

**MINISTRY OF EDUCATION AND TRAINING MINISTRY OF HEALTH  
NATIONAL INSTITUTE OF MALARIOLOGY PARASITOLOGY  
AND ENTOMOLOGY**

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**CURRENT STATUS OF OPERATION MICROSCOPY  
SITE AND EFFICIENCY MEASURES OF IMPROVING  
DETECTION OF MALARIA PARASITES UP  
IN THE NORTHWEST REGION (2011-2012)**

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## BACKGROUND

Malaria has been recognised as a human disease for thousands of years and remains one of the most common diseases affecting humans worldwide. Half the world's population is exposed to the risk of getting malaria infection. As well as its direct health cost, it carries a significant economic burden in countries where there is endemic disease. The goal of malaria control is to prevent mortality and reduce morbidity and social and economic losses. Basic technical elements of the malaria control strategy are: to provide early diagnosis and prompt treatment. Malaria control program in Vietnam focused on epidemiology surveillance which including diagnostic, case management, planning and prevention. Assessment of malaria microscopy is an important element in the quality of malaria diagnostic.

The first suspicion of malaria is usually based on clinical symptoms. In a number of cases of malaria diagnosed based on clinical symptoms, resulting in patients with fever despite not yet been tested as treatment of malaria patients. Patients with fever were treated antimalarials leads to patients with other acute diseases are also treated as malaria. Diagnosis of parasites by microscopic examination under a microscope smear is still the method of choice and is the "gold standard". Examination of malaria parasites is important in epidemiological studies and experimental malaria drug resistance. In recent years the number of malaria patients in the North West Province region at a high level. However, the parasite was detected compared with the number of inappropriate case ratio parasite/ case very low. For the reasons stated information and analysis on the comprehensive review of the operation of the microscope site and take measures to improve the quality of the operation microscope location, demand response prevention and eliminate malaria in the new phase is essential.

The thesis aims of:

*1 Describe the situation of operation microscope location in the North West Province area.*

*2 Evaluation of the effect some interventions improve the quality of detection of malaria parasites in the study sites.*

## CHAPTER 1: OVERVIEW

### 1.1. History of malaria

In 400 BC, Hypocrates described the clinical symptoms of malaria, "Malaria - hot" and show the disease-related factors such as disease occurrence time of year, where patient survival.

In 1880, images of malaria parasites (parasitemia) was discovered and described for the first time by Laveran in the blood of patients. In 1890, Romanovski discovered stained malaria parasites by Green - and Eosin methylene (Giemsa staining) and he also described the technical analysis of malaria parasites.

Malaria has been mentioned in the literature Vietnam from the thirteenth century. Tue Tinh wrote about a cure "reverse disability" (ie malaria).

### 1.2. Malaria spread

#### **Figure1.1. The process of transmission malaria**

For malaria prevention to be effective, it needs to cut transmission the disease process. In which killing germs is the best method, so that diagnostic tests play an important role in prevention and elimination.

### 1.3. Malaria in the world

Malaria different in each country, depending on natural conditions, biological, economic factors, low education, transportation difficulty, residential mobility, to develop economic projects such as hydroelectric, forestry. In 2009, The World Health Organization reported that 107 countries and territories with malaria, estimate 3.2 billion people. Every year have been between 350 - 500 million patients and more than 1 million people die from malaria, mostly women and children in Africa.

### 1.4. The situation malaria prevention program in Vietnam

Time from 1958 -1975: Due to the Vietnam should be divided two part North and South:

- North: 1958 - 1961 preparation periods: 1961 - 1964 attacks; 1965 - 1975 offensives. Parasite prevalence of 5 / 10,000 population
- South: 1958 -1959 preparation period: 1960 -1964 attacks period; 1965 - 1975 offensive end. In 1980 malaria was rising in many provinces in mountainous and coastal areas, with 1,138 people dying from malaria. In 1992, the Amsterdam conferences call on controlling malaria worldwide. From 1992 - 1995 malaria control program has done best the goal of reducing death,

reduced translation, reduced suffering (in Vietnam from 144 malaria cases in 1992 to 1995 had 2 outbreaks of malaria). Period from 1991 to 2000 decreased the number from 1.091 million patients to 293 016 in 2000 to 2004 was 128 622 patients. 2004 did not have malaria.

### **1.5. Malaria situation in the North West Province region**

Currently, the North West region remains one of the areas with severe malaria endemicity. In the North West in recent years found only 2 species *P. falciparum* and *P. vivax*, the percentage change in each period.

Despite achieving considerable success in recent years, but the malaria situations of the North West region is unstable, the risk of an outbreak is very high. People's habit going to the forest, sleeping **behavior** is also risk factors for malaria infection increases in **some** ethnic groups.

### **1.6. The assay malaria parasites present**

- QBC technique (Quantative Buffy Coat)
- Acridine Orange staining technique - AO
- Rapid diagnostic method using test strips (Rapid Diagnostic Tests - RDTs)
- Test the indirect fluorescent antibody (IFAT - Indirect Fluorescent Antibody Test)
- Test indirect hemagglutination (IHA - Haemoagglutination Indirect Assay)
- Immune precipitates (Immuno - Precipitation Techniques)
- Absorb enzyme-linked immunosorbent assay (ELISA)
- Polymerase chain reaction technique (PCR)
- DNA hybrid technique (Hybrid DNA Technology)
- Examination of a blood smear stained with Giemsa and examined under a microscope:

In 1880 the first time Laveran was discovered the parasite by Giemsa staining method and examined under a microscope. Although at present there were some technical and immune sera for diagnosis of malaria parasites, but mostly based on microscope and blood smear to determine the species of parasite. Laboratory diagnosis by microscopic examination of stained blood films continuous to be the method of choice, or the common reference standards, for case management and epidemiological reseach, WHO considered as the gold standard.

### **1.7. The reseach of microscopic sites**

#### ***1.7.1. The reseach of microscopic sites of the world***

In Africa since 1997 have been established systems for early detection of malaria. Early diagnosis and treatment are fundamental elements of the national malaria control program. The correct diagnosis, early diagnosis at facility medical help for timely treatment is. Astrategic that organizations established the microscopy site help diagnose, in order to reducedd the mortality and malaria, patients management. The term "malaria detection post" (MDP) has emerged from the first period of the malaria **eradication** in Mexico, guatemala. In the United States, MDP is called: information post for fever cases (IPFC).

In recent years the research mainly focused on technical issues equipment, introducing microscope and testing. However, some research also showed the limitations of malaria diagnosis by microscope:

- Lack of policies for the development of laboratory services. Lack of funding for malaria diagnosis.
- Poor quality microscope. Difficulty in maintaining the operation microscope in good condition. The problem of high cost in maintaining adequate equipment and chemicals
- Training and retraining of staff not good. Delays in providing test results for treatment. Lack of quality assurance and laboratory monitoring

These limitations can be overcome if there is a clear policy and realize the importance level of laboratory services. There should be adequate funding and equipment for quality assurance systems.

### ***1.7.2. Microscopy site in Vietnam***

In Vietnam, the term "Microscopy site" has meaning to detecting malaria. Microscopy site in Vietnam was established in the commune health centers, polyclinics or district health center, some provinces have put in Microscopy site with military. Microscopy site integrate and coordinate activities with other health programs, direct service for the diagnosis and treatment of malaria. As reported by the National Malaria Control Program, Vietnam has 2803 Microscopy site .

The identification of malaria parasites based on tests will increase the rate of parasite/ patients, reduced costs for treatment. However, identifying parasites dependent on the ability and quality microscopist and Microscopy site activity.

### ***1.7.3. Microscopy site in the North West of Vietnam***

Time from 1992 - 1995 in the North West region and the Northern mountainous region has some little the Microscopy site, only in regional polyclinics. Currently, a total of 268 Microscopy sites in district and commune. In Lao Cai, Dien Bien and Lai Chau provinces also Microscopy site of military medical.

## ***1.8. Quality assurance in laboratory***

Regular assessment of laboratory capacity has a great influence on the quality of treatment for patients.

The fact that even in the best conditions there is no test is perfect, quality assurance laboratory total many problem of the effects of quality control and quality assessment. To help clinicians for diagnosis and timely treatment the laboratory must be able to test and the results reliable, accurate, clear and comparable between laboratories.

Quality assurance includes:

- Internal Quality Control (IQC), External Quality Assessment (EQA).
- Monitoring and standardization of skills.

The Microscopy site in Vietnam is evaluated based on the external quality assessment monthly (cross – checking), quarterly to the higher level. However, direct monitoring and evaluation activities in Microscopy site often very limited (due to limited financial resources).

## **CHAPTER 2: METHODOLOGY**

### **2.1. Study sites**

The research was conducted in the provinces of North-West region, including 6 provinces: Hoa Binh, Son La, Dien Bien, Lai Chau, Lao Cai and Yen Bai. This area is still malaria endemic in the moderate and severe.

### **2.2. Research period**

The research was conducted in 2 years: from May 2011 to March 12/2012.

- From May 5-7 / 2011: Select microscopy sites at 6 Province to surveillance and assessment of activities in the microscopy site and malaria situation in five years from 2007-2011.

- From July 2011 to December 2012, select the microscopy site of Muong Te districts (Lai Chau), Muong Cha, Tuan Giao (Dien Bien), Van Chan (Yen Bai) to assessment the effectiveness of intervention in microscopy sites.

- From July 2011 to December 2012: Conducting interventions and assessment the effectiveness of interventions in the microscopy site, we compare and assessment the Microscopy site of Son La, Lao Cai and Hoa Binh province.

### **2.3. Subjects**

A number of concepts:

- The microscopy: Health facilities have the microscope serves malaria prevention (except in provincial).

- Examine: including medical staff (doctors, technicians, midwives, nurses, nurse, midwife ...) reading slide of malaria parasites.

#### **2.3.1. The microscopy site**

- The microscopy site commune, commune.
- Records and reports stored malaria-related activities.

#### **2.3.2. Assessment microscopy site**

All the microscopist in the microscopy site was selected.

#### **2.3.3. Equipment and chemicals:**

- Chemicals:
- + Giemsa

- + Buffer solution
- + Oil immersion
- + Methylc

Microscopy site:

- Instruments used in microscopy site: slide, glass, pH paper, pipettes, cylinder...
- Document for list of patients
- List of tests
- Other documents in microscopy site.

## **2.4. Study methods**

### **2.4.1. Research design: on - site evaluation**

- Assessment the Microscopy site from 2007 to 2011
- Survey and describe the current status of the activity in Microscopy site
- Research and controlled intervention:
  - + Comparing before and after conducted the intervention in the Microscopy site
  - + Compared to other Microscopy site in another provinces: Son La, Lao Cai and Hoa Binh.
  - + Assessment the efficacy of the measures after 6 months, after 12 months and after 18 years conduct the intervention.

### **2.4.2. Sample size and sampling methodology:**

- \* Sample size:
  - Assessment of sample size: 30 Microscopy site conduct select (including Microscopy sites in commune), according to the random method.
  - Assessment effectiveness: Select 30 Microscopy site in the research sites.
  - + Select 2 groups
  - + Intervention group:
    - Select 3 provinces including Lai Chau and Dien Bien is high malaria endemic areas, Yen Bai has moderate malaria.
    - In this province there are Dien Bien and Lai Chau have investment of the Global Fund Project, Yen Bai province has't project.
    - 15 Microscopy site in commune and in the district of Lai Chau, Dien Bien and Yen Bai.
  - + Non-intervention group:
    - Select 3 provinces including Son La, Lao Cai is high malaria area, Hoa Binh is moderate malaria area.
    - In the three provinces controlled Lao Cai and Son La provinces have invested the Global Fund Projects, Hoa Binh province has't project.
    - Select 15 Microscopy site in Son La, Lao Cai, Hoa Binh to control.

\* Sampling method:

Sampling for assessment of activities in the microscopy site

- Make a list of the district provinces, in each province select two districts, a total 12 districts/6 provinces.



- + Make a list of the Microscopy site of 12 districts
- + Calculate the sampling interval randomly select 30 microscopy sites.
- + Total 12 districts and 30 communes Microscopy site to assess the situation.
- + List Microscopy site assessment and intervention (Appendix 10)
- Select to assessment the effectiveness of intervention measures:
- + 2 districts of Dien Bien is severe malaria area and moderate district including Muong Cha and Tuan Giao districts, a total of 7 microscopy site.
- + 1 districts of moderate and severe malaria in Lai Chau: Muong Te district, a total of 5 microscope sites.
- + 1 district, Yen Bai province: Van Chan district, total 3 microscopy sites.
- Assesment compared to the Non-intervention: 15 Microscopy site in Son La, Hoa Binh, Lao Cai:
- + Son La: Moc Chau and Song Ma district, total 6 microscope sites
- + Lao Cai: Assesment in Sa Pa and Bat Xat district, total 4 microscope sites.
- + Hoa Binh: Assesment in Lac Son and Da Bac districts, total 5 microscopy sites.

### **2.4.3. Contents research:**

#### *2.4.3.1. Performance assessment*

- \* Human Resources at microscope sites:
  - The number of people working in the laboratory
  - Age, gender of microscopist
  - The training microscopist:
    - + Beginner, intermediate, college, university
    - + Training attended recently
    - Where professional training
    - Training: 3-5 days, 2 weeks, > 5 weeks.
    - Number of years of experience working as a microscopist
    - Allowance, currently enjoying toxic
    - Microscopist has more jobs part-time (out of parasite testing)
    - The average number of slides read/month, read/day.
- \* Equipment in microscopy site.
  - Microscopes:
  - Chemical tests:
  - Testing tools:
    - Rapid diagnostic test
  - Bench space:
- \* Activity in microscope site
  - Population in area
  - The number of detected slides/ month / year
  - The percentage of the total number of positive/patient.
  - The percentage of slide positive
  - The annual parasites

- The annual smear tests
- Number slide taken the initiative through epidemiological surveillance, passive some slide in the patients examined at medical facilities.
- Time to answer the result (hours, days)
- Acute treatment
- Send slide to cross - checking
- The percentage of errors slides
- Slides poorly stained
- Bio-security practices.
- \* Skills of laboratory tests at Microscopy site
- Slides stained, slides storage, record keeping
- Skills reading slide (based on the slide set)
- \* Review the level of theory test
- \* Supervision:
  - Number of times the route on the basis of 1 year supervised
  - Activity monitoring, content monitoring of Microscopy sites to village health workers.
- \* The people go to microscopy sites :
  - Distance from microscopy site to the neighborhoods (in km - interviewed health workers).
  - Time away from residential areas farthest to microscopy site (depending on vehicle)
  - Duration of test work at Microscopy site (hours).
- 2.4.3.2. *Research interventions improve the quality of detected parasites:***
  - Group intervention in the district microscopy site
  - Controls: Microscopy site in Son La, Lao Cai, Hoa Binh.
- \* The intervention
  - Provides equipments, chemicals
  - Training for microscopist, supporting training for new microscopist.
  - Coordinate Lai Chau, Dien Bien, Yen Bai provinces for the microscopist training in microscopy site .
  - Periodically check the microscopist skills reading slide (6 month/times).
- 2.4.4. *Techniques applied in research***
  - Skills detection parasites by microscope (Giemsa staining)
  - Measurement of pH
  - Surveys and interviews microscopist
- 2.4.5. *Indicators and assessment methods in research***

The quality microscopes

  - Good:
    - + Objective lenses, eyepieces are not fungi, mold, scratches.
    - + The stage movement mechanism is precise and stable
  - Normal: When one or more of the details is not guaranteed, but can read the parasite.

- Failing, needs repair: burning bulbs, screws tight macro level and micro-adjustable difficulty levels, at peripheral, dirt and dust in the field, fuse broken.
- Do not use:
  - + Failed microscopy can not be used to detect parasites.
  - + Eyepiece have fungi.
- Skills of microscopist:
  - Skills prepared thick blood smear
  - Skills prepared thin blood smears.
  - Prepare buffer solution
  - Prepare Giemsa.
  - Staining and wash.
- Quality of Giemsa stained blood smears
  - \* Thick slide:
    - Dimensions: slide blood diameter 1.0 to 1.2 cm.
    - Thickness: can read the text of the paper when put blood smear on paper.
    - Stain slide: right and enough time.
    - Wash: the field clean, no residue of Giemsa.
    - Each field has 15-20 white blood cells
    - Slide label: code smear test the same in list.
  - \* Thin slide:
    - Dimensions: length from 2 to 2.5 cm
    - Stain: right and enough time.
    - Wash: the field clean, no residue of Giemsa.
    - Red blood cells are single on slide.
    - Thin smears without air, not fat
    - Slide label: code of smear the same with list paper.
- Quality assessment slide:
  - Slide has 5 or more point.
  - Fail: The from 0-4 point
- Assessment test results reading slide
- Examiner reading the slide set:
  - The first assessment: 5 slides (according to routine evaluation of project microscopy sites of Global Fund).
  - The next time: assessment use 10 slide according to WHO
  - Slide set assessment including *P. falciparum*, *P. vivax*, *P. malariae*, mix slides and negative slides.
  - Agreement: The microscopist' answers like results of the slide set.
  - False:
    - + False negative: slide positive (+) but the answer is negative (-)
    - + False positive: slide negative (-) answer is positive (+)
  - Lack of malaria parasite stages:
- + Slide detect only one species (slide mix parasite)

+ Slide infection only one but answer is mix.

Grades:

- Each slide correct: 3 points.
- Lack or excess strain: 1 point
- Slide error: 0 points

Following levels:

\* Achieved and not

- Scoring: Total scores > 7 points (> 70%), not being wrong. Allowed to be lack of stage.

- Fail:: Total score <7 points (<70%).

\* Ranking:

- Good: > 90% points
- Acceptable: 70% - <90% points
- Unacceptable: 50% - <70% points
- Weak: less than 50% points

\* Results theory test:

Design theory questionnaire (Appendix 9).

- Questionnaire about parasite's form
- The prepare buffer solution and Giemsa
- Check 10 questions, each correct answer 1 point
- Total points of each microscopist.
- Ranking and evaluation as read slide.

2.4.5.2. Assessment interventions

- Skills to prepared slide
- Skills detected parasites.
- How much time to answer the test
- Take blood smear findings active and passive in Microscopy sites

## **2.5. Data analysis**

- Data collected is analysed with EPI INFO and Excel
- Using statistical methods, comparison and analysis of qualitative data.
- Use the biomedical statistical test to evaluate the effectiveness

## **2.6. Error and controlling**

### **2.6.1. Error:**

- The retrospective data, collected may be wrong by collecting and reporting at each Microscopy site different.
- Error code error checking slide.
- Interviewed microscopist: local language, recall bias, ethnic language.
- Errors in the assessment process.

### **2.6.2. Error controlling:**

- The questionnaire was designed and edited, used before conducting the interview.
- Training for staff.

- Required the time answer the results.
- Coordinate with provincial staff fluent ethnic interviewing the microscopist.

### **2.7. Research materials and data collection:**

#### **\* Questionnaire:**

Questionnaire was developed based on the activities of microscopy site and capacity of staff working in laboratory, especially service diagnosis, treatment and management patients.

#### **\* Questionnaires:**

- Questionnaires is based on the theory test training.
- Questionnaire design brief
- Consists of questionnaires
- + Select the correct answer
- + Simple question
- \* Designed the standard slide (slide set), assessment skills of microscopists
- Slide set was made in NIMPE
- Slide set 1 including: 5 slides (including thin and thick smear), staining Giemsa 4% for 45 minutes (in the routine).
- The next slide set: 10 slide including thin and thick smears staining Giemsa 4% for 45 minutes (in the routine).
- The slide set include: *P.f*; *P.v*; *P.m*, mix and negative slides.
- Slide was coded before to testing

### **2.8. Ethical in reseach:**

- Strictly abide by the ethical rules in biomedical research.
- The data and findings use to medicine.
- This research improving the quality of diagnosis and treatment in microscopy site enable early detection and timely treatment benefit health, economic, social, ethnic people of the North - West.
- Outline of the thesis was passed in the Assembly ethical of biomedical research of NIMPE.

## CHAPTER 3: RESULTS AND DISCUSSION

### 3.1. Malaria situation and activities of the microscopy site in 6 Province

#### 3.1.1. Malaria situation in the provinces research 2011

##### *Hình 3.1. Patients and parasites in province year 2011*

Number of patients in 5 years was reduced 57.66 %, from 11,365 to 4,820; parasite reduced 84.72% from 707 to 108. The ratio of parasite/patients is low 2.24%; This ratio in the Central – Highland provinces higher than: 69.21%

##### *Figure 3.3. The species of the parasite in year 2011-2012*

The separated of the parasite in 2011 compared in 2012, there has been a change. The percentage of *P. falciparum* - infected patients in 2012 reduced compared to 2011 (24.76% and 28.7%), the proportion of patients infected with *P. vivax* decreased significantly in 2012 compared with 2011 (64.8% and 65.7%). In 2012 the number of patients infected with parasites coordination higher than 2011 (10.6% and 5.56%)

### 3.1.2. The network of microscopy site in the provinces

**Figure 3.3. Distribution microscopy site in the provinces reseach**

Province	Total	Microscopy site in							
		District		Commune		Clinic		Other	
		SL	%	SL	%	SL	%	SL	%
Lai Chau	38	7	18.4	18	47.4	12	31.6	1	2.6
Dien Bien	34	9	26.5	8	23.5	17	50.0	1	3.0
Son La	59	22	32.4	45	66.1	0	.0	1	1.5
Lao Cai	33	8	24.2	14	42.5	11	33.3	0	0
Yen Bai	66	9	13.6	47	71.2	10	15.2	0	0
Hoa Binh	38	11	28.9	24	63.2	3	7.9	0	0
<b>Total</b>	<b>268</b>	<b>66</b>	<b>24.6</b>	<b>156</b>	<b>58.2</b>	<b>53</b>	<b>19.8</b>	<b>3</b>	<b>1.1</b>

The number of microscopy site in commune for 58.2%; for 24.6% in district. Each district has from 1 to 2 sites, each district in Son La have 2 site in district (District 1 of PMCs, one of the district hospitals).

**Table 3.4. The coverage of microscopy site in research provinces 2011**

Province	Total site	Population	Population/site	Number commune/ site
Lai Chau	38	350,143	9214	2.58
Dien Bien	34	404,626	11901	3.29
Son La	59	1.125,403	19075	3.49
Lao Cai	33	621,076	18,820	4.97
Yen Bai	66	761,567	11,539	2.73
Hoa Binh	38	825,593	21,726	5.53
<b>Total</b>	<b>268</b>	<b>4,088,408</b>	<b>15,255</b>	<b>3.62</b>

Population/ microscopy site change, the highest about 21 thousand people in Hoa Binh, Lai Chau in each microscopy site have a population of less than about 10 thousand people. Each microscopy site change from 2 to 6 communes (2.58 to 5.53 communes).

Coverage of microscopy sites equivalent: 3.7 commune/ microscopy site (Country), coverage in Dak Lak is 1.95 commune/ microscopy site, Ninh Thuan 1 Commune / microscopy site

**Figure 3.5. Distant and time from the site to people**

Province	Distant (km)	Time (hours)
Lai Chau	21.75	1.3
Dien Bien	39.8	1.5
Son La	22.57	1.3
Lao Cai	15.2	0.8
Yen Bai	8.17	0.5
Hoa Binh	21.0	0.8
<b>Total</b>	<b>21.07 (± 17.59)</b>	<b>1.4</b>

Some distance from residential areas to microscopy site so far, averaging 21.07 km. microscopy site service scope of general relativity, the distant farrest is 90 km. Time to go to microscopy site average from 0.5 hours to 1.5 hours (depending

vehicles). Compared with research in Central - Central Highlands is nearer ( $10.82 \pm 10.06$  km).

**Figure 3.6. Number microscopy sites in province, from 2007 - 2011**

Province	Number microscopy site of the years				
	2007	2008	2009	2010	2011
Lai Chau	27	32	36	37	38
Dien Bien	30	33	34	34	34
Son La	44	45	53	55	59
Lao Cai	27	27	27	33	33
Yen Bai	64	66	66	66	66
Hoa Binh	32	34	34	34	38
<b>Sum</b>	<b>224</b>	<b>237</b>	<b>250</b>	<b>259</b>	<b>268</b>

The microscopy site after 5 years (2007-2011) has increased by 44 microscopy site (19, 6%), Lai Chau and Son La provinces are 2 microscopy site number of newly formed most: Lai Chau: 11, Son La: 15. at Dien Bien little extra: 4 microscopy site .

**Figure 3.4 . Slide active detection and passive in the microscopy 2011 - 2012**

The rate of detection of active and passive disease disproportionately, slide collect initiative only a verysmall part, of slide collect actively between provinces. The ratio slides collected initiative from 2007 to 2011 reducedd from 34.4% to 21.92%.

**Table 3.8. Time to send slides for cross - checking**

Province	1 month	3 month	6 month	Total
Lai Chau	3	1	0	4
Dien Bien	3	1	1	5
Son La	7	0	0	7
Lao Cai	3	1	1	5
Yen Bai	6	0	0	6
Hoa Binh	3	0	0	3
<b>Sum (rate %)</b>	<b>25 (83.33)</b>	<b>3 (10.0)</b>	<b>2 (6.67)</b>	<b>30 (100)</b>

There are 83.33% microscopy site send slides to checks monthly under the provisions of malaria control programs.



At some microscopy site sending slides to checks too late (Lao Cai, Dien Bien) send quarterly checks slide 1 month/time: 10.0%; 6 month/time: 6.67%.

### 3.1.3. Human resources in the microscopy site

#### *Figure 3.8. Years of experience of microscopists*

The ratio of microscopists experienced more than 5 years accounted for 46.67% is relatively high, microscopist have training in the last 2 years (13.33%).

**Table 3.9. Training address and training times**

Province	Training address			Time training		
	NIMPE	Medical schools	Other	≥ 5 week	1 < 5 week	< 1week
Lai Chau	0	4	0	3	1	0
Dien Bien	0	3	2	1	2	2
Son La	1	6	0	2	3	0
Lao Cai	0	4	1	2	0	4
Yen Bai	0	4	2	2	4	1
Hoa Binh	0	3	0	0	3	0
<b>Sum</b>	<b>1</b>	<b>24</b>	<b>5</b>	<b>10</b>	<b>13</b>	<b>7</b>
<b>Rate (%)</b>	<b>3.3</b>	<b>80.0</b>	<b>16.67</b>	<b>33.3</b>	<b>43.3</b>	<b>23.4</b>

Almost microscopists trained medical professionals at medical schools in provinces: 80%; rate microscopists trained in laboratory techniques at the NIMPE low as 3.3%; in other places is 16.67%. Number microscopists have training significant proportion (23.4%). Only 33.3% of the microscopists trained enough time. WHO guidelines: the time training to detect malaria parasites is 5 weeks for new trainee, such training is not enough time as required.

#### *Figure 3:10. The microscopists to be retrained*

40% microscopists to be retrained late 1 year, 33.3% microscopist not be retrained, with 10% microscopists be retrained over 3 years ago.

According to WHO the microscopist receive regular training 3 years/times, the microscopist not often the training will affect to the quality of detection parasite.

### 3.1.4. Facilities at the microscopy site

**Table 3:11. Bench space and lighting in the microscopy site**

Province	Number	The room		Lighting	
		Private	Common	Acceptable	Unacceptable
Lai Chau	4	0	4	4	0
Dien Bien	5	2	3	5	0
Son La	7	0	7	6	1
Lao Cai	5	2	3	5	0
Yen Bai	6	6	0	5	1
Hoa Binh	3	0	3	3	0
<b>Total (%)</b>	<b>30 (100)</b>	<b>10 (33.3)</b>	<b>20 (66.7)</b>	<b>28 (93.3)</b>	<b>2 (6.7)</b>

The survey results showed that 66.7% site not have private laboratory which place together with other activities at the health facility (the examination, bookkeeping, common clinic ...). In Yen Bai the laboratories are located private. Most laboratories are guaranteed lighting. Only 6.7% is not sufficient laboratory lighting (in Son La and Dien Bien).

### **Figure 3.13. Quality microscope in the microscopy site**

Some facilities have 2 microscopes to detect parasite and TB test. In total 36 out of 30 sites 5.6% microscopy sites currently failed, need repairs and replacements of 2.8%, better rate is relatively high: 63.9%.

Compared to the amount of microscopy in Central - West Highlands, the number of microscopy quality in the North West region is much lower, while only 3.06% microscopy Central - West Highlands and 96.94% satisfactory good glass, the glass in the Northwest of satisfactory (normal type) accounted for 27.8%. The results of the assessment in 2010 [46] showed that the rate microscopy higher quality (74%).

### 3.1.5. Tools, chemicals in the microscopy sites

**Table 3:13. Kits and tools used chemical testing**

Province	Number site	Tools set	Tools			
			Cylinder	pH paper	Pipet	Drying rack
Lai Chau	4	4	4	1	2	4
Dien Bien	5	5	4	2	4	5
Son La	7	7	6	0	5	7
Lao cai	5	5	4	0	5	4
Yen Bai	6	5	3	0	4	3
Hoa Binh	3	3	2	2	2	2
<b>Total (%)</b>	<b>30 (100)</b>	<b>29 (93.3)</b>	<b>23 (76.7)</b>	<b>5(16.7)</b>	<b>22 (73.3)</b>	<b>25 (83.3)</b>

93.3% microscopy site have tools set, a little have't tools set (6.7%). The microscopy site of Lai Chau, Dien Bien, Hoa Binh has tools set. Especially with only 16.7% microscopy sites have pH paper.

### 3.14. Microscopy site have equipment

Province	Number site	Timing clock	Counter	Bench AIDS	Slide set
Lai Chau	4	1	3	2	1
Dien Bien	5	2	2	4	1
Lao Cai	5	0	0	5	3
Yen Bai	6	0	3	4	6
Son La	7	0	1	2	2
Hoa Binh	3	0	1	3	1
<b>Total (%)</b>	<b>30 (100)</b>	<b>3 (10,0)</b>	<b>10 (33,3)</b>	<b>20 (66,7)</b>	<b>14 (46,7)</b>

Most of microscopy site have tools set but lacks many tools in service for testing, only 10% of microscopy site with timing clock. 46.7% microscopy site with the slide set, 66.7% had bench aids parasite.

**Table 3.15. Microscopy site have chemicals to testing**

Province	Number site	Buffer	Adjusted solution	Giemsa	Oil immersion
Lai Chau	4	2	2	2	4
Dien Bien	5	3	3	4	5
Son La	7	2	2	7	7
Lao Cai	5	1	1	4	5
Yen Bai	6	2	2	6	6
Hoa Binh	3	1	1	3	3
<b>Total (%)</b>	<b>30 (100)</b>	<b>11 (36.7)</b>	<b>11 (36.7)</b>	<b>26 (86.7)</b>	<b>30 (100)</b>

36.7% microscopy site have not to prepare buffer solution, 100% enough oil immersion, 13.3% lack of Giemsa. In the microscopy site of Son La, Hoa Binh, Yen Bai do not have enough Giemsa to use.

### *3.1.6. Skills of microscopist in the microscopy sites*

**Table 3:16. Skills to prepared and staining blood slide**

Province	Number	Prepare slide acceptable		Staining acceptable		Wear gloves
		Thick film	Thin film	Prepare Giemsa	Staining	
Lai Chau	4	3	2	0	0	3
Dien Bien	5	3	2	1	1	2
Son La	7	5	1	3	6	4
Lao Cai	5	4	1	0	1	3
Yen Bai	6	3	3	3	3	4
Hoa Binh	3	3	2	1	2	0
<b>Total (%)</b>	<b>30 (100)</b>	<b>21 (70)</b>	<b>11 (36.7)</b>	<b>8 (26.7)</b>	<b>13 (43.3)</b>	<b>16 (53.3)</b>

Prepare thick smear acceptable 70.0%, many microscopist of Son La, Yen Bai prepare not good. Techniques made thin smear is poorly, only 36.7% microscopist.

There are 53.3% microscopist wear gloves when taking a patient's blood. 73.3% make Giemsa solution incorrect, 100% microscopist of Lai Chau and Lao Cai make Giemsa solution correct. Staining accept for 43.3% (unaccept 56.3%).

H. Yousofi Darani research in Iran: check 3783 slide showed ratios good quality very low: 34.0%.

Le Khanh Thuan research in Central - West Highlands: ratio slides good quality 65.78%.

### *Figure 3:15. Check theory for the microscopist*

The result shows that the microscopist don't understand the theory, 13.3% microscopists scored weak, medium for 53.7%, only 13.3% is good

### 3.2. Effective of improve the quality detection malaria parasites (2011 - 2012)

**Table 3.23. The result of theory test**

Time	Number test	Intervention		Non-intervention		P
		Incorrect	Rate %	ncorrect	Rate %	
Prior intervention	150	61	40.67	58	38.67	0.05 <sup>∇</sup>
		$\chi^2 = 0.125$				
After 6 month	150	42	28.0	53	35.33	0.05 <sup>∇</sup>
		$\chi^2 = 1.864$				
After 12 month	150	30	20.0	47	31.33	0.05 <sup>^</sup>
		$\chi^2 = 5.049$				
After 18 month	150	5	3.33	42	28.0	<sup>^</sup> 0.05
		$\chi^2 = 60.917; p < 0.05$ $p > 0.05; \chi^2 = 3.84$ $\chi^2 = 7.945; 95\% CI = 0.3295 - 0.8327$				

10 questions for each microscopist (total 150 questions for each group).

After 6 month in the intervention group the ratio answer incorrect decreased from 40.67 % to 28.0 %. In the Non-intervention group the ratio decreased from 38.67% to 35,33%.

After 6 month the ratio answer incorrect in the intervention group decreased from 20.0%. In the non-intervention group 31.3 % ( $p > 0.05$ ).

After 18 month in the control microscopy sites decreased from 38.67 % to 28.0% ( $p > 0,05$ ), in the intervention group decreased 3.33%, lower than the non-intervention group ( $p < 0.05$ ).

#### 3.2.3. Results improve skills in the practice of microscopist

**Table 3 24 Number thick blood smear unacceptable**

Time	Number slide	Intervention		Non-intervention		P
		Number slide	Rate %	Number slide	Rate %	
Prior intervention	75	33	44.0	32	42.67	$> 0,05$
		$\chi^2 = 0.027$				
After intervention 6 month	75	15	20.0	26	34.67	$< 0,05$
		$\chi^2 = 14.246$				
After intervention 12 month	75	10	13.33	27	36.0	$< 0,05$
		$\chi^2 = 10.368$				
After intervention 18 month	75	9	12.0	22	29.33	$< 0,05$
		$\chi^2 = 19.048; p < 0.05$		$\chi^2 = 2.894; p > 0.05$		
		$\chi^2 = 6.872; 95\% CI = 0.2018 - 0.8291$				

Check the skill make thick smear: practice make 5 slides (blood negative). 15 microscopist in microscopy site intervention will do 75 slides and 75 slides in non-intervention group.

After 6 months, the rate thick smear in the intervention group decreased from 44.0% before the intervention to 20.0%, the control group also decreased from 42.67% to 34.67%, however, the degree of reduction in the intervention group was lower than non-intervention group ( $p < 0.05$ ).

After 12 months, the rate of blood smears unacceptable in the control group despite reduced to 29.33% but no meaning ( $p > 0.05$ ). This rate in the intervention group decreased 13.33%, much lower than the non-intervention group ( $p < 0.05$ ).

After 18 months, technique prepared thick smear showed that the intervention group was much better than before, the rate fell from 44.0% slides to 12.0% compared with 29.33 % of the non-intervention group ( $p < 0.05$ ).

**Table 3. 25. Number of thin slides unacceptable**

Time	Number slide	Intervention		Non-intervention		P
		Number slide	Rate %	Number slide	Rate %	
Prior intervention	75	59	78.67	61	81.33	$> 0.05$
After 6 month	75	47	62.67	62	82.67	$< 0.05$
After 12 month	75	29	38.67	57	76.0	$< 0.05$
After 18 month	75	22	29.33	54	72.0	$< 0.01$
		$\chi^2 = 36.742; p < 0.01$		$\chi^2 = 1.826; p > 0.05$		
		$\chi^2 = 27.312$ 95% CI = 0.2790 - 0.5949				

Each microscopist practice make 5 thin smear (intervention group and the control group, each group made 75 slide). After 6 months, the technique prepared thin smear at the intervention group better than the control ( $p < 0.05$ ). The rate in the non-intervention group did not change (81.33% versus 82.67%). After 12 months, the rate thin smear unacceptable by the intervention group decreased to 38.67%. This rate of the non-intervention group did not decrease: 76.0% ( $p > 0.05$ ). After 18 months, the rate thin slide unacceptable in the intervention group decreased 29.33% ( $p < 0.01$ ). Rate in the non-intervention group decreased from 81.33% to 72.0%. Techniques prepared thin smear of microscopist in the intervention site better than the non-intervention group ( $p < 0.01$ ).

**Table 3.26. Number of Giemsa solution incorrect**

Time	Number of sample	Intervention		Non-intervention		P
		Sample	Rate %	Sample	Rate %	
Prior intervention	30	23	76.67	22	73.33	> 0.05
$\chi^2 = 0.089$						
After 6 month	30	16	53.33	22	73.33	> 0.05
$\chi^2 = 2.584$ ; 95 % CI = 0.4884 - 1.0831						
After 12 month	30	8	26.67	23	76.67	< 0.05
$\chi^2 = 15.017$						
After 18 month	30	3	10.0	17	56.67	< 0.05
		$\chi^2 = 27.149$ ; $p < 0.01$ $\chi^2 = 1.832$ ; $p > 0.05$				
$\chi^2 = 14.7$ 95 % CI = 0.0577 - 0.5399						

Microscopists made 2 sample Giemsa solution: 4% for routine staining and 10% for faster (total of 30 samples / group). Staining 5 slides has both thick and thin smears. Results no agreement in the intervention group and the control group before the intervention: 76.67% and 73.33% ( $p > 0.05$ ). After 6 months, fail made sample rate of the intervention group had decreased but not meaning ( $p > 0.05$ ). After 12 months, the proportion of the intervention group was 26.67%, but increased in the non-intervention group ( $p < 0.05$ ). After 18 months, the rate of reduction intervention group was 10.0% faster ( $p < 0.05$ ), delayed non-intervention group decreased from 73.33% to 56.67% ( $p > 0.05$ ). After 2 years of intervention made wrong sample rate decreased in the intervention group than the non-intervention group ( $p < 0.05$ ).

**Table 3.27. The number of slide stain unacceptable**

Time	Number slide	Intervention		Non-intervention		P
		Number slide	Rate %	Number slide	Rate %	
Prior intervention	75	42	56.0	39	52.0	> 0.05
$\chi^2 = 0.242$						
After month	75	30	40.0	40	53.33	> 0.05
$\chi^2 = 2.679$						
After 12 month	75	15	20.0	37	49.33	< 0.05
$\chi^2 = 14.246$						
After 18 month	75	13	17.33	37	49.33	< 0.05
		$\chi^2 = 24.144$ ; $p < 0.05$ $\chi^2 = 0.107$ ; $p > 0.05$				
$\chi^2 = 17.28$ ; 95 % CI = 0.2038 - 0.6059						

Each microscopist had staining 5 slide, including thick and thin smears (75 slide/ group). After 6 months, the rate of unsatisfactory slide staining of the intervention group decreased from 56.0% to 40.0%. This rate of the non-intervention group did not decrease but increased from 52.0% to 53.33% ( $p > 0.05$ ). After 12 months, the rate in the intervention group decreased to 20.0%; lower than 49.33% for the non-intervention group ( $p < 0.05$ ).

After 18 months, the staining technique in the intervention group is better than the control group, ratios slide staining in the intervention group decreased to 17.33%, in the non-intervention group there was no significant reduction 49.33% ( $p > 0.05$ ).

**Table 3.28. Number of slide reading incorrect in the microscopy site**

Time	Total	Intervention		Non-intervention		P
		Number slide	Rate %	Number slide	Rate %	
Prior intervention	75	33	44.0	31	41,33	$> 0.05$ $\chi^2 = 0,109$
After 6 month	150	57	38.0	69	46,0	$> 0.05$ $\chi^2 = 1,97$
After 12 month	150	41	27.33	62	41,33	$< 0.05$ $\chi^2 = 6.52$
After 18 month	150	31	20.66	63	42,0	$< 0.05$ $\chi^2 = 13.375; p < 0.01$ $\chi^2 = 0.009; p > 0.05$ $\chi^2 = 15.864; 95 \% CI = 0.3414 - 0.7093$

Microscopist reading slide, includes: *P. vivax*, *P. falciparum*, *P. malariae*, coordinating blue and negative slides. The errors include wrong from negative to positive, from positive to negative, from *P.f* to *P.v*; or *P.m*.... False results slide prior intervention can not difference between the intervention and non-intervention group: 44.0% and 41.33% ( $p > 0.05$ ).

After 6 months, the rate fell in two groups, but no meaning ( $p > 0.05$ ). After 12 months, the proportion of slides inspired by wrong intervention group decreased to 27.33%, lower than the non-intervention group: 41.33% ( $p < 0.05$ ). Reading slide in the intervention group was improved after 18 months, the rate fell from 40.0% to 20.66% ( $p < 0.01$ ) and better than the non-intervention group ( $p < 0.05$ )

### **Hình 25. Rate of slide detect wrong in the intervention site**

Rate slide detect wrong in the intervention site following 2 years shrink specified against microscopy site against stock ( $p < 0,05$ ), at its microscopy site against stock rate increase.



## **CONCLUSIONS AND RECOMMENDATIONS**

### **1. CONCLUSIONS**

#### **1.1. Current situation of the microscopic site of North West Province region**

- Two years 2011 and 2012 the number of microscopy site (communes, districts) increased from 224 to 268 (19.6%), the number of slides detected also increasing every year (248 099 versus 282 552).
- Average 1 microscopy site covered 3.62 commune and 15 255 people.
- Percentage of test qualified secondary education: 53.4%. The rate of annual examiner training on laboratory techniques: 16.7% - 40.0%.
- Microscopy is in good used condition 63.9%; 19.84% microscopys do not use electricity, by using only natural light.
- 93.3% of the microscopy site equipped with tools set, supplies of chemicals for testing only response was from 10.0% to 66.0%.
- Skills made slide malaria parasites of qualified microscopists is 36.7% (thin smear) and 70% (thick smear).
- Skills detect malaria parasites achieve quite and good: 53.3%.
- Time to answer result (before 2 hour) is 50.0% now and in the days: 26.7%.
- The microscopy site sent slide monthly checks: 83.33%.

#### **2. The result of interventions to improve the operation of the microscopy site in study sites.**

After 18 months of interventions for 15 microscopy site include: training, chemical suppliers, tools set and strengthen monitoring and evaluation, the results showed that:

- The rate prepared thick smear and thin smear unsatisfactory of microscopists has decreased from 44.0% and 76.67% to 12.0% and 29.33%, reduction compared with the controls group ( $p < 0.05$ ).
- The percentage of the prepared Giemsa solution and stained slide unacceptable decreased from 76.67% and 56.0% to 10.0% and 17.33%, reduced than the control group ( $p < 0.05$ ).
- The rate of false slide decreased from prior intervention 44.0% to 20.66% ( $p < 0.05$ ), decreased compared with the control group ( $p < 0.05$ ).
- 93.3% tested early reply within 2 hours, resulting in early reply within 2 hours compared with the control group ( $p < 0.05$ )
- 100.0% microscopy site sent slide to cross - checking monthly, better than the control group ( $p < 0.05$ ).

### **2. RECOMMENDATIONS**

- Regular training for microscopist in the microscopy site under routine microscopy of the World Health Organization. Timely repaired the microscope was damaged, chemicals and provide adequate tools to ensure the operation of the microscopy site. Use the microscope to other tests.
- Strengthening the external quality assessment to improve the capacity of microscopist. Construction and evaluation process of the operation of external quality control microscopy site to the malaria elimination stage.

## **LIST OF PUBLISHED STUDIES RELATED TO THE THESIS OF THE AUTHOR**

- 1 Tran Dinh Dao Hoang Ngoc Thu, Nguyen Thi Hong Phuc et al (2010), "The microscope site status of detecting malaria parasites in Yen Bai", Journal of Prevention of malaria and parasitic diseases, number 5, pp. 60-65.
- 2 Nguyen Thi Hong Phuc, Bui Huu Toan et al (2012), "Assessment of the microscopy site status at 3 in Son La, Lai Chau and Dien Bien provinces", Journal of Prevention of malaria and parasitic diseases identical, No. 1, pp. 25-32.
- 3 Nguyen Thi Hong Phuc Tran Thanh Duong (2013), "The performance testing work in the North West region", Journal of Prevention of malaria and other parasitic diseases, The first specialized research conferences, pp. 27-34.
- 4 Nguyen Manh Hung, Ho Dinh Trung, Ly Van Ngo, Nguyen Thi Hong Phuc et al (2013), Insects testing procedure - Medical Parasitology, Medical Publishing, 2013, pp. 7-25.
- 5 Nguyen Thi Hong Phuc, Le Xuan Hung, Tran Thanh Duong et al (2014), "The effectiveness of measures to improve the quality of laboratory malaria parasite quintal microscopic site in North West region", Journal of Prevention of malaria and parasitic diseases, No 2/2014, pp. 61-65.