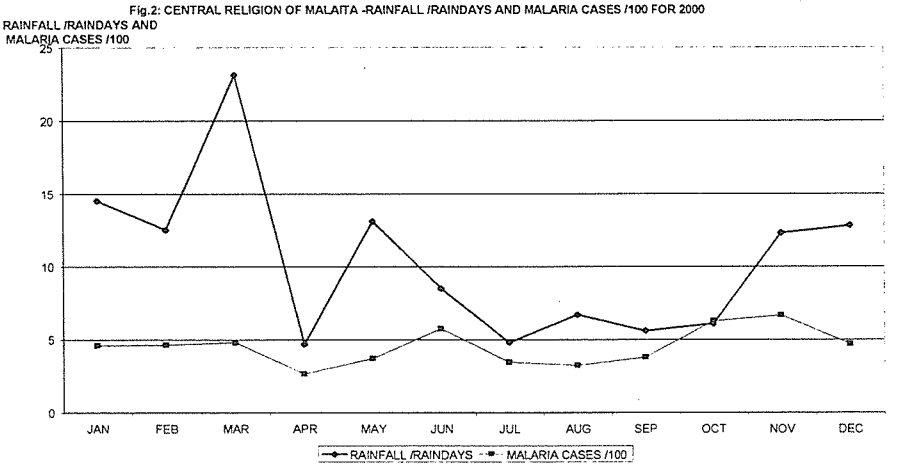
The use of monthly rainfall to predict whether there will be an increase or decrease of malaria cases/incidence is not a good indicator.

2.1.3. Rainfall intensity and malaria cases correlation

The creation of favourable breeding sites for mosquitoes is by rainfall. However tomuch rain causes flushing, destroying breeding sites resulting in low mosquito density thus less transmission. The total volume of rainfall falling (Rain intensity = Fainfall/raindays) may determine the creation of favourable breeding sites or flushing, thus may correlate with transmission and malaria cases.

When monthly rainfall intensities are correlated with their respective malaria cases (see Fig 2) only five months showed a positive correlation (March,April,May, Jul and November). In 2001, only five months and in 2002 only six months. All the other years (2003-2005) also showed that the relationship between rainfall intensity and malaria cases is not consistent each month.

Fig.2: CENTRAL RELIGION OF MALAITA -RAINFALL /RAINDAYS AND MALARIA CASES /100 FOR 2000



The impact of rainfall in a certain month is assumed to be seen on the following month. Hence, when malaria cases are dragged forward by one month only five months has positive correlations (May, Jun,Jul,Aug,Oct). The same could be seen for the years 2001-2005, that there is no consistent correlation between rain intensity and malaria cases even if cases are dragged one month forward.

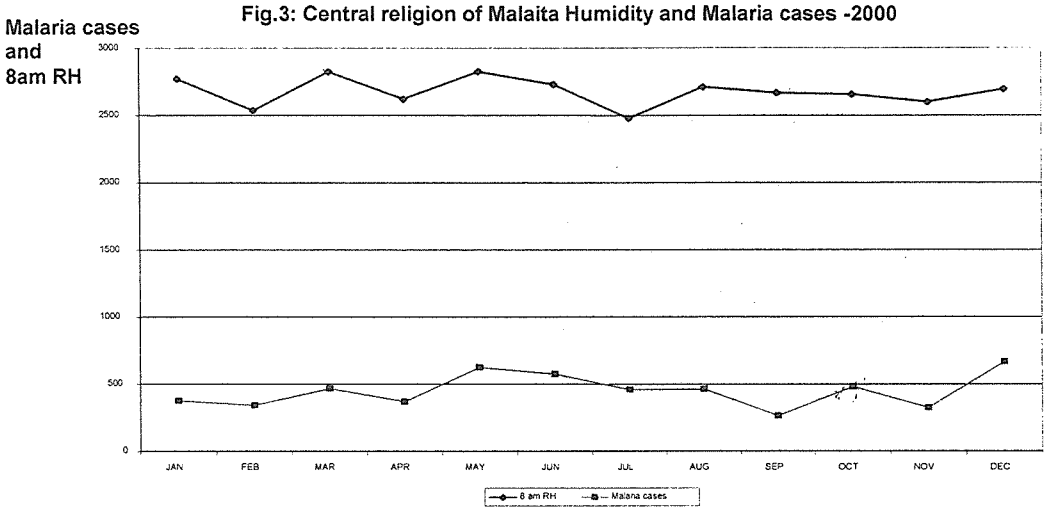
2.1.4. Rainfall intensity and malaria incidence correlation

The same picture that is seen when comparing rain intensity and cases (fig.2) is seen also for rain intensity and incidence. There is only five months that showed a positive correlation between rain intensity and malaria cases.

2.1.5. Humidity and malaria cases correlation

One of the parameters measured by the Meteorology division is humidity. Humidity is measured at 8 am and 2pm each day. Each month, total humidity is calculated. In 2000, total monthly humidity at 8 am compared with their respective malaria cases showed a consistent correlation (Fig.3). When there is an increase in humidity the same will happen for malaria cases. Humidity at 2pm also showed a similar picture, except for the month of July.

Fig.3: Central religion of Malaita Humidity and Malaria cases -2000



When the total monthly humidity figures for 8am and 2pm are averaged and correlated with their respective monthly cases it showed a better correlation . When there is an increase or decrease in humidity the same will happen for malaria cases

2.1.6. Humidity and malaria incidence correlation

When humidity is correlated with malaria incidence a similar picture as for humidity and malaria cases (fig.3) is shown.

Data for 1998 and 2001 showed the same picture as that for 2000, a positive correlation between average humidity and cases/incidence.

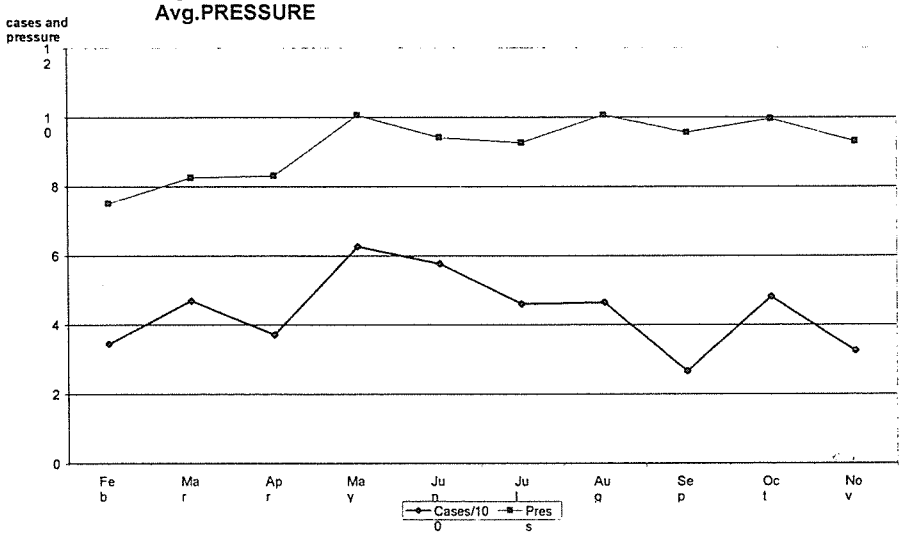
Humidity is a good indicator to use to determine whether malaria cases/incidence will increase or decrease. But it does not tell us by how much is the increase/decrease.

2.1.7. High pressure and malaria cases correlation

Air pressure is one of the parameters that the Meteorology Office measure daily. Each day the highest and lowest pressures are recorded. The highest pressures each month are averaged and correlated with malaria cases for that respective month. The same is done for the low pressures. Results showed that there is no correlation.

However there is a good correlation between air pressure(averaged) and malaria cases when cases are shifted forward by one month (Fig.4). When pressure drops or increase malaria cases will drop or increase respectively, a month later.

Fig.4: MALARIA CASES (Shifted forward) AND ITS CORESSPONDING Avg.PRESSURE



2.2. CONCLUSION

The present conclusion is based on the data collected so far, as more data is collected and analysed these conclusions would be strengthened :

1) The best meteorology parameters that could be used to predict an increase or decrease of malaria are Humidity and Air pressure.
2) Monthly Humidity is correlated with its respective monthly malaria cases/incidence. If field officer could measure their own humidity and monitor its trend they could predict within that month whether malaria will increase or decrease.
3) A month's air pressure is correlated with its next month's malaria case/incidence. This would help field managers to predict, whether their malaria cases/incidence would increase/decrease the coming month. Hence giving them enough time to act.

3. RESULTS OF PLASMODIUM VIVAX MALARIA STUDY

3.1. P.vivax malaria trend in Solomon Islands

The burden of malaria in the Solomon Islands is so huge that reducing the total malaria incidence is a priority; however, there was no special attention for P.falciparum or *P.vivax*. Since 1992 total malaria incidence had been successfully reduced from 441

cases/1000 population to 155.1 cases/1000 in 2005 (fig.5). The reduction was seen for both species, both tend to drop simultaneously . As shown in table 1 the *P.vivax* ratio was generally maintained hence that for *P.falciparum* also, except in 1996-97 where the annual trend of *P.vivax* ratio increased to >44% and thereafter showed a down ward trend.

Fig.5:MALARIA TREND FOR SOLOMON ISLANDS

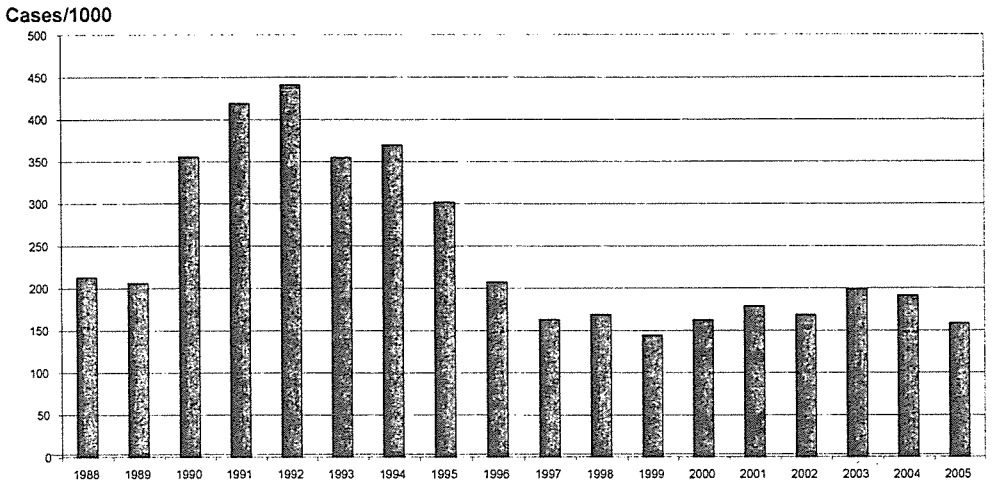


Table 1: **Annual P. vivax ratio**

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Pv ratio	37.4%	40.6%	36.9%	39.4 %	48%	44%	34%	30%	31.4 %	33.6 %	33.2 %	29.6 %	28.6 %	29.3 %

3.2. The relationship between malaria incidence reduction rate and P.vivax predominance

Since 1992, annual malaria incidence has been gradually reduced. The rate of reduction varies from province to province. Some provinces were so effective in their control programs and with a small population base have achieved a high reduction rate compared to others. Some of the provinces with their high reduction rates saw a shift from a high parasite *P.faciparum* ratio (the predominant species) to a high *P.vivax* ratio.

Table 2a show that the lower a reduction rate, the longer it takes for the occurrence of *P.vivax* predominance. A malaria incidence reduction rate of >41.3% will take only one year for *P. vivax* to become a predominant parasite population if the initial Pv ratio is >39.10%. If the initial *P.vivax ratio* is <27.4% it is not easy for *P. vivax* to become predominant within one year, even if a malaria reduction rate of 50%/year is achieved as for Malaita(MP1) in table 2b.
A malaria incidence reduction rate of 28-33%/year will take 2 years for *P.vivax* to become predominant if the initial *P.vivax* ratio is > 37.2% - this was observed in Isabel

province and Honiara City. A reduction rate of 19%/year will take 4 years if the initial P.vivax ratio is 41.7% (observed for Makira-Ulawa province) and a reduction of about 14%/year will take 5 years if the initial P.vivax ratio is 27-39.4% (observed for Temotu and Central Island provinces).

Table 2a: Malaria reduction rates in comparison with period taken for *P.vivax* to be predominant.

Provinces	Initial PV ratio	Period taken to over-turn PV ratio		Malaria incidence reduction rate/year
Central Islands (CIP)	27.20%		5	18%
Temotu(P1)	39.40%		5	14.70%
Makira Ulawa(MUP)	41.70%		4	19%
Solomon Islands(SI)	37.90%		4	13%
Isabel (IP)	37.20%		2	33%
Honiara (Hon)	44.10%		2	28%
Temotu (TP2)	39.10%		1	41.30%

NB: There were two occasions that Temotu province (TP) experienced having P.vivax predominancy, 1997 (TP1) and 2002(TP2)

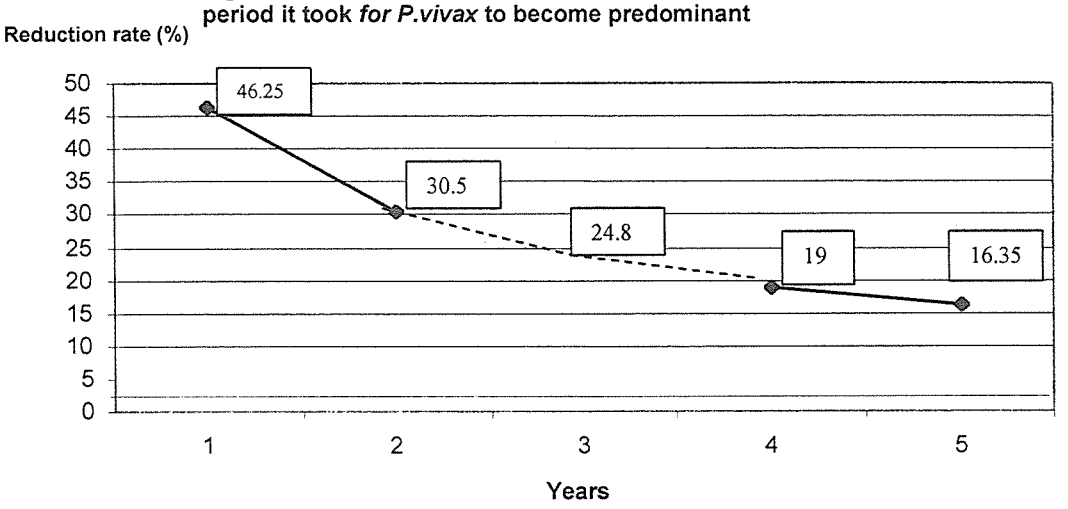
Table 2b: Malaria reduction rates in comparison with period taken *for P.vivax* to almost reach 50% ratio.

Provinces	Initial PV ratio	Period taken to reach high PV ratio	Malaria incidence reduction rate/year
Malaita (MP1)	27.40%	1	50.10%
Guadalcanal (GP1)	31.10%	1	20.30%
Temotu	39.4%	2	30.8%
Malaita (MP2)	27.40%	5	14.20%
Guadalcanal (GP2)	31.10%	8	9.10%

NB: Malaita (MP) had two periods that they reduced malaria for resulting in P.vivax ratio almost 50%, 1992-93(MP1) and 1992-97 (MP2). Guadalcanal (GP) also had two periods, 1992-93(GP1) and 1992-2000(GP2).

It is estimated that a malaria reduction rate of about 24.8%/year (NB: 24.8 is an estimate, an average of 30.5 and 19) will take 3 years (fig.6) if the initial P.vivax ratio is 37-41%.

Fig 6: The malaria incidence reduction rate (avge) and the period it took *for P.vivax* to become predominant



When the initial *P.vivax ratio* is near 50% it requires only a reduction rate of more than 15.10%/year before *P.vivax* becomes predominant (see table 3).

Table 3: **Malaria reduction rates in comparison with period taken for P.vivax to be predominant, in provinces that has an initial *P.vivax* ratio of >48%.**

Provinces	Initial PV ratio	Period taken to over-turn PV ratio	Malaria incidence reduction rate/year	Initial malaria incidence
WP	48.10%	1	15.10%	522.2
CHP	48.70%	1	33%	681

3.3. The relationship between bednet coverage and P.vivax predominance

The primary prevention strategy for malaria control in the Solomon Islands is insecticide treated bednets. Other supplementary measures are used if they are available or appropriate. Bednet coverage therefore is a measure of the strength of the vector control program in a particular province.

Table 4 show that when the initial *P.vivax* ratio is <30%, bednet coverage has to reach more than 88.5% before *P.falciparum* is reduced to a level where *P.vivax* becomes predominant.

Where the initial *P.vivax* ratio is >40%, bednet coverage has to reach 78% or more before *P.vivax* becomes predominant. Between 30-40% ratio bednet coverage has to be >80%.

On average(Solomon Islands), when the initial *P.vivax's* proportion is >37.9% bednet coverage has to be >60% before *P.vivax* becomes predominant.

Table 4: The relationship between the period it took to achieve a certain bednet coverage with the period it took for *P.vivax* to become predominant.

Province	Initial PV proportion	Incidence reduction rate	Years of operation to achieve PV predominance	Bednet coverage at year of PV predominance
Honiara	44.1	978-333.9 (65.9%)	1994-96	60.7%
Isabel	37.2	432.5-146.5 (66.1%)	1992-94	130%
Makira	41.7	306.1-74 (75.8%)	1992-96	48.8%
Choiseul	48.7	681-456.5 (33%)	1992-93	48.6%
Western	48.1	522.2-443.2 (15.1%)	1994-95	68.9%
Central	27.2	426-50.6 (88.1%)	1992-97	114.5%
Temotu	39.4	254.1-67.4 (73.4%)	1992-97	62.4%*
Temotu	39.1	138.1-67.4 (51.2%)	1996-97	62.4%*
Temotu	41.7	84.8-49.8 (41.3%)	2001-02	70.5%
Solomon	**37.9**	**436.5-209.4 (52%)**	**1992-96**	**60%**

3.4. The control of *P.vivax* malaria in various populations

The success of the control of both *P.vivax* and *P.falciparum* depends on several factors. In the Solomon Islands one of the factors is the population of an island. The smallest province in regards to population, Rennnel and Belona, used to have malaria, but was eradicated during the Malaria Eradication Programme period (1969-76).

Isabel province has a population of around 23,256 (2004 estimate), with its smaller population it took two years to reach a bednet coverage of 130% and reduced its malaria incidence from 432.5 cases/1000 population (1992) to 146.5 cases/1000 population (1994). A 66.1% reduction in 2 years (see fig.5) resulting in *P.vivax* becoming predominant .

Malaita province has a population of 144,617 (2004 estimates). It took 5 years to reduce its malaria incidence from 227.8 cases/1000 to 66.3 cases/1000, a 70.9% reduction and still could not achieve a *P.vivax* predominance.

A small populated province has the following advantages: it is easily managed and only a few villages/population to cover.

3.5. Treatment and drug resistance

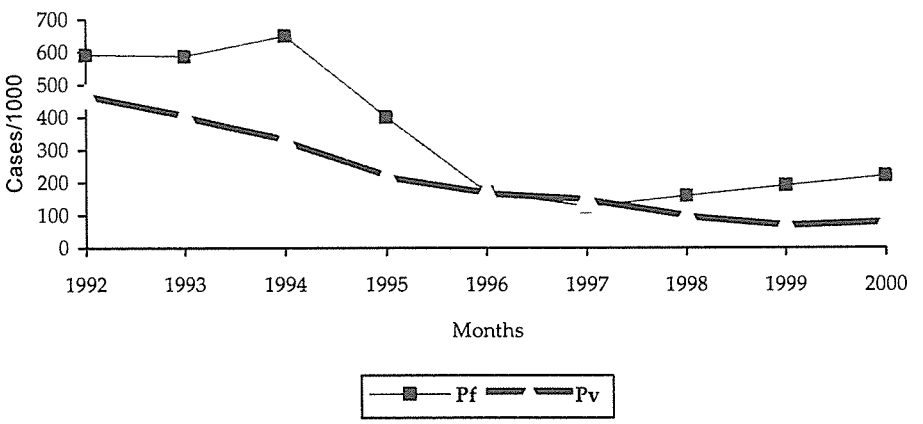
Since 1969 the treatment for *P.vivax* and *P.falciparum* was chloroquine plus primaquine. Primaquine then was given as a gametocidal agent and was given as a single dose of 45mg . In 1991 primaquine was withdrawn because it was observed to cause haemolyses, followed by acute renal failure in people with glucose-6-phosphate dehydrogenase deficiency (G6PD).

Invivo studies done in Honiara, the capital city, in 1995-1996, showed 30.43% resistance to chloroquine. However, qualitative analyses on the subjects that developed parasitemia showed only 15.21% were resistant to chloroquine. The reappearance of parasite in the other 15.23% patients may be due to new infections or a relaps of *P.vivax*. The cases which developed parasitimia after the standard treatment of chloroquine were treated again with a combination of chloroquine and primaquine (at 15mg/day for 14 days). The treatment was effective in clearing parasitimia.

3.5.1. Primaquine for the treatment of Plasmodium vivax malaria

A trial was done in Honiara in 1998 to see the effectiveness of using chloroquine and primaquine as a treatment for the hypnozoites and resistanct *P. vivax*. The regimen used was 3 days of chloroquine (10 mg/kg/day) and 14 days of primaquine (0.25 mg/kg/day). The result (Figure 7), showed dramatic reduction of *Plasmodium vivax in 1998.*.

Fig.7: The effect of Primaquine on the P. vivax to P. falciparum Annual Incidence in Honiara



Based on the above study the Solomon Islands formally reintroduced primaquine, for the treatment of *P.vivax*, in combination with chloroquine. The new treatment protocol for P.vivax, in 1998:- 3 days of chloroquine (10 mg/kg/day) and 14 days of primaquine (0.25

mg/kg/day), had proven very effective in reducing the *P.vivax* incidence rate and maintaining it low.

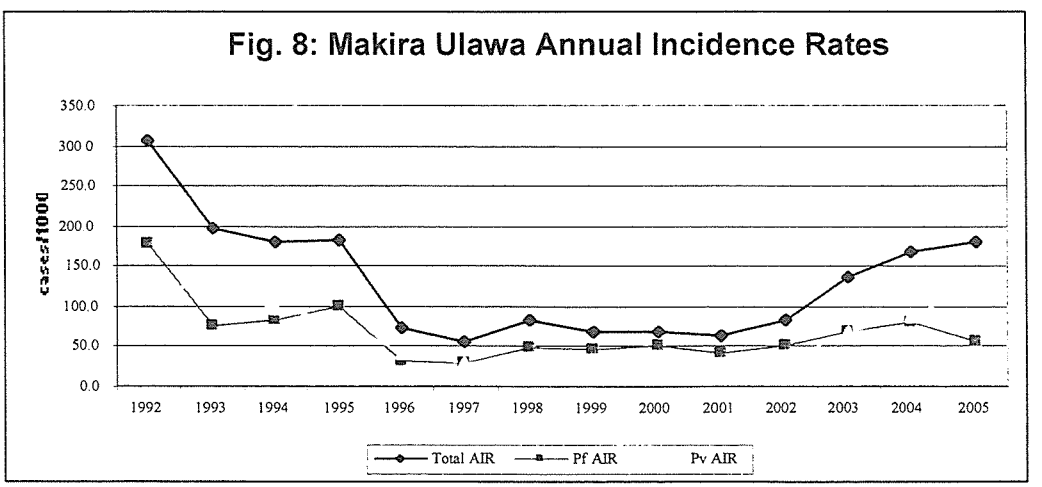
3.6. The control of *P. vivax* using vector control, supplemented with proper treatment

The malaria control program in Honiara was intensified in 1993. Almost all control activities available were used: awareness, larviciding, community participation, residual spraying and impregnated bednets. This resulted in a drastic drop in total malaria incidence from 1058cases/1000 population in 1992 to 254.6cases/1000 in 1998. Though total malaria incidence increased again in 1999 because of the ethnic tension *P.vivax* incidence rate did not increase, but continued to drop, except for a slight increase in 2001 (see fig.7).

When proper treatment for *P.vivax* was not introduced its incidence could increase. In 2002 malaria started increasing in Makira Ulawa. A lot of vector control activities were done but despite all these efforts *P.vivax* continued to increase in 2004-2005 (fig 8). Makira Ulawa has never introduced the new treatment protocol for *P.vivax*. If the new treatment protocol for P.vivax would have been used the *P.vivax* increase in 2004-2005 would not have occurred.

Similarly in Shortland islands (fig 9) malaria continued to increase with *P.vivax* contributing 77.3% of all cases. A survey done showed that clinicians are not treating *P.vivax* according to the new treatment protocol.

A good vector control program does not guarantee a suppression of *P.vivax*. Sometimes vector control needs to be supplemented with correct treatment .



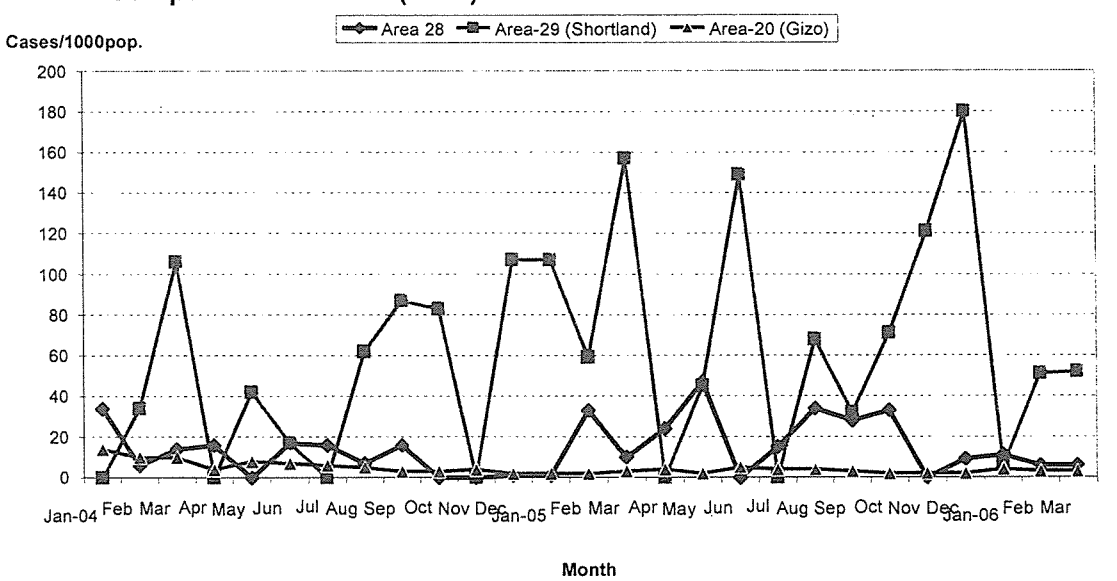
3.7. Constraints with the new treatment protocol for *P.vivax*

3.7.1. Clinician's contribution

The use of primaquine for the treatment *P.vivax* is a strategy used in the Solomon Islands for the control of malaria. When malaria incidence is reduced to a level where *P vivax* becomes predominant then the correct treatment of *P.vivax* becomes important.

Treatment of patients is mandated for clinicians, unfortunately most of the clinicians in the rural health facilities are not prepared to change to the new treatment protocol. The impact of such negligence could be devastating. In areas where malaria had been significantly reduced it could increase again with *P.vivax* being the predominant species.

Figure 9: Monthly malaria incidence rate in Shortlands compared to area 20 (Gizo) and area 28



3.7.2. Treatment compliance

Having an effective treatment with better compliance is of prime importance. Both has to be considered if the *P.vivax* incidence is to be reduced. The treatment schedule for *P.vivax* takes 17 days. The period is long and poor compliance may turn an effective regimen become ineffective in reducing *P.vivax*.

A survey done by in 2004 on treatment compliance showed that when using a pre-packed treatment (packing treatment according to days of treatment) there is 86.4% (n=102) compliance. Traditional packaging (putting all the tablets in one packet) there was 85.3% (n=97) compliance. Patients tend to comply more when treatment was pre-packed.

Patients treated for *P.vivax* were followed up to confirm cure rate. Results from the survey showed that patients treated with pre-packed treatment has a non-cure rate of 16.91%, traditional packaging has a non-cure rate of 15.51%.

The challenge for the Vector Borne Disease Control programme (VBDCP) is to maintain the non-cure rates lower than 16.9%. If the non-cure rates are higher than 20% the treatment has to be changed, as it is not different from a drug resistance of 20%.

3.8. CONCLUSSION

1) The initial *P.falciparum* and *P.vivax* ratio determines the bednet coverage that is required for the *P.falciparum* ratio to drop lower than that of *P.vivax* , resulting in *P.vivax* becoming predominant.

When the initial *P.vivax* ratio is <30%, bednet coverage has to reach more than 88.5% before *P.falciparum* is reduced to a level where *P.vivax* becomes predominant. If the initial *P.vivax* ratio is >40%, bednet coverage has to reach 78% or more before *P.vivax* becomes predominant. Between 30-40% ratio (*P.vivax*) bednet coverage has to be >80%.

2) The incidence reduction rate correlates with the period it takes for *P.falciparum* ratio to drop lower than that of *P.vivax*, so that *P.vivax* becomes predominant.

A malaria incidence reduction rate of >41.3% will take only one year before *P. vivax* becomes predominant if the initial ratio is >39.10%. A malaria incidence reduction rate of 28-33%/year will take 2 years before *P.vivax* become predominant if the initial *P.vivax* ratio is > 37.2%. A reduction rate of 19%/year will take 4 years and 14%/year 5 years.

3) When *P.vivax* malaria becomes a predominant species it needs proper treatment protocols before it could be reduced. The new treatment protocol of CQ+PQ(14days) was proven to be very effective for treating *P.vivax*. The new treatment regimen does not only cures *P.vivax* malaria, but kills the relapse and hypnozoit stages also.

4) When field officers implement vector control activities it is important that they know the expected time *P.vivax* would become predominant, based on the initial *P.vivax* ratio, bednet coverage achieved and annual incidence reduction rate. A change in parasite predominance means a change in control strategy.

5) Vector control activities reduces *P.vivax* at a very slow rate or may not have an impact. Only by the use of the present treatment regimen:CQ plus PQ (14 days) will *P.vivax* be reduced. Clinicians must be informed of the expected time *P.vivax* malaria would become predominant. Clinicians that are not aware of the new treatment regiment should be taught prior to the expected time.

6) As *P.vivax* becomes predominant awareness to improve treatment compliance should be intensified as the reduction of *P.vivax* malaria depends not only on correct treatment alone, but compliance also.

A cure rate of 83.1-84.1% is satisfactory, it should be maintained higher as a non-cure rate of 20% is not different to a resistance of 20%. When resistance is 20% or higher the treatment has to be changed.

Annual Report for April 2006-March 2007

Project title: Risk Assessment of Malaria in Thailand (in order to support the project "Establish new monitoring tools of malaria")

Principle Investigator:
Jeeraphat Sirichaisinthop, MD, MPH
Director of Vector Borne Disease Training Center (Phrabuddhabat), Bureau of Vector Borne Disease, Department of Disease Control, Ministry of Public Health, Thailand.

Research activities:

In Thailand *Plasmodium falciparum* and *P. vivax* are highly prevalent in many malaria endemic areas. An increasing trend of *P.vivax* has been observed during last 10 years in manay parts of the country. Assessment of malaria then would facilitate studies of malaria. But after the organization reform recently the malaria surveillance system started showing delay of case reports and missing of information in some areas. We propose to strengthen the surveillance system of malaria in Thailand especially in key areas where gaps of information were found. This will help getting a better picture of malaria and deliver a better assessment of malaria.

The Specific Aims:

1. To identify high malaria areas in Thailand.

2. To support or strengthen the surveillance in some key areas where gaps of information were found.

3. To assess risk of malaria in areas where changes would occur as to support studies on malaria.

Progress for period of April 2006-March 2007

1.Malaria Situation in Thailand has been reviewed and presented in the PV meeting in Shanghai in Jan 2007.

2. A review of malaria surveillance system to identify areas where information gap occurred had been started. Some area have been identified such as Chanthaburi province at Thai-Cambodian border where incomplete report was recently found.

Future Plan:

1. Assessment of *vivax* malaria by province will be done in order to identify if there is any pattern of change in vivax trend.

2. Support of malaria surveillance in Chanthaburi will be done to maintain complete reports.

3. Further review of surveillance system will be done to identify areas where information gaps would be found but with great malaria concern.

Annual Report for April 2006-February 2007

Project title: Establish new monitoring tools of malaria

Principle Investigator:
Jetsumon (Sattabongkot) Prachumsri, PhD.
1. Chief, Laboratory Science Section, Department of Entomology, USA Medical Component, Armed Forces Research Institute of Medical Science, Bangkok, Thailand.
2. Adjunct Professor, Biology Department, Faculty of Sciences, Burapha University, Chonburi, Thailand
3. Adjunct Staff, Pathobiology Department, Faculty of Sciences, Mahidol University, Bangkok, Thailand

Research activities:

In Thailand *Plasmodium falciparum* and *P. vivax* are highly prevalent in many malaria endemic areas, whereas *P. malariae* and *P. ovale* have been found only in a small proportion of cases. For 4 years we have studied malaria transmission in a village in western Thailand where malaria is hyperendemic. The majority of parasite carriers show no symptoms with low parasitaemia all year round, which suggests that these individuals have naturally acquired protective immunity. We propose to identify the correlate(s) of protective immunity to *P. falciparum* and *P. vivax* in this population. Blood will be collected by venipuncture from people with malaria positive or negative blood smears. Serum and peripheral blood mononuclear cells (PBMC) will be separated for each sample. Humoral immunity to sporozoite, blood and liver stages of *P. falciparum* and *P. vivax* will be characterized to identify parasite epitope(s) which will be a vaccine candidate(s) that is (are) able to enhance human protective immunity. This approach will also give us a chance to find out new parasite antigens for the diagnostics and/or epidemiological surveillance.

The Specific Aims:

1. To identify protective immune response in population with symptom and non-symptom by characterize humoral immunity to *P. falciparum* and *P. vivax* parasite using parasite crude extracts and recombinant proteins of both known malaria vaccine candidates and novel candidates.

2. To identify parasite antigen(s) that activates humoral immune response to blood, liver and sporozoite stage parasites.

Progress for period of April 2005-February 2006

Development of Loop-Mediated Isothermal Amplification (LAMP) for malaria diagnosis:

1. Blood samples collected from patients at Maesod clinics were used to evaluate Loop-Mediated Isothermal Amplification method for malaria diagnosis. Dr. Tsuboi developed the conditions to use LAMP for detection of all four species of malaria parasite in laboratory. Plasma and blood cells from each donor were separated and frozen in dryice before being transported to laboratories in Bangkok and at Ehime University for development of LAMP conditions.

2. After attending the meeting in Shanghai in Jan 2007, a proposal to evaluate LAMP at field clinics has been proposed to WHO office in Thailand. WHO will sponsor proof-of-concept research to evaluate if LAMP can be used at field clinics or in malaria endemic area.

Antigens preparation for genome wide screening of new malaria vaccine candidates

1. Sporozoite and liver stages antigens were prepared from mosquitoes fed on malaria infected blood.

2. Blood stage antigens preparation has been delayed due to the delay approval of new human use protocol required for blood collection.

3. Additional plasma that showed transmission blocking efficacy was sent to Dr. Takafumi Tsuboi laboratory for screening of malaria antigens for future vaccines or developing of diagnosis for surveillance of malaria transmission.

Future Plan:

1. There will be more samples collected in the following year.

2. Evaluation of LAMP for diagnosis of malaria at field clinics will be started in May 2007.

3. More malaria antigens of different developmental stages will be prepared and used for screening of vaccine candidates.

Strengthening Malaria Surveillance System In Central Java Province Phase 2, Implementation.

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Vector Borne Diseases Control Ministry of Health Indonesia, Central Java Provincial Health Office, Wonosobo District Health Office, Pekalongan District Health Office.

ABSTRACT

This phase is a continue action from phase 1 research, which is implementation phase. Implementation phases only be taken in Wonosobo district as case site. On implementation phase, training were conducted among 18 VMAs from 2 villages (Turip and Somogedhe villages). These areas are selected due to the most endemic areas and the remotes from health center. There are no implementation action conducted in Pekalongan district as control site.

Training were conducted for 4 days, in health center. Before training, there were preparation activities, such as meetings at district up to village level. The meetings concluded sites selection and gaining commitment. The syllabus for training included malaria case finding and detection, malaria case management, malaria diagnostic, malaria treatment, follow up cases, counseling, migrant surveillance, reporting and recording, and health education. These materials will prepare the VMAs to conduct community base surveillance system. After training, VMAs were equipped with RDTs and conducted the activities on daily activity basis.

Malaria program officer conducted supervision to examine the activities of

VMAs. Since training, VMAs successfully found 383 clinical cases and tested them with RDTs, resulted 10 positive cases. All positive cases got cure within a day. VMAs also took blood slide from all migrant workers who came from other places.

In conclusion, VMAs have many important roles to establish community base surveillance system. The roles are: increasing accessibility the community to medical help, taking fast respond due to monitor the environmental condition surrounding patient's houses, increasing awareness of the community to malaria prevention program, reporting cases to health center.

This phase recommends to evaluate community base surveillance system comprehensively regarding sustainability of the system, and also to narrow objective to find proper indicator for malaria surveillance especially in very low endemic areas.

Phase I Results

It is indicated that malaria incidence in Central Java has been decline. The Annual Parasite Incidence (API) in 2002 is 1.44 ‰, decreases to 0.51‰ in 2003, and 0.07 ‰ in 2005. Although, within Central Java, API of Wonosobo District is still the highest among other districts, which is 0.62 ‰ in 2005. This district has ecological conditions that support to increase the number of breeding places potentially.

In phase I study, there were two main groups assessed in both case and control groups by using qualitative research method. The first group was health workers who in charge in malaria case detection and malaria surveillance. The second group was Village Malaria Agents (VMA). VMAs are community member that have been trained specifically by health workers for detecting malaria case at village level and case investigation.

VMAs and malaria cadres have important rule in community based-malaria detection. They can detect malaria incidence among the community and treat the patients immediately. Malaria program officer of health center can supervise VMAs and malaria cadres and also collects and analyze data from

VMAs. Malaria program officer of district health office can measure the impact of malaria surveillance among the community. District officer also can support the community with technical assistants and arrange some budget from local government.

Community base surveillance system can detect malaria incidence directly from the community and also can increase the awareness of malaria incidence. Community base surveillance system is carry out by VMAs as a part of community participation actions. VMAs would collaborate with Health Center and District Health Office.

Phase 2 study will focus on community base surveillance system through implementation of study's intervention program. Intervention program for phase 2 study are trainings for VMAs, on the job training, monitoring and evaluation activities.

INTRODUCTION

Malaria is a world wide public health problem, mainly in Africa and South East Asia. In Indonesia, Malaria is third leading cause of death in the Eastern Provinces of Indonesia. It is estimated that 15 millions clinical cases occur yearly resulting in 23,483 deaths (National Health Household Survey 2001)

Malaria Control Program has been established in Java and Bali Region by fully laboratory confirmation for all suspect malaria cases. Positive cases will be treated with prompt anti malarial drugs. As a result, morbidity and mortality in Central Java has decrease significantly. The API is decreasing dramatically from 1.44 ‰ in 2002 to 0.06 ‰ in 2007. Similarly, Wonosobo and Pekalongan Districts indicate that API for both districts decrease every year. It can be seen in table. 1.