTS	20,800	5,000	3,150		76,000	104,950
OVERHEADS 1997	66,776	90,000	16,733	6,947	39,395	219,851
TOTAL EXPENDITURE	$2,022,908	$721,400	$567,017	$670,758	$833,105	$4,815,188
UNDER (OVER) EXPENDITURE	$904	($88,589)	($94,509)	($130,203)	$7,895	($304,502)
CARRIED FORWARD FROM 1997	$309,184	$88,589	$87,669			$485,442
BALANCE END 1998	$310,088	$0	($6,840)	($130,203)	$7,895	$180,940