

究は少なく、いかなる遺伝子型が存在しているのかについては不明であった。そこでカンボジアやインドネシアにおいてマラリアの疫学調査と同時に、G6PD 欠損症の疫学調査を継続して行い、得られた試料から遺伝子解析を行った。

B. 研究方法

ベトナム・ラムドン省バオロック、インドネシア・フローレス島マウメレ、ミャンマー・モン州タトーンにおいてマラリアの疫学調査を行い、採集された熱帯熱マラリア原虫野生株のスポロゾイト表面抗原CS遺伝子のT細胞エピトープ（Th2RおよびTh3R）の遺伝子変異を解析した。

マラリアとG6PD欠損症の野外調査は、カンボジア・プノンペン市およびラッタナキリ州、バタンバン州、カンポット州の村落においてG6PD迅速診断法を用いて疫学調査を実施した。インドネシアでは、フローレス島マウメレの他、マンガライ族、バジャワ族、リウン族、ナゲケオ族、パルエ族、ラランツカ族、シッカ族の7族が住んでいる都市や集落、さらに西チモール島やスラウェシ島北部と南東部において行った。

採血は現地関係者が行い、インフォームドコンセントが得られたボランティアから0.5~1.0 mlの静脈血を採取した。遺伝子型の解析は自治医大・松岡教授のグループが実施した。

C. 研究結果と考察

1) ベトナム、インドネシア、ミャンマーの3ヶ国から採集された熱帯熱マラリア原虫サンプルを用いて解析した結果、熱帯熱マラリア原虫のスポロ

ゾイト表面抗原CS遺伝子のT細胞エピトープ（Th2RおよびTh3R）は特定の型が分布していることが判明し、アフリカに分布する原虫に見られるような激しい遺伝子変異は認められなかった。これらの結果は、免疫抑制による選択を受けていないことを示している。

2) 平成18年度のG6PD欠損症調査では、カンボジアから見出された47例中の欠損者の46例がG6PD Viangchan型であり、クメール族の祖先は一つと考えられた。残りの1例はG6PD Unionであり、海洋性民族のものであった。平成19年度では、12例のG6PD欠損症が見いだされ、全例がG6PD Viangchan型であった。その内の1例は男性であるにもかかわらずヘテロ接合体であり、他の性マーカー・プライマーを用いて調べた結果、XXYクラインフェルター症候群と考えられた。

3) インドネシアではフローレス島マウメレ近郊のバジョー族（海洋ジプシーの一族でミンダナオ島由来）から新型の変異（G6PD Bajo Maumere）が見出された。また、この民族もViangchan型が優占型であったが、土着のシッカ族・エンデ族の変異型の構成ではViangchan型は極めてまれで、47例中1例しか認められなかった。シッカ族では33例中半数以上の14例が中国広東省由来のG6PD Kaipingであり、エンデ族とも大きく異なっていた。さらに、平成19年度には、フローレス島の主たる7部族全てを調査し、従来と同じく多数の変異型が見出された。しかし、チモール島やスラウェシ島では、見出された変異型はVanua Lava型（海洋性

民族型の1種)非常に多く、フローレス島の民族とは大きく異なっていた。

E. 健康危機情報

東南アジアにおけるマラリアは、アルテミシニン(アルテスネート)混合治療法の導入により、殆どの流行国から激減している。最初に導入したベトナムでは、1998年頃から減少し始め、現在では散発的に流行が見られる程度で、それもカンボジア国境に限られており、熱帯熱マラリアの年間の死者数も1ケタ台になっている。カンボジアにおいてもマラリアは激減し、車が通行できる村落では患者数が激減しているが、メフロキンを混合薬として使用しているため、タイ国境のメフロキン強度耐性地域では熱帯熱マラリアの治療効果が悪くなっている。混合療法の片方の薬剤の選択に問題があるようである。

インドネシアでは、平成18年度からアルテミシニン・アモディアキン混合治療法の導入が始まり、効果が出つつある。しかし、毎日、一度に8錠の薬剤を服用しなければならず、他の国と比較すると副作用出現の割合が多い。

G6PD欠損症は各国共に5%前後の欠損症が検出されているが、新生児黄疸などの激しい症例は認められていない。

F. 研究発表

Matsuoka, H., Nguon, C., Kanbe, T., Jalloh, A., Sato, H., Yoshida, S., Hirai, M., Arai, M., Socheat, D., Kawamoto, F.: Glucose-6-phosphate dehydrogenase (G6PD) mutations in Cambodia: G6PD Viangchan (871G > A) is the most common variant in the Cambodian population. *J. Hum. Genet.*, 50, 468-472,

2005

Jalloh, A., Thien, H. V., Ferreira, M. U., Ohashi, J., Matsuoka, H., Kanbe, T., Kikuchi, A., Kawamoto, F.: Sequence variation in the T-cell epitopes of the *Plasmodium falciparum* circumsporozoite (CS) protein among field isolates is temporally stable: a five-year longitudinal study in Southern Vietnam. *J. Clin. Microbiol.* 44, 1229-1235, 2006

Arai, M., Kosuge, K., Kawamoto, F., Matsuoka, H.: Reactivity of blood samples spotted onto filter papers in the WST-8 method for screening of G6PD deficiency. *Acta Medica Okayama*, 60, 127-134, 2006

Kawamoto, F., Matsuoka, H., Kanbe, T., Tantular, I.S., Pusarawati, S., Kerong, I.H., et al: Further investigations of glucose-6-phosphate dehydrogenase variants in Flores Island, eastern Indonesia. *J. Human Genet.*, 51, 952-957, 2006

Matsuoka, H., Thuan, D.T.V., Thien, H.V., Kanbe, T., Jalloh, A., Hirai, M., Arai, M., Dung, N.T., Kawamoto, F.: Seven different glucose-6-phosphate dehydrogenase variants including a new variant distributed in Lam Dong Province in Southern Vietnam. *Acta Medica Okayama*, 61, 213-219, 2007

Ikuta, K., Torimoto, E., Inamura, H., Shindo, M., Sato, T., Kawamoto, F., Yamasaki, H., Kohgo, H.: A case of imported tertian malaria occurred despite prophylaxis by mefloquine in East Timor. *J. BTHA*, 10, 50-51, 2007

Karunaweera N.D., Ferreira M.U., Munasinghe A., Barnwell J.W., Collins W.E., King C.L., Kawamoto F., Hartl D.L., Wirth D.F.: Extensive microsatellite diversity in the human malariaparasite *Plasmodium vivax*. *Gene* 410, 105-112, 2008

知的所有権の取得状況

特許登録：

特許名称：四日熱マラリア原虫とその診断

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特許名称：グルコース-6-リン酸脱水素酵素異常症の保因の診断方法

発明者：川本 文彦

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特許名称：マラリア顕微鏡及びそれを用いる励起フィルター並びにマラリア原虫の観察方法

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厚生労働科学研究費(振興・再興感染症研究事業)
分担研究報告書

アジアで流行している感染症の我が国への侵入監視の強化に関する研究

「マalaria流行の数理解析」に関する研究

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研究要旨： 地球温暖化の進展に伴い、生息密度の増大や生息域の拡大が進行し、本邦でもマalariaの侵入や再興が懸念されるようになってきた。隣国韓国では、1979年に一度終息した三日熱マalariaが再び1993年ごろより、再びDMZを越えて侵入し、マalaria感染環が維持されるに至った。また、クロロキン薬剤耐性株によるマalaria流行拡大が懸念されている。本研究では、マalariaの侵入、感染流行の拡大についてマalaria伝播数理モデルによる考察を行った。これらにより、国内のマalaria感染環の成立の可否について検討する。これらの検討結果は、我が国の厚生行政の立案に役立つものと考えられる。

三年間のまとめ 主要な研究成果は下記のとおりである。

1) 隣国韓国DMZにおける三日熱マalaria再興に関するモデル解析

韓国DMZ地域を対象地として、南北両域の三日熱伝播モデルを構成し、三日熱マalariaの特徴の一つである肝臓休眠体による再発のパターン、月別患者発生推移の機構、再興の状況、コントロール対策等の効果についてシミュレーションに基づく解析を行った。

2) マalaria薬剤耐性株の拡散によるマalaria流行拡大の危険性に関するシミュレーション ソロモン諸島における事例データに基づき薬剤感受性株、耐性株を組み入れたモデル開発を行い、薬剤耐性株侵入による集団治療投薬効果への影響、クロロキン投与継続による薬剤耐性株拡大に関する解析を実施した。

3) 本邦への熱帯熱マalaria侵入感染拡大の危険性に関する数理モデル予測 第2次大戦後の1950年代入植者によりマalaria流行が再燃した八重山群島・石垣島を対象地としてマalaria侵入の可能性の検討を進めた。気候要因に基づく熱帯熱マalaria媒介蚊 *An. minimus* 動態統計モデルを構成し、将来の気候変動予測に基づき媒介蚊の予測を行った。八重山熱帯熱マalaria伝播モデルに基づき、旧有病地を対象として確率シミュレーションを試みた。

A. 研究目的

研究の第1の目的は、三日熱マalaria伝播数理モデルに基づき、国内への三日熱マalaria感染侵入による感染環の成立の可能性について検討することである。アジア地域では、マalaria対策が進み、マalaria流行の様相に変化が現れている。しかし、朝鮮半島では、近年三日熱マalariaが再興するに至り、また、マalaria流行国からの国際航空便によるマalaria侵入なども懸念されている。このため、朝鮮半島において1990年代に再興したマalaria流行について、マalaria伝播数理モデルを構築し、韓国におけるマalaria感染拡大状況の解析を行い、更にマalaria・コントロール効果について検討を行う。本邦への三日熱マalaria侵入についてのいくつかのシナリオを設定し、マalariaの国内侵入監視の評価を行う。

研究の第2の目的は、熱帯熱マalariaの侵入の可能性の検討である。このため、熱帯熱マalaria媒介蚊の生息する八重山諸島石垣島を対象として熱帯熱マalariaに関する過去の流行状況の分析を通して国内マalaria侵入数理モデルに関する研究を行う。

研究の第3の目的は、クロロキンに抵抗性を持つ薬剤耐性株がマalaria流行拡大に果たす役割を、シミュレーションにより予測することである。

B. 研究方法

1. マalaria媒介蚊の動態統計モデルの構成 八重山群島・石垣島には、熱帯熱マalaria媒介蚊として*An. minimus*が生息している。今回気候要因(気温、降水量)に基づく媒介蚊動態統計モデルを構成した。さらに将来の気候変動予測を過去50余年の観測データに基づき実施し、その結果に基づき媒介

蚊の密度予測を行った。

2. ストカステック伝播数理モデルの構成 マalariaの国内侵入は、マalaria媒介蚊の生息する地域において、少数又は1人の感染者より感染拡大が開始されると考えられる。少人数の集団では、流行に揺らぎが大きく作用し、その結果これらをDeterministicモデルで取り扱うのみでは不十分である。流行の中央値とともに信頼区間の範囲を予測し、また流行再興の確率を調べることは、マalariaの国内侵入監視の評価を行う上で、有用な道具となる。

3. マalaria・コントロールと薬剤耐性株 マalaria・コントロールの主要な方法である集団治療投薬の反復が薬剤耐性株の拡大をもたらす。住民、媒介蚊集団における感染をクロロキンに対する感受性、耐性の2種に区分する数理モデルを構成した。

C. 研究結果

1. 朝鮮半島DMZ近傍の韓国2地域を対象とした三日熱マalaria流行シミュレーションで同地域の流行再興をフォローアップすることが出来た。

2. 一般線形化モデルにより、石垣島の気温、降水量に基づくマalaria媒介蚊*An. minimus*の密度の推定式を得た。さらに、気温の上昇の将来予測を行い、これによる将来のマalaria媒介蚊密度増大の推定を行った。

3. クロロキン耐性熱帯熱マalaria株侵入前後の集団治療投薬の流行に及ぼす影響を調べたところ、開始時24%のものが1年目16.7%、17.6%、2年目12.3%、13.9%、3年目10.1%、12.5%と推移しその差は2%となった。

D. 考察

1. 朝鮮半島のマalaria媒介蚊*An. sinensis*

は、6月より9月まで出現し、高い季節性を示す。媒介蚊季節動態と再発パターンモデルに基づき、高い再発率と幅広い再発期間にも拘わらず、マラリア発症者の季節変動をほぼ再現することが出来た。

2. 熱帯熱マラリアの侵入の可能性についての検討を、石垣島入島観光客に関する統計、気温・降水量などの気象統計並びに予測及びこれに基づく *An. minimus* 動態モデル、マラリア診断までの期間をもとに熱帯熱マラリア伝播モデルを改編した確率シミュレーションを行うこととする。

E. 結論

1. 朝鮮半島DMZ近傍の韓国2地域を対象とした三日熱マラリア流行シミュレーションにより、コントロール要因「早期診断」、「気象」、「感染源対策」について流行低減の及ぼす影響を調べた結果これらが複合的に作用し、2,000年代の低減が実現していた。

この結果は、将来我国への三日熱マラリア再興の危険が生じたとき、対策を立案する厚生行政の指針となる。

2. クロロキン薬剤耐性を考慮した熱帯熱マラリア伝播モデルによる薬剤耐性株拡大の状況をシミュレートした結果、集団治療投薬の coverage が50%程度のとき、15年経過後耐性株の占める割合は15%以上となった。本結果は、マラリア薬剤耐性株拡大速度を示し、関係行政施策に役立つ。

3. 石垣島を対象とした、熱帯熱マラリア再興について検討した結果、感染環の確立には診断に至る期間の長短が大きく関係しているとの結論を得た。本研究をさらに進めれば、近未来に熱帯熱マラリア侵入の危険が現実化したときその厚生行政対策としての示唆を与えることができる。

G. 研究発表

(1) 論文

1. Ishikawa H.
Evolving Mathematical Models of Infectious Diseases with a Complicated Route of Transmission, *J. Fac. Environmental Sci. & Tech. Okayama U. Special Edition*, 13-16 (2005)
2. Hisakane N, Ishikawa H, Kirinoki M, Sinuon M, Socheat D, Matsuda H.
Mathematical modelling for the transmission of *Schistosoma mekongi*: Kratie province in Cambodia. In: *Parasitic Zoonoses in Asian-Pacific Regions 2006*, Eds. Isao Nagano & Yuzo Takahashi. pp.81-89 Sankei-sya Co., Nagoya (2006)
3. Ishikawa H, Ohmae H, Pangilinan R, Redulla A and Matsuda H.
Modelling the dynamics and control of *Schistosoma japonicum* transmission on Bohol island, the Philippines. *Parasitology International*. **55** (1) 23-29 (2006).
4. Ishikawa H.
Mathematical modeling of *Echinococcus multilocularis* transmission. *Parasitology International*. **55S**, S259-S261, (2006)
5. Nishina T, Chin T, Fujita K & Ishikawa H.
A stochastic model of *Echinococcus multilocularis* focusing on protoscoles, *J. Fac. Environmental Sci. & Tech. Okayama U.* **11** (1) 9-14 (2006)
6. Fujita K, Chen TT, Nishina T and Ishikawa H.
Modeling of Re-emerging

- Plasmodium vivax in the Northern Area of the Republic of Korea Based on a Mathematical Model. *J. Fac. Environmental Sci. & Tech. Okayama U.* **11**(1) 1-7 (2006)
7. Fukutome A, Watashi K, Kawakami N and Ishikawa H. Mathematical modeling of Severe Acute Respiratory Syndrome nosocomial transmission in Japan: the dynamics of incident cases and prevalent cases. *Microbiology and Immunology.* **51** (9) 823-832. (2007)
 8. 陳甜甜、仁科朝彦、久兼直人、石川洋文. クロロキン薬剤耐性に関する熱帯熱マラリア数理モデル解析。ーソロモン諸島を対象としたシミュレーション。 *J. Fac. Environmental Sci. & Tech. Okayama U.* **12** (1) 19-27 (2007)
 9. Nishina T, Ishikawa H. A stochastic model of Echinococcus multilocularis transmission in Hokkaido, Japan, focusing on the infection process. *Parasitology Research.* **102** 465-479 (2008)
 10. 植木優夫、中川祐希、笛田薫、石川洋文
石垣島におけるマラリア流行解析のための統計モデリング
J. Fac. Environmental Sci. & Tech. Okayama U. To appear in vol. **13** (2008)
 11. Zenihana T, Hisakane N, Morimoto T and Ishikawa H.
Analysis of the effectiveness of control strategies against bioterrorist smallpox attacks by using Individual Based Model
J. Fac. Environmental Sci. & Tech. Okayama U. To appear in vol. **13** (2008)
- (2)講演
1. 藤田一寿、西浦博、石川洋文
韓国北部地域における三日熱マラリア再興の数理モデル解析. 第74回日本寄生虫学会大会、米子市 米子コンベンションセンター 2005.4
 2. Ishikawa, H.
Mathematical modeling of Echinococcus multilocularis transmission in Japan. Taeniasis / Cysticercosis and Echinococcosis International Symposium with Focus on Asia and the Pacific.
Asahikawa, Hokkaido 2005.7
 3. 福留彩子、藤田一寿、仁科朝彦、陳甜甜、石川洋文
国内SARS侵入を想定した場合の数理モデルによる流行予測. ワークショップ「熱帯、輸入感染症に対する国内対応」 第46回日本熱帯医学会大会、京都市 国立国際会議場 2005.10
 4. 福留彩子、石川洋文
SARSによる院内感染の影響シミュレーション. 感染症理論疫学研究大会 2006 - 数理疫学・数理生態学・数理統計学の融合. 東京、2006.1
 5. Ishikawa H, Fujita K.
Mathematical model of malaria transmission and control—Reemerging of vivax malaria in Korea. Malaria and enteric protozoan infections in South-east Asia. National Institute of Infectious Diseases, Tokyo 2006.1
 6. 仁科朝彦、陳甜甜、久兼直人、石川洋文
エキノコックス感染伝播に関する stochasticモデルとコントロール・シミュレーション. 第75回日本寄生虫学会大

- 会. 弘前市. 006.5.
7. Hisakane N, Kirinoki M, Nishina T, Chen TT, Sinuon M, Socheat D, Ishikawa H, Matsuda H
Mathematical modelling for the transmission of Schistosomiasis mekongi, focused on Kratie province in Cambodia. Asian-Pacific Congress for Parasitic Zoonoses. Gifu. 2006.8
 8. 陳甜甜、仁科朝彦、久兼直人、大前比呂思、石川洋文
クロロキン薬剤耐性を考慮した熱帯熱マラリア伝播モデルの構成:ソロモン諸島を対象として. ワークショップ:マラリアの疫学と予防. 第47回日本熱帯医学会・第21回日本国際保健医療学会合同学会. 長崎市 2006.10
 9. 勝田啓子, 石川洋文, 栗原考次, 大前比呂思
マラリア感染に対するヒトの抵抗力を考慮したモデル構築とその統計的評価
日本計算機統計学会 第20回シンポジウム. 東京 2006.10
 10. 久兼直人、千種雄一、桐木雅史、銭花知弘、松田肇、石川洋文
中間宿主貝の動態を考慮した数理モデルによるメコン住血吸虫症のコントロール解析. 第48回日本熱帯医学会別府市. 2007.10
 11. 隣恵理子、中川祐希、石川洋文
デング熱症不顕性感染の流行への影響に関する数理モデル解析 -タイを対象として. 第48回日本熱帯医学会別府市. 2007.10
 12. Ishikawa H, Nakagawa Y, Bito T, Ueki M, Fueda K, Fujita K, ChinTT.
Is there any probability of malaria emerging in Japn? -From the malaria transmission models' point of view. International Meeting on Malaria Network. National Institute of Infectious Diseases, Tokyo. 2008.11
 13. 銭花知宏,久兼直人,森本智子,石川洋文
天然痘バイオテロ攻撃に対するコントロール対策のIndividual Based Modelに基づく効果判定. 第78回日本衛生学会 熊本市. 2008.3
 14. 中川祐希、尾藤伴行、隣恵理子、植木優夫、笛田薫、石川洋文
石垣島を対象とした熱帯熱マラリア浸入に関する数理モデル解析. 第77回日本寄生虫学会. 長崎市、2008.4.(予定)

**Ministry of Health
National Center for Parasitology,
Entomology and Malaria Control
(CNM)**

**Kingdom of Cambodia
Nation- Religion- King**

**Report of Project Activities
on
Strengthening and integrating of Malaria
Control Activities in Remote and
Endemic Villages in Kampot
Province, Southern Cambodia.**

Period: September 2007 to February 2008

Date: 29th February 2008

**Dr. Duong Socheat
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Supported

By

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I. Introduction:

Malaria is still a concern as one of the main causes of mortality and morbidity in the Kingdom of Cambodia posing a severe economic threat on the families, due to the loss of income being spent on the private drug market in a futile way as they are found to be often dangerous and inappropriate and sometimes offering counterfeit drugs. According to rapid population growth, economic demand and poverty, many people migrated to forested areas and engaged in deforestation converting it for farming for their livelihood. They are the risk groups for getting malaria. Increasing human contacts with vector mosquitoes in the newly developed region and the lack of access to health care have caused for the malaria being epidemic in these forest fringe areas.

It has both the short- and long-term consequences for national economic development and has therefore been given high priority by the government and donor agencies. Malaria is the third highest known cause of outpatient attendance (4.6%) and the first cause of hospitalization (13.7 %) and hospital death (16 %) according to the latest statistics collected. Real figures are certainly much higher as most malaria cases are either treated first through private clinics and drug sellers or do not seek treatment at all.

In Cambodia the malaria transmission happened in the remote forest areas with little development or nothing and in very poor areas that created complexity in controlling that disease as well as problem of providing and receiving the service delivery from the public health sector. The main problems are that those areas were isolated with the complicated geographical barriers, no roads or roads are very bad or very far away from the health facility that caused hurdle for the intervention, especially in the rainy season. In addition, the dearth of transportation means,, the expensive cost of traveling etc...combined with the limited budget provision for malaria control program made those hyper endemic and secluded areas separated the public service for many years. Besides the above mentioned, there are still many problems involved and contributed to the low utilization of the public health service.

Responding to this serious problem of malaria, in 2005-2006, with the important grant from Ministry of Health, Welfare and Labor, Japan (A grant on "Research for emerging and re-emerging infections"), the National Malaria Center has piloted the community-based malaria control in six selected newly formed remote villages in Stung Keo commune, Kampot district, Kampot Province. Through this generous support of General National Institute of Infectious Diseases, Japan for the control activities in the project area, the accurate baseline data on malaria incidence and prevalence in those pilot villages was collected. The village volunteers were selected and trained for offering the malaria diagnosis and treatment through Paracheck and Antimalaria Drug Combination Therapy (ACT) to the community according to the national malaria guidelines. The additional health education sessions on malaria prevention and insecticide bed net utilization were also introduced to raise the level of community awareness and their health seeking behavior for early diagnosis and prompt treatment.

II. The Project site

The project site based in Stung Keo commune, Kampot district, and the distance from the commune to the provincial town is about 40 km. This commune is a newly developed region located in the North West of the provincial town in the mountainous forest fringe area and under the health service coverage of the health center Kampong Kreng. As the forest-dependants, the main income of villagers is generated mostly from forest products such as wood, charcoals, wild animals, bamboo etc... Since the problem of accessibility to receive the health delivery from health facility in the catchment areas and in order to institute an effective malaria control and monitoring system in that remote community, six villages were selected for the pilot study. The 6 villages are as follow Dong, Malech Kul, Anlong Mac Prang, Trapang Kok, Damrei Phong and Kampong Chen villages. The current total population in the Stung Keo commune is 6,046 persons with the land area 348.6 Km² (34,860 Hectares). The density of the study area is 17.34 / Km² with the ethnic minorities about 15%.

III. Aim of the project:

The aim of the project is to strengthen the monitoring of the existing volunteer network with the further integration of other operational and feasible interventions to reduce malaria morbidity and mortality in the newly developed area (Stung Keo Commune)

In order to prevent malaria epidemics in the region, it is vital to closely monitor malaria incidence and prevalence and investigate malaria risk factors such as migration, land transformation and residents' behavior change.

This project will meet the urgent need to investigate and control local malaria cases as well as to monitor and prevent possible malaria epidemics.

IV. Objectives of the Project:

1. To integrate and decentralize the re-impregnation activities to volunteers through ITN training with the direct monitoring from the HC, OD and PHD.
2. To oversee the malaria incidence and epidemiological trend in the villages, especially the pregnant women and children under five.
3. To monitor the volunteers' performance related to the malaria control activities based in the community.
4. To strengthen the community's knowledge and practice through the active health education through the community-based network for preventing them from malaria and making them accessible to get the prompt and correct treatment at public health service.

V. The implementing agency:

The National Center for Parasitology, Entomology and Malaria Control is the implementing agency of this project in coordination with the concerned Provincial Health Department, Operational District, Health Centre for their active participation in all the activities of this project with the help of Village Malaria Workers at the village level. All supplies and other demands needed during the project period are provided

from the budget received by the project as a grant but National Malaria Programme distributed impregnated nets to the project area.

VI. Summary of the results of the activities implemented during the project period

A) Integrated training on malaria intervention for the village malaria workers

The integrated training was organized in order to incorporate the malaria prevention intervention for an effective malaria control by increasing the insecticide treated net(ITN) coverage in the piloted villages and to strengthen the capacity of village malaria workers and the provincial supervisory team for monitoring the malaria incidence in the study villages.

The contents of the training relating mainly to net retreatment, utilization and its care taking (before and after the re-treatment), especially the record writing were also offered to the volunteers. The demonstration for the net re-impregnation was carried out inside the classroom and in the community. When the training course was finished the ITN kits were provided to the volunteers for implementing the retreatment activity in their own villages.

B) The monitoring of the malaria incidence and epidemiological trend in the study villages

In order to monitor the malaria incidence and epidemiological trend of the villages, especially, to follow up the malaria situation in the villages and provide early warning of the malaria outbreak, the malaria data was collected through the village volunteers based in the villages. The supervisory visit from the routine monitoring team from the National Malaria Center, Provincial Health Department, Operational District and Health Center also involved in those routine activity. Most of the malaria cases recorded and treated was the patients who came back from the forest where the high malaria transmission occurred in those areas. From September 2007 to February 2008, a total of 329 patients were tested by rapid diagnosis tests (Paracheck) and 217 patients were positive. Among the malaria positive cases, around 85% is the male aged between 15 to 49 years old and 15% for the age group from 15-49 female. Although the malaria increased in phase III but the positive rate was decreased about 14% i.e from 80% to 66% if compare with same period of the project implementation in phase II. The results of the malaria data collected in the study villages from Sep. 2007 to Feb. 2008 could be depicted in the following tables:

Malaria cases collected in 6 study villages from Sep.2007-Feb.2008

Month	RDT used	RDT positive	0-4 y	5-14 y	15-49y M	15-49y F	> 49 y M	> 49 y F
Sep/07	50	38	0	0	24	14	0	0
Oct/07	54	36	0	0	27	9	0	0
Nov/07	61	46	0	0	42	4	0	0
Dec/07	74	52	0	0	48	4	0	0
Jan/08	31	21	0	0	21	0	0	0
Feb/08	59	24	1	2	20	1	0	0
Total	329	217	1	2	182	32	0	0

questions), cause of malaria, signs and symptoms, performing rapid diagnostic test (paracheck), interpreting the RDT results, dosages of anti-malarial per age group. Record keeping of the RDT tested, results and treatment provided. Dangers signs of malaria and referral of RDT negative fever cases. Note the migration of population, construction of new house, land transformation and residents' behavior change. At the end of the training, each VMW was given a special kit that included dipstick tests, lancets, alcohol, dissolvent; A+ M pre-packaged boxes for working in their own villages.



Baseline Survey activities in the first year of the project

The findings related to knowledge of malaria sign/symptom in the study villages range from 57.90% to 87.10% with the average 71%. Regarding to the health seeking behavior, it varies from one village to another (27%-41.9%) and only 32.90% of the interviewees go to the treat at the public health facility. As for the normal bednet utilization, it ranks from 43.60%-64.20% with the average 52%. Less than 52% of all interviewed villagers used the insecticide treated nets. Related to the forest working exposure, 10.70% of them said they went to the forest.

Duding the blood survey, there are 62 patients in the study villages, came for blood testing and 33.80% of them are positive with the Rapid Diagnosis Test (RDT).

The result of the blood smear survey demonstrated that 38 over 655 participants were positive (5.8%).Among the positive cases, 78.94% is Plasmodium Falciparum, 15.78% Plasmodium Vivax and mixed infection(Pf+Pv) is 5.26%.

The summary result of the malaria case detection, demographic information, land transformation including house hold(HH) and population increase in the first year of the project could be depicted in the table below:

Total HH	Total Pop.	HH increase	Population increase	Land Transformation	Fever patients	RDT tested	RDT Positive	Refer to HCs
888	4498	14	51	300 hectares	238	146	60	10

B- Summary of activities and results of the second year project

1- Refresher training on malaria intervention with project malaria workers

In the second year of the project, the 2-day refresher training was provided to VMW for strengthening them and to ensure the good quality of the service delivery and to develop the capacity building add on to the existing knowledge gained from the previous year. The revision sessions regarding to signs and symptoms of malaria, diagnosis, treatment, RDT use, record writing etc... were conducted at the provincial health department. Before the training, the pre-test score of the study villages ranged from 53%-76% with the average score 64%. However, after the post-test, the score ranked from 70%-97% with the average score 85%. Therefore, there are 21% increased compares to the pretest.



Meeting with PHD

VMW Training activity

During the second year of the study, the summary result of the malaria case detection, demographic information, land transformation including house hold(HH) and population increase by month could be demonstrated as the following table:

Month	Total HH	Total pop.	HH increase	Pop increase	Land transformation (in Hectare)	Fever patients	RDT positive	Refer to HCs
Jun/06	899	4657	4	17	85	28	19	1
Jul/06	912	4739	13	82	75	26	14	3
Aug/06	912	4739	0	0	36	29	20	0
Sep/06	912	4739	0	0	102	29	21	1
Oct/06	912	4739	0	0	16	33	28	0
Nov/06	912	4739	00	00	23	19	16	0
Dec/06	912	4739	00	00	00	24	18	2
Jan/07	912	4739	00	00	00	16	12	0
Feb/07	912	4739	00	00	00	08	06	0
Total	912	4739	99	337	204	205	154	7

2- Provide accurate diagnosis and treatment according to the national guidelines to control malaria and to prevent drug resistance

During the second year of the project, the malaria cases were monitor and recoded. From June 2006 to February 2007, there are 205 fever patients tested by rapid diagnosis, 154 of them were positive which give the malaria positive rate of 75.12%. The malaria cases collected could be summarized in the table below:

Month	0-4 year	5-14y	15-49 y (Male)	15-49 y (Female)	>49 y (Male)	>49 y (Female)
June	00	01	16	02	00	00
July	00	02	08	03	01	00
August	00	06	10	04	00	00
Sept.	00	05	13	01	02	00
Oct.	00	02	26	00	00	00
Nov.	00	01	14	01	00	00
Dec.	00	05	11	01	01	00
Jan.	00	02	07	02	01	00
Feb.	00	00	00	03	03	00
Total	00	24	105	17	8	0

3- Improve knowledge and skills of residents to prevent malaria

In order to prevent malaria the project malaria worker in their own villages made the regular schedule (for every weeks) to gather the villagers and to provide health education to the community by using leaflets, posters and flipcharts. In addition, the impregnated mosquito nets were distributed to all the families in the project area. In the second year of the project, 1,500 impregnated mosquito nets were provided for all the families in study villages and 180 nets were re-impregnated by the project malaria worker. Through the village workers, 65 health education sessions were provided to the villagers with the total of 3,249 populations participated.

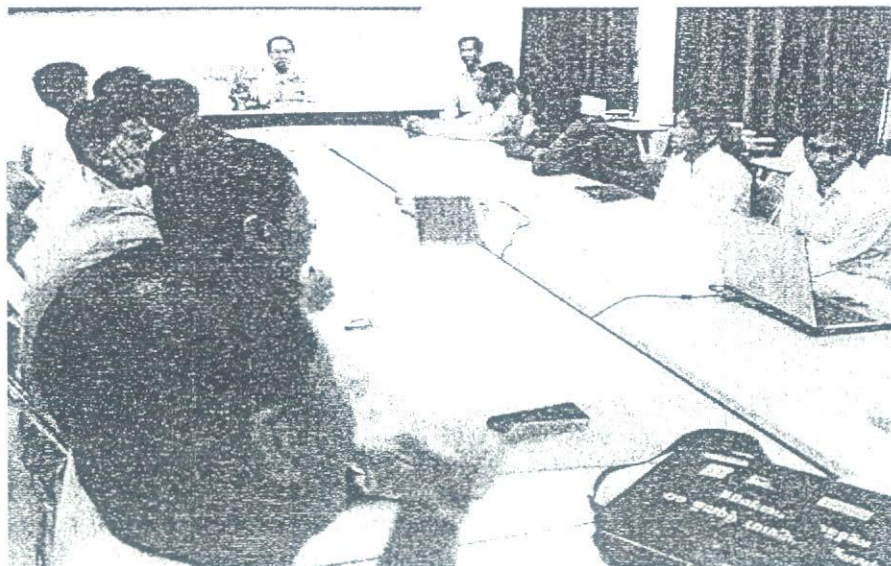


ITN Distribution and health education to the project villages (Stung Keo commune)

C- The activities and results of the third year project

1- Integrated training on malaria intervention for the village malaria workers

In the 3rd year of the project, the integrated training was organized in order to incorporate the malaria prevention intervention for an effective malaria control by increasing the insecticide treated net(ITN) coverage in the piloted villages and to strengthen the capacity of village malaria workers and the provincial supervisory team for monitoring the malaria incidence in the study villages.



Integrated/ITN Training Activity for VMWs

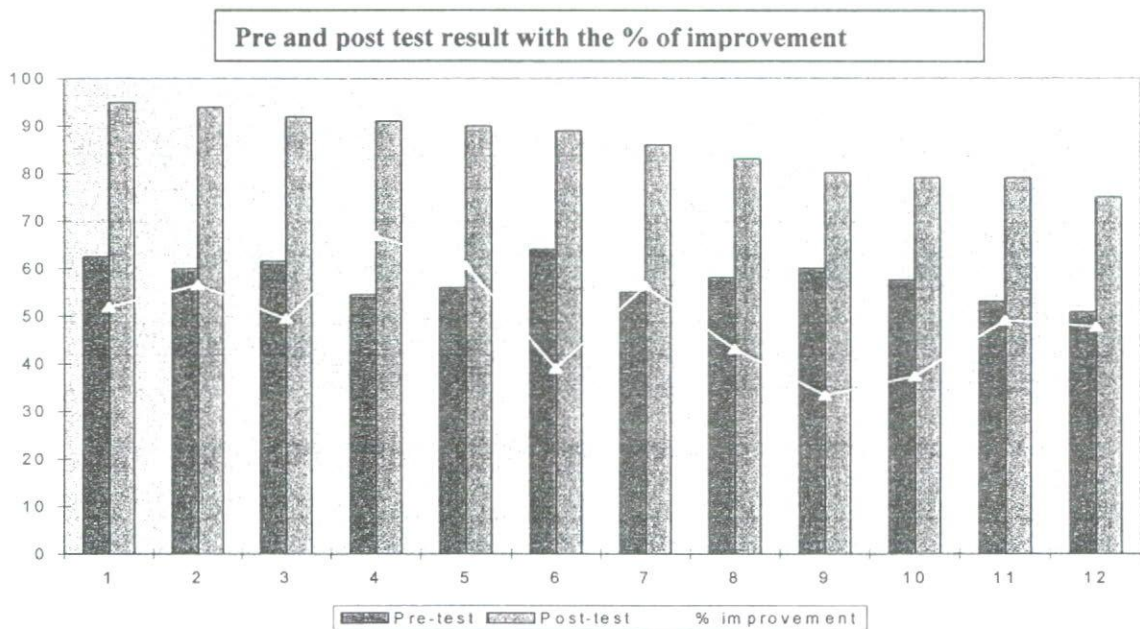
The contents of the training relating mainly to net retreatment, utilization and its care taking (before and after the re-treatment), especially the record writing were also offered to the volunteers. The demonstration for the net re-impregnation was carried out inside the classroom and in the community. When the training course was finished the ITN kits were provided to the volunteers for implementing the retreatment activity in their own villages.



ITN kits distribution to VMWs for net reimpregnation activity

Various participatory learning methodologies were used in the integrated training course. Those techniques included brainstorming, small and large group discussions, exercises, demonstrations, discussions and practice in the field (field visits) etc in order to provide a comprehensive and explicit understanding of each topic introduced in the course.

A pre and post test using the same questionnaire was also administered to the participants. Before starting and ending the training course, all participants were requested to fill out the pre-testing questionnaire following by multiple choices of answers. The result of the pretest showed that most of participants got the score more than 50 (the lowest score is 51 and the highest is 64). After training, however, there was significant increase in the knowledge levels and the score obtained by the participants in the post-test. The post-test showed that the score range from 95 to 75 with the increase of the overall average percentage of improvement with 28%.



2- The monitoring of the malaria incidence and epidemiological trend in the study villages

In order to monitor the malaria incidence and epidemiological trend of the villages, especially, to follow up the malaria situation in the villages and provide early warning of the malaria outbreak, the malaria data was collected through the village volunteers based in the villages. The supervisory visit from the routine monitoring team from the National Malaria Center, Provincial Health Department, Operational District and Health Center also involved in those routine activity. Most of the malaria cases recorded and treated was the patients who came back from the forest where the high malaria transmission occurred in those areas. From September 2007 to February 2008, a total of 329 patients were tested by rapid diagnosis tests (Paracheck) and 217 patients were positive. Among the malaria positive cases, around 85% is the male aged between 15 to 49 years old and 15% for the age group from 15-49 female. Although the malaria increased in phase III but the positive rate was decreased about 14% i.e from 80% to 66% if compare with same period of the project implementation

in phase II. The results of the malaria data collected in the study villages from Sep. 2007 to Feb. 2008 could be depicted in the following tables:

Malaria cases collected in 6 study villages from Sep.2006-Jan.2007

Month	RDT tested	RDT positive	0-4 y	5-14 y	15-49 y M	15-49y F	> 49 y M	> 49 Y F
Sep/06	28	21	0	5	13	1	2	0
Oct/06	33	28	0	2	26	0	0	0
Nov/06	19	16	0	1	14	1	0	0
Dec/06	22	18	0	5	11	1	1	0
Jan/07	16	12	2	7	2	1	0	0
Feb/07	8	6	0	0	0	3	3	0
Total	126	101	2	20	66	7	6	0

Malaria cases collected in 6 study villages from Sep.2007-Jan.2008

Month	RDT used	RDT positive	0-4 y	5-14 y	15-49y M	15-49y F	> 49 y M	> 49 y F
Sep/07	50	38	0	0	24	14	0	0
Oct/07	54	36	0	0	27	9	0	0
Nov/07	61	46	0	0	42	4	0	0
Dec/07	74	52	0	0	48	4	0	0
Jan/08	31	21	0	0	21	0	0	0
Feb/08	59	24	1	2	20	1	0	0
Total	329	217	1	2	182	32	0	0

Monthly malaria positive cases in the monitoring villages

Month	Sep	Oct	Nov	Dec	Jan	Feb	Total
Anglongmakprang	9	14	16	14	9	10	72
Kampongchen	9	6	8	7	4	3	37
Dong	3	6	8	11	2	2	32
Maleckul	7	3	9	8	2	2	31
Trapangkok	7	5	2	10	2	4	30
Dorei Phong	3	2	3	2	2	3	15
Total	38	36	46	52	21	24	217

Monthly malaria in pregnant women in the monitoring villages

Month	# pregnant women in Commune	Total RDT used	RDT positive	RDT Negative	Positive rate
Sep/07	51	14	3	11	21
Oct/07	61	12	2	10	17
Nov/07	61	3	0	3	0
Dec/07	51	0	0	0	0
Jan/08	55	6	0	6	0
Feb/08	33	30	1	29	3
Total	312	65	6	59	9

Activity of VMWs tested the pregnant woman for malaria



During this year 3 of the project implementation, the blood survey was also conducted in order to evaluate the malaria prevalence comparing to the baseline survey before starting the study. 308 villagers were randomized screening during the survey. The overall slide positive rate in the study commune is only 3.6%, so it decreased if compare with baseline survey in 2005 (5.8%). The reduction also observed in Pf from 4.9% to 2.3% and little increase in Pv from 0.9%-1.3%. The findings of the findings could be summarized in the below table:

The results of the blood surevy in phase III

No	Name of Village	No of blood slides	No of slide positive	P. Vivax	P. falciparum	Mixte(Pf+Pv)
1	Malech Koul	52	3	3	0	0
2	Anlong MacPrang	50	0	0	0	0
3	Dom Rei Phong	55	7	0	7	0
4	Kampong Chen	50	1	1	0	0
5	Dong	50	0	0	0	0
6	Trapang Kok	51	0	0	0	0
Total		308	11(3.6%)	4(1.3%)	7(2.3%)	0

3- The monitoring of the volunteers' performance related to the malaria control activities based in the community

Since the education of the VMWs is limited and the training course just organized in a short period, so the technical supervisory support and other assistance are very important and extremely useful for the pilot project. For providing the malaria diagnosis and treatment's accuracy and ensuring the appropriateness of VMWs' work, particularly, for preventing the drug resistance, the supervision of the volunteers' activities has been conducted routinely to examine their activities related to the malaria diagnosis and treatment. The supervisory team from OD/HC staff has checked the records written, RDTs and malaria drug used by volunteers for the accuracy and appropriateness of their work to ensure that they followed the national malaria guidelines and refer the severe and complicated malaria patients to the nearest public health facilities. The supervisory team also assessed the project

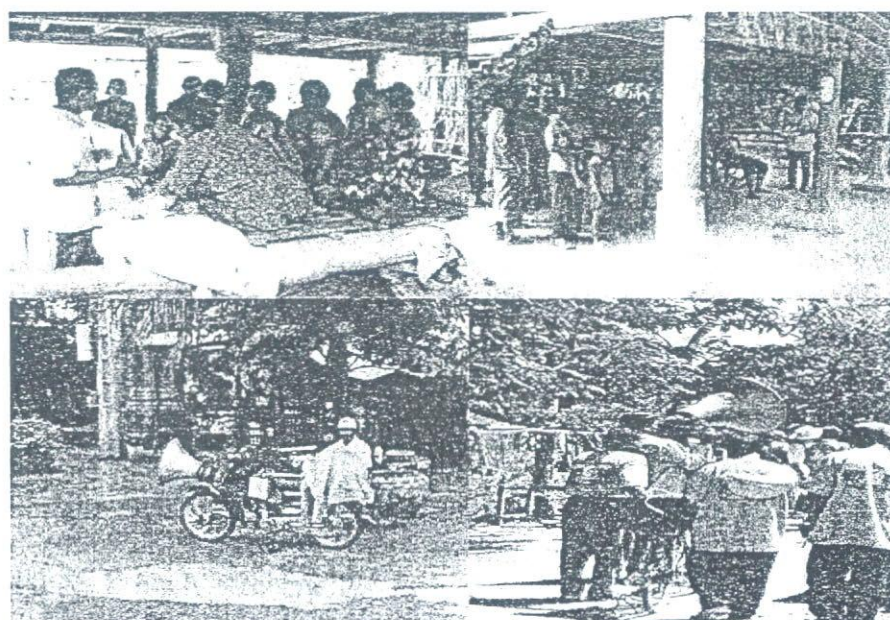
satisfaction and volunteers' performance in order to improve the activity of the project in future. According to the result received, more than 90% of the villagers sought treatment from the VMWs as the first choice of treatment and nearly 100% of them gratify with the project activity and the performance of the VMWs in their community.



VMW performs the RDT test for the sick patients in the study villages

4- Strengthen and increase the community's knowledge on malaria prevention through the active health education and ITN distribution by using the community-based network

Since the health education is one of the important factors for success of any program on the lines of prevention is better than cure, the expansion and participation of the other health educator groups within the community is a very crucial issue to consider in the implementation of the project. Therefore, in this 3 year of the project various group of health educator were selected and to provide the health messages in the gathering, meeting or any festival in the village. During the project period, 75 health education sessions were provided to the study villages and 3,750 villagers participated in the events.



Health education activity at the study villages