Cost of Quality Assurance of Malaria Microscopy : The Philippines and Thailand

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I. INTRODUCTION

For a disease like Malaria which affects people with low socio economic status, quality service promotes equity in health (Wirth et al, 2006). Prompt treatment, one of the four pillars of Roll Back Malaria (RBM), relies heavily on the accurate and timely diagnosis of malaria. This is increasingly apparent as the WHO moves to promote the global use of costly malaria treatments and especially artemisinin-based combination therapy (ACTS). While rapid diagnostic tools (RDT) are in the process of being finessed, malaria microscopy seems to hold its place in malaria diagnosis.

Microscopy has been practised as the predominant malaria diagnostic system in Thailand for several decades, since the inception of the program (Malaria Division, 1980). However, the continued viability of microscopy is threatened by the large scale exit of trained microscopists due to retirement. This problem is exasperated by the historical 'batch' training of microscopists and their subsequent homogenous age. Conversely, the Philippines has only recently invested in microscopy (AusAID-DOH-RBM/WHO, 2004) and while retirement is not currently a constraint, high attrition rates prompted by low salaries, few career opportunities and migration towards overseas work, has increased microscopy costs.

In recognition of these factors, it is imperative that reliable quality assurance (QA) of mircoscopy is maintained, whereby QA refers to the quality monitoring of slide examination to ensure the correct diagnosis of malarial parasitic infection in blood cells and the types of malaria parasites present.

The costs of maintaining a QA scheme must be explicitly recognised and budgeted for not only in Thailand and the Philippines, but also in other regional countries which are contemplating different malaria diagnostic approaches such as Laos and Cambodia.

While it is widely accepted that malaria microscopy is still the mainstay of a malaria control program, the highly technical and resource burden nature of the intervention must be appreciated. The training of microscopists to ensure that they maintain skills and keep good equipment are two issues that make malaria microscopy costly. An assessment of costs, and potential cost savings, involved in maintaining a QA programme for malaria microscopy is instrumental in providing guidance to an improved QA system for malaria microscopy.

Objectives

- To describe the existing and proposed scheme for quality assurance of malaria microscopy in Thailand and the Philippines, respectively.
- To perform a cost analysis of the quality assurance of malaria microscopy of the Philippines and Thailand.

II. METHODOLOGY

Data collection methods

Data was collected during March and April 2005 for Thailand and the Philippines respectively and was based on specific information obtained from key informant interviews and from desk reviews of existing country documents.

Interviews: the study relied mainly on information provided by key informants identified by the WHO Western Pacific Regional Office staff in Manila and the Thai Malaria Control Program. This information and the associated costing estimates were regarded as the most accurate descriptions of the QA system. The following sources were interviewed:

- The head of the malaria control programme and other officers responsible for malaria microscopy in both countries.
- WHO malariologists at the country level and where available, responsible officers in charge of external funding projects including the Global Fund for Malaria, TB and AIDS.
- Chief of the Reference Laboratory in Bangkok.
- Director of the National Malaria Control Programme in Thailand.
- Other personnel such as university personnel who provided services such as training or supervision in microscopy for the national malaria control programme.

Desk review of existing documents :

- Reports of the National Malaria Control Programme, and, specifically for Thailand, the 2002 Annual report.
- Documents pertaining to training programmes and their related budgets, e.g. the Training schedule for the Philippines, 2004.
- The Manual for Malaria Clinic (1992) Malaria Division, Ministry of Public Health Thailand.

QA costing methods

The study presents solely financial costing of the major items and expensive resources directly related to QA. Calculations were based on temporally and spatially static data using various assumptions and the cost level estimated in the study should, therefore, not be considered as definite, but subject to the quality and availability of data.

Based on this premise, the study ignored several input items, such as office and small medical supplies, electricity and utilities as it was hypothesised that these costs would constitute only an insignificant incremental cost and be covered by routine malaria services anyway.

Although we recognise the importance of the private sector's role in malaria diagnosis and treatment, the QA models in both countries assumed no private sector involvement.

The following basic assumptions for the cost calculations were adopted ;

- Costing only in the initial year, when the capital costs were highest. We therefore assumed no discounting.
- All prices including exchange rates, reflect real market prices.
- Existence of basic capacity and infrastructure, hence the costs are mostly incremental to routine malaria activities.
- Equal spatial and temporal distribution of skills and capacity.
- Full time workload for validators /checkers and microscopists.
- Constant non personnel operating costs: logistics, postage/ telecommunication, procurement.
- Insignificant information system and procurement costs.
- Integration and decentralization does not affect QA costs.

Costs were categorized and analysed according to two cost structures, namely the costs by Activity and the costs by Budget (inputs).

Costs by QA activity consisted of the following items :

- Cost of training checkers or validators included all costs of training activities that endow an individual with the skills necessary for slide checking or validating, supervision and maintenance of microscopes.
- Cost of slide checking by checkers or validators involved three items: the salary of checkers or validators, the cost of sending slides for validation, and the cost of consumables incurred by validators for checking the slides.
- Cost of supervision to microscopists at the peripheral level involved per diem and supervisor travel to provide consultative visits to microscopists, both as routing activities and as remedial measures.
- Cost of external assessment involved the costs incurred by an external evaluation of laboratory processes and competencies of validators or checkers.

Costs by QA budget (input) classification consisted of the following items :

- Capital costs consisted of two major items: training of validators or checkers, and equipment (microscopes).
- Personnel cost included the salaries of validators and checkers at all levels.
- Supply costs included both medical and laboratory supplies at validating labs at all levels.
- Transportation, travel and miscellaneous costs. This item included the transportation and travel as well as other miscellaneous costs involved in the supervision for QA, such as logistics.

Data processing and analysis methods

Data processing and analysis used a specifically developed spreadsheet template to cost items whilst facilitating sensitivity analysis.

The study developed three indicators for unit costs: 1) QA cost per slide checked or validated, and 2) QA cost per "correct" slide (true positive, true negative, correct parasite).Additionally, two financing indicators were used: 1) percent share of cost to total malaria budget, and 2) share of external funds.

III. RESULTS

The existing QA scheme for malaria microscopy in Thailand

The study selected the QA model that has been implemented since the beginning of the programme some 50 years ago and it remains very similar to when the programme was a vertical malaria control programme. The three levels of QA in the Thai malaria control program are summarised here.

Level 1. Regional level QA is completed at the regional malaria laboratory in one of the 12 Offices for the Vector Borne Disease Control (OVBC). Slides from all malaria clinics or other types of service provisions, such as health centres and OPDs, are sent to the Center for the Vector borne Disease Control (CVBC) for randomization. There are about 600 microscopists at this level. 10% of the slides are sent to the regional lab for checking.

This is done every ten days. The checking is conducted by all 30 checkers who also provide supervision and feed back to the microscopists at the peripheral level. All of the checked slides are marked with new serial numbers for the purpose of randomization and for re checking.

Level 2. National level QA checking is done at the malaria control programme's reference laboratory. The 12 regional malaria labs volunteer to send ten percent of the checked slides, through randomization, for re checking by five checkers. Supervisors from this level visit the 12 regional labs at least once a year for feedback.

Level 3. External assessment has two components :

- ISO/TEC 17025: 1999 certification. The Malaria Division (now Malaria Section of the Bureau for Vector-Borne Disease Control) invited the Department of Standards to inspect and certify for the above certification. Cost was incurred only once at the beginning of the activity. The Department of Standards inspects and re certifies the lab once every year with no further cost.
- Inter laboratory assessment. The three reputable malaria labs in Bangkok volunteer to help each other. This is done once a year when ten slides are made from new patients. All five checkers at the national level are to identify the slides. The same set of slides is sent to the "sister" labs at the Faculty of Tropical Medicine, Mahidol University and the Armed Forces Research Institute for Medical Sciences (AFRIMS). If results from these three labs are inconsistent, then PCR is used as the gold standard.

The proposed QA scheme for malaria microscopy in the Philippines

Comprehensive, whole country data for the Philippines was not available. At the same time, several QA models are supported by external funding agencies and are now being piloted in the country. Integration of these different models has yet to be implemented and in light of the differences between QA models, the study selected the one deemed by key informants to be a likely candidate for implementation.

There are three levels of QA, using LQAS (Lot Quality Assurance System) :

Level 1. Regional or provincial level: 100-120 slides per one microscopist, depending upon the workload, are sent to validators at the regional level. At certain locations such as Palawan, this checking takes place at the provincial level, using validators from the regional level. Slides are sent for checking quarterly.

Level 2. National level QA slide validation occurs only when necessary, e.g. when there is disagreement between the microscopists who initially read the slides and the regional level validators who validated the slides. In addition to the validation of slides from the regional lab, supervision from this level to the regional level is planned once a year per province.

Level 3. External quality assurance. Due to high costs, this is planned only once every two years. The external evaluator assesses, validates, and strengthens capacity of the national core group.

Cost level and structure (Tables 1 and 2)

Thailand

The total estimated cost of QA malaria microscopy in Thailand, calculated by activity, is USD 402,098 per year, marginally less then 2% of the total malaria budget.

When considering the cost of QA by activity, slide checking and supervision accounts for over 80% of the QA budget (55% and 28% respectively). This is significantly higher than that incurred in the Philippines programme (only 8%). Training accounts for only 9%, and a similar share goes to external assessment. The latter has two components: 1) inter lab assessment (national malaria slide bank preparations), and 2) ISO certification. Both activities are performed by national departments or agencies. The first component does not impose operating cost for the QA programme, while the latter incurs the cost once every 10 years. The cost of external assessment in Thailand, therefore, exists only in the initial year.

The QA cost by input or budget classification in the Thai malaria control programme is quite similar to other programs, where personnel cost dominates the highest share (55%). The second

largest share is made up of logistical costs (23%), followed by capital costs (21%). The high logistical costs are concordant with the emphasis on supervision activities in Thailand.

The Philippines

The Philippines QA cost estimate by activity is about half of Thailand's; USD 228,524. There is an approximately 10% discrepancy between total cost by budget classification and total cost by QA activities in the results of both countries.

The highest share of costs by QA activities is accounted for by slide checking. The training component constitutes a much larger share than that in Thailand, thus highlighting the hitherto fewer qualified staff and the need for further investment to encourage staff to remain in the profession once trained.

The capital costs are nearly double (40%) that of Thailand, while the share of personnel cost is very similar to Thailand.

Table 1 **Cost by Budget Classification (Initial Year)**

Item	Thailand			Philippines		
	Baht	USD	% Share	Peso	USD	% Share
Capital	2,883,673	75,886	21	5,749,800	104,542	40
Personnel	7,680,000	202,105	54.8	7,686,000	139,745	53
Supplies	210,000	5,526	1.5	252,000	4,582	2
Transportation, travel and misc.	3,244,860	85,391	23	834,840	15,179	6
Totals	**14,018,533**	**368,909**	**100**	**14,522,640**	**264,048**	**100**

Table 2 **Cost by Activity (Initial Year)**

Item	Thailand			Philippines		
	Baht	USD	% Share	Peso	USD	% Share
Training	1,308,673	34,439	9	4,368,800	79,433	35
Slide checking	8,352,960	219,815	55	7,184,107	130,620	57
Supervision	4,218,100	111,003	28	1,015,938	18,472	8
External assessment (one time)	1,400,000	36,842	9	-	-	-
Totals	**15,279,733**	**402,098**	**100**	**12,568,845**	**228,524**	**100**

Cost indicators (Table 3)

Unit costs in Thailand :

Thailand has adhered to the WHO's guideline of 10% slide checking with less than 1% incorrect slides. Based on the current total number of slides, more than 3 million slides were examined. In compliance with the WHO, about 297,187 slides were checked and 294,215 slides were correct. Therefore, the unit cost of Thailand was relatively low: USD 1.35 per slide checked and 1.37 per correct slide (true positive, true negative and correct malaria parasite). For the whole program, the cost was USD 0.13. However, if the level of correct slides fell from the WHO guideline target of 99% to the 60% level found in the Philippines, the total number of correct slides would be only 178,312, raising the cost per correct slide to USD 2.25.

Unit costs in the Philippines

Based on a conservative estimate, the Philippines's overall program produces 130,300 malaria slides annually. The cost per slide is USD 1.76. The number of checked or validated slides depends on the number of microscopists. A reference number of microscopists is 774, each generally send 100 slides per year for validation. The total number of validated slides is therefore estimated at 77,400, annually. The cost per checked slide is USD 2.95 and the cost per correct slide is USD 4.95, based on 60% of slides being correct.

The unit cost per correct slide will, therefore, be lower if the quality of microscopy is improved, for example, via better supervision. If the level of correct slides can be raised to 80% or 61,920 correct slides, the cost per correct slide would be reduced to USD 3.95 or a dollar cheaper, hence QA looks more cost effective even when below the WHO guideline target of 99% correct identification.

Table 3 **Comparing QA Unit Costs between Thailand and the Philippines**

Items	Thailand[1]	Philippines[2]
Total QA cost (USD)	402,098	228,524
	QA Outputs	
No. of total slides	3,142,319	130,000
No. checked slides	297,187 (~10%)	77,400
No. "correct" slides	294.215 (99%)	48,490 (60%)
	Unit Outputs	
Cost/slide	0.13	1.76
Cost/slide checked	1.35	2.95
Cost/ "correct"	1.37	4.95

Financing indicators

While the lack of reliable data in the Philippines prevented a calculation of the share of the total malaria budget allocated to QA, the figure for Thailand is less than 2% of the total annual malaria control budget. Such a low share, even for Thailand where QA has always been a priority in the malaria control program, indicates good value for money. However, the low relative cost may be due to the maturity of Thailand's model and the already available workforce. The cost by activity (Table 2) seems to support this fact with training accounting for only 9% of the total QA. This is in contrast with the Philippines where training accounts for as high as 35%.

The share of external finance for QA in the Philippines program is as high as 80%, while that in Thailand it is much lower due to a policy emphasis on self-reliance in financing. When the QA is highly dependent on external sources it may result in fragmented and multiple QA systems depending on which QA models are applied. Normalized standards even within the same country may be necessary.

Table 4 **Comparing QA Cost Indicators**

	Thailand (in baht)		Philippines[3] (in Peso)	
	Total budget	QA cost	Total budget	QA cost
	800m	15.3m	3m	12.5m
Share of QA cost as percentage of total malaria budget	1.9%		80%	
Share of external funds	Insignificant		80%	

[1] REal data, Malaria Annual Report, Malaria Division,2002.

[2] Estamated data by key informants.

[3] Thebudgetry source for QA is external to the proramme.The total budget for malaria control was reported to be 3 million per year.

IV. DISCUSSIONS

QA malaria microscopy should be an integral part of malaria control. Without appropriate QA, diagnosis will be unreliable, presenting a higher risk of transmission and increasing drug resistance. This can reduce the value for money or cost effectiveness of the overall malaria control program. An effective QA model is therefore essential and should ensure competent microscopists, evaluators and supervisors are employed, equipment is of a good standard and well maintained, a built in checking and monitoring system is in place and incentives to retain staff are sufficient.

The QA malaria microscopy model in Thailand has always been a core and integral element of the malaria control program since the eradication and vertical period. With the current integration, the system has been somewhat modified. The costing was based on the model originally designed with an add on, inter lab assessment. Even with

an elaborated QA malaria microscopy model, the direct financial cost of QA is only about 2% of the total malaria control budget. This value is at the lower end of the QA investment range recently reported to yield large benefits through the improved and reduced use of expensive drugs (Trigg 2005). However, as experienced microscopists and validators reach retiring age, technical human capacity will reduce and may leave QA unsustainable. A loss of QA checkers and microscopists through retirement in the case of Thailand or through a high turnover rate in the Philippines, can threaten the sustainability of QA microscopy.

There must be short term and long term solutions to avoid the weakening of the QA microscopy and to reduce the re training costs. Apart from the human resource issues of QA, the appropriate quality and quantity of microscopes and essential infrastructure and services is essential and the high capital and maintenance costs required must be budgeted for. Although this paper did not attempt to measure the benefits of QA, Trigg (2005), observed that QA investment will bring medium to long term benefits through ancillary development achievments both medically affiliated (e.g. fewer drugs used and decreased malaria morbidity and mortality) and in broader contributions to help aleiviate poverty and achieve the United Nations Millenium Development Goals. The broader benefits arising from reliable water and electricity supplies and trained medical staff, as neccesitated by any QA scheme, are oftern overlooked in the microscopy and broader medical literature, yet these infastructural developments may contribute comendably to the eleviation of poverty in a more integrated, cross disciplinary approach as alluded to by Audibert (2006). The intrinsic contribution of poverty eleiviation to promote malaria control emphasises the invaluable nature of this interconnection.

Thailand uses constant percentage (10%) checking of all slides, while the Philippines uses the Lot Quality Assurance System (LQAS) for slide checking where microscopists submit an almost constant number of slides for checking regardless of the number of slide that they examined. QA unit

costs are therefore not sensitive to the performance of the slides examined. Rather, the unit cost is dependent on malaria endemicity, human performance and competency, the diagnostic method used, coverage and access of the overall malaria control program and the external validation system adopted. In Thailand, when the overall blood slide production is low, there are fewer slides checked and the cost per correct slide is therefore high. If the Philippines can lower malaria endemicity, fewer slides will be produced and the unit costs will be higher. Similarly, high malaria endemicity in Thailand infers more slide checking and hence lower costs per slide; that is under 2 USD. This indicates that QA costs measured as unit costs will rise, at the margin, as malaria control programs become more successful in the future and fewer patients are tested for malaria. Paradoxically, the total cost of QA by activity will fall. This highlights the importance for nations evaluating QA schemes to select an appropriate costing system and understand the potentially conflicting output data so as not to prematurely curtail QA programmes due to perceived rising costs.

Due to a lack of data and unclear policy concerning the involvement of private providers, the study ignored the private sector. In practice malaria patients usually seek private care or self treatment wherever health care is not fully accessible. In the Philippines, with a supply shortage of malarial drugs, suspected malaria cases often seek care elsewhere without proper diagnosis and treatment. This can lead to increasing drug resistance and unnecessary costs in terms of drugs, mortality and morbidity. Currently, most private providers use RDT even if its quality remains questionable due to, for instance, inappropriate storage and transportation. For an effective QA system, the private sector must be included particularly where the private sector dominates the provision of malaria services.

Where microscopy is the basis for malaria control, QA can significantly determine its effectiveness. At the same time, the level of QA work and quality depends on the coverage and drug policy of the malaria control program. Therefore, appropriate malaria drug policy, supplies, surveillance and control measures must be well established to make the level of QA investment, calculated by this paper, worthwhile.

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