CHAPTER 4

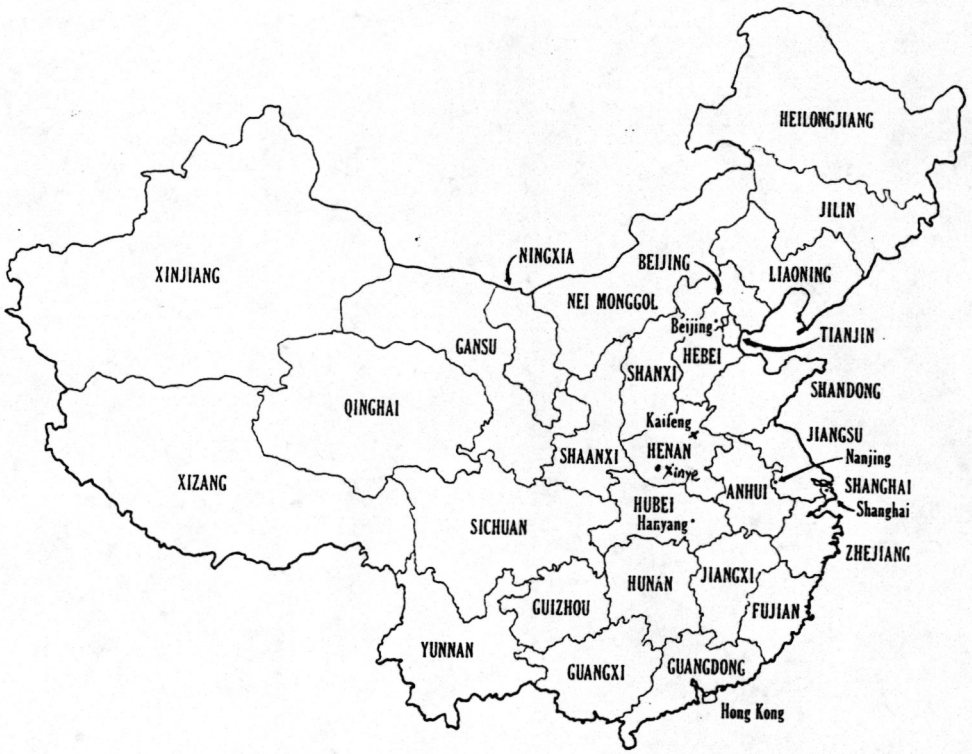
RESEARCH METHODS

This was a retrospective study of costs of malaria case detection. It only took the viewpoint of the direct costs incurred by providers. Two counties' data from a 23 counties' survey was used to estimate the costs in the micro level study. The data of 23 counties was used to perform the macro-level study.

4.1 Study Areas

Purposive sampling has been used considering the feasibility of research and collaboration of local authorities concerned. The two counties Kaifeng, Xinyie from one province Henan were selected for the micro-level study (Figure 4-1).

Figure 4-1 Location of the Two Counties (Map)



The two counties have similar geographical structure, transportation systems, types of health care services, accessibility to the health care, malaria incidence rate (less than 1 per ten thousand). One county, Xinyie, implemented Scheme A, another county, Kaifeng carried out Scheme B. The surveillance statistics of two counties (1993) are given in Table 4-1.

Table 4-1 Surveillance Statistics of Two Counties (1993)

Items	Kaifen County (Scheme B)	Xinyie County (Scheme A)
Population	650513	713012
Incidence rate (malaria)	$7.1 * 10^{-5}$	$1.4 * 10^{-5}$
ABER	0.37 %	2.2 %
SPR	1.89 %	0.18 %
No. of P. vivax	49	10
No. of P. falciparum	0	0
CFR (malaria)	0	0

ABER - Annual blood examination rate
SPR - Slide positive rate
CFR - Case fatality rate

The general information of health services in the rural areas of the two counties is given in Table 4-2.

Table 4-2 General Information of Health Services in the Rural Areas of The Two Counties

County / Items	Xinye County (County A)	Kaifen County (County B)
Township Health Center (THC)		
Number of THC	16	21
Number of Physician	47	56
Number of Pharmacist	30	43
Number of Microscopist	10	13
Number of Assistant	16	21
Village Clinics (VC)		
Number of VC	43	51
Number of village doctors	45	54

Both counties are located in plains. The farmers in these rural areas are involved in planting: corn, wheat, cotton, and vegetables. The average incomes per capita in these areas belong to the middle level.

4.2 Study Period

January 1993 to December 1993 (micro-level study)
January 1992 to December 1993 (macro-level study)

4.3 Operational Definitions

* The direct operating cost is the cost which is incurred by institution for diagnosing and treating malaria cases.

* The outcomes of the two schemes are the immediate outcomes which are the number of slides examined and the number of positive cases detected.

* The additional direct operating cost is the difference in the costs for providing the diagnoses and treatment for fever outpatients in order to detect malaria cases when implementing Scheme A and Scheme B in the same areas.

* The additional cases detected are the malaria positive cases detected in FUO outpatients when carrying out Scheme A in comparison with Scheme B.

* Situational change means alteration in the given conditions : slide positive rates and numbers of slides examined for FUO.

* Cost per slide examined = total direct operating cost / total number of slides examined

* Cost per positive case detected = total direct operating cost / total number of positive cases detected

* Slide positive rate = total number of slides of positive for malaria parasites / total number of blood slides examined

* Additional direct operating costs for additional cases detected = the difference in the direct operating costs of the resources used when Scheme A and Scheme B were implemented in the same areas respectively / the malaria positive cases detected in the FUO group.

4.4 Criteria for Clinical Diagnosis of Fever Origin

* Malaria : typical malaria syndrome: periodic paroxysms (quotidian or tertian), each accompanied by a feeling of cold or shaking with chill, fever, and sweating, and with a noticeable intermittent stage of respite up to the next paroxysm

* Suspected Malaria : a paroxysm with the main symptoms but without periodicity, or an irregular fever with non-specific symptoms responding to antimalarial treatment

* Fever of Unknown Origin: no definite diagnosis of another febrile disease was made and the possibility of malaria infection cannot be ruled out

4.5 Types of data collected

The secondary data of relevant costs and performances were collected. The cost data included the salaries of personnel (physicians, pharmacists, microscopists, assistants in anti-malaria teams), material costs and drug costs. The performance data included the number of slides examined and the number of positive cases detected.

4.6 Data Collection

Related data have been collected from 1993 all the year around for micro-level study or from 1992 to 1993 for macro-level study. The data were collected and their sources are presented in Table 4-3.

4.7 General Information

4.7.1 Salaries of Personnel

At township health centers, the average salaries of physicians, pharmacists were 300 Yuan, 250 Yuan per month per capita. The average salaries of microscopists in the Stations of Malaria Microscopical Detection and assistants in anti-malaria groups were 250 Yuan, per month per capita respectively.

At village clinics, the average salary of village doctor was 300 Yuan per month per capita (source: Henan Provincial Health Bureau, 1993).

4.7.2 Number of Outpatient visits

At a township health center, on average, the number of internal-medicine outpatient visits was nearly 40 per day. The number of total outpatient visits was approximately 90 per day. On average, at village clinics, the number of patient visits was about 30 per day (source: Henan Provincial Health Bureau, 1993).

4.7.3 Total Service Days

Total service days of the health personnel in a year is 306 days (excluding official holidays and weekends)

Table 4-3 Data Collected and Their Sources

Item	Sources
Salaries and wages of physician, pharmacist and malaria personnel	Salary accounts and provincial health personnel salary scale
Materials:slide & coverslip stains, alcohol, needle	Related report (Collaborating group, 1993)
Drugs: presumptive and radical treatment	Related report (Collaborating group, 1993)
Total No. of patients' visits for internal-medicine outpatient service in THCs in one county all the year around	Health service statistics (Henan Provincial Health Bureau, 1993)
Total No. of outpatients' visits in THCs in one county all the year around	Health service statistics (Henan Provincial Health Bureau, 1993)
Total No. of patients' visits in VCs in one county all the year around	Health service statistics (Henan Provincial Health Bureau, 1993)
total No.of fever patient visits from different groups of clinical diagnoses for fever outpatients all the year around	The record of malaria surveillance (Collaborating group, 1993)
Positive cases detected in each group of clinical diagnoses for fever outpatients in one county all the year around	The record of malaria surveillance (Collaborating group, 1993)

4.8 Quantifying the Costs

4.8.1 Manpower - time allocated to malaria case detection and treatment

To determine the direct operating costs of manpower, the number of outpatient visits were used as the criterion to allocate the time of physicians, pharmacists to diagnosis and treatment contributed to

malaria surveillance. In a similar way, for the assistants in anti-malaria teams, their salaries were allocated to malaria case detection and treatment on the basis of time spent on relevant activities (Table 4-4). For microscopists, their salaries were all allocated to malaria case detection and treatment since all their working activities (taking, preparing and examining blood slides) were related to the activity being studied.

The apportioned factors used to allocate the costs of personnel to malaria case diagnoses and treatment are given as follows:

* For physicians, the apportioned factor is N_f / N_i.

* For pharmacist, the apportioned factor is N_f / N_o.

* For microscopists in Scheme B, the apportioned factor is $N_{p.s} / N_{t.s}$. For microscopists in Scheme A, the apportioned factor is 1, because their all activities were related to malaria case diagnosis and treatment.

* For village doctors, the apportioned factor is N_{vf} / N_{vc}.

N_f = Total numbers of typical fever, suspected malaria fever, and FUO internal-medicine outpatient visits in the THC of County A total number of typical malaria and suspected malaria fever internal-medicine outpatient visits in the THC of County B in the year

N_i = Total numbers of internal-medicine outpatient visits in the THC of County A or County B in the year .

N_o = Total number of outpatient visits in the THCs in one county all the year around

$N_{p.s}$ = Number of slides examined for malaria parasites from two kinds of fever outpatients in County B in the year

$N_{t.s}$ = Total number of slides examined by microscopists in County B in the year

N_{vf} = N_{vfa} or N_{vfb}

N_{vc} = $N_{v2} * N_{v3}$

N_{vfa} = $N_{f1}' + N_{f2}' + N_{f3}'$ (In Scheme A, Village Clinic)

N_{vfb} = $N_{f1}' + N_{f2}'$ (In Scheme B, Village Clinic)

N_{vc} = Total number of patients visits in the VC in one county all the year around

N_{v2} = Total number of village clinics in one county

N_{v3} = Average number of patients who visited VC per clinic per year

For the assistants in the anti-malaria teams, because they had five activities, we assume each activity took the assistants the same amount of time. So 20% of the assistants working time was devoted to malaria case detection and treatment. That is 20% of their salaries should be allocated to the studied activity.

The details of the formula for allocating the costs of physicians and pharmacists to malaria case diagnosis and treatment are given in appendices.

Table 4-4 Basis of Allocating Manpower for Malaria Surveillance

Manpower	Units of measurement	Criteria
Physician Pharmacist	visit	% of visits from fever outpatients
Assistant in anti-malaria team	time	% of time spent on malaria case detection and treatment

When the number of visits were used as the basis of allocating the personnel's salaries to malaria case detection and treatment, the assumption was that a visit for fever involved the same amount of physician's, or pharmacist's time as visits for other diseases; the assistants in anti-malaria team spent the same time on the several activities.

4.8.2 Material and Drugs Used for Malaria Case Detection and Treatment

The material cost per slide examined was based on the result of a report in China (Collaborating group, 1993).

According to the drug dosages and kinds for presumptive and radical treatment per capita and the prices (Collaborating group, 1993), then drug costs per person were obtained.

The total material costs and drug costs were assessed by multiplying the related unit costs by the total number of blood slides

for certain kinds fever outpatients , by the total number of fever outpatients who get presumptive treatment, and by the total number of positive cases detected who get radical treatment, respectively.

4.9 Criteria for Evaluating the Two Schemes Under Certain Conditions

* cost per positive case detected (Table 4-5)
* cost per slide examined (Table 4-5)

Table 4-5 Criteria Used to Measure the Outcomes in Two Schemes

Scheme	Outcomes	Unit cost
Scheme A or Scheme B	1. Cost per positive case detected = total cost of diagnosis and treatment / No. of positive cases detected in each scheme	Cost / positive cases detected
	2. Cost per slide examined = total cost of diagnosis and treatment/total No. of blood slides examined in each scheme	Cost /slides examined
Scheme A	3. Cost per positive case detected in FUO = additional cost / additional positive cases detected in FUO	Additional cost /Additional positive cases detected from FUO

4.10 Analysis of Data

The annual direct cost profiles for malaria case detection and the annual direct cost items for different types of diagnoses for fever outpatients in each scheme were calculated. When these costs were related to the proportion of and real number of malaria cases detected in different clinical diagnoses for fever outpatients in each scheme, the costs per slide examined and costs per positive case detected were obtained.

The additional costs of the relevant resources used for detecting positive cases from FUO can be obtained by summing the costs contributed by manpower, material and drugs for FUO. The additional cases detected are the malaria positive cases detected from FUO outpatients when Scheme A was implemented in comparison with Scheme B in the same areas. Then, the additional cost per positive case detected were thus obtained.

The data obtained when Scheme A or Scheme B was implemented in County A would be used as the baseline data to study the relationship between the unit costs of the two schemes and the changes of the slide positive rate and the number of slides examined for the FUO cases under some assumptions. Lotus and other appropriate computer programs were used.

For the macro-level study of the two schemes, with several assumptions the estimated costs of the two schemes were obtained, then compared . The data of the performances used in the macro-level study were the results of the national survey on 23 counties in 1992 and 1993.

4.11 The Relation Between the Changes of the SPR and the Cost per Positive Case Detected

4.11.1 Assumptions

The following were assumed to be constant in County A.

- the number of personnel whose work is related to passive case detection (diagnosis and treatment) in malaria surveillance (physicians, pharmacists, microscopists and assistants in the anti-malaria teams)
- the total number of typical malaria, suspected malaria and FUO fever outpatients
- the total number of outpatient visits
- there is no economy of scales for the radical treatment drugs

4.11.2 Variables

- SPR in Scheme A
- SPR' in Scheme B
- Cost per positive case detected

4.11.3 Formulae for Computing the Cost per Positive Case Detected with Changes of SPR

According to the methods and items used in costing, following equation could be obtained :

$$T_{c'a} = T_p + T_m + T_{d.p} + T_{d.r} \qquad (4.1)$$

$T_{c \cdot a}$ - the total costs of resources used by three kinds of fever outpatients in Scheme A

T_p - the costs of the personnel in Scheme A

T_m - the costs of the material in Scheme A

$T_{d.p}$ - the costs of the drugs for presumptive treatment in Scheme A

$T_{d.r}$ - the costs of the drugs for radical treatment in Scheme A.

$$T_{p.m.d} = T_p + T_m + T_{d.p} \qquad (4.2)$$

$T_{p.m.d}$ - the costs of the following resources : personnel, material, drugs for presumptive treatment in Scheme A

$$T_{d.r} = N_{p.a} * C_{d.r} \qquad (4.3)$$

$$= N * SPR * C_{d.r} \qquad (4.4)$$

$N_{p.a}$ = the number of positive cases detected in Scheme A

N = the number of slides examined in Scheme A

$C_{d.r}$ = the cost of drugs for radical treatment per positive malaria case

So, the cost per positive case detected in Scheme A (C_a)

$$\begin{aligned} C_a &= T_{c.a} / N_{p.a} \\ &= (T_p + T_m + T_{d.p} + T_{d.r}) / (N * SPR) \\ &= (T_{p.m.d} + T_{d.r}) / (N * SPR) \\ &= (T_{p.m.d} + N * SPR * C_{d.r}) / (N * SPR) \\ &= C_{d.r} + (T_{p.m.d} / N * 1/SPR) \end{aligned} \qquad (4.5)$$

Similarly, when Scheme B was implemented,

$$T_{c \cdot b} = T_p' + T_m' + T_{d.p}' + T_{d.r}' \qquad (4.6)$$

$T_{c.b}$ - the total costs of resources used by two kinds of fever outpatients in Scheme B

T_p' - the costs of the personnel in Scheme B

T_m' - the costs of the material in Scheme B

$T_{d.p}'$ - the costs of the drugs for presumptive treatment in Scheme B

$T_{d.r}'$ - the costs of the drugs for radical treatment in Scheme B.

$$T_{p.m.d}' = T_p' + T_m' + T_{d.p}' \qquad (4.7)$$

$T_{p.m.d}'$ - the costs of the following resources : personnel, material, drugs for presumptive treatment in Scheme B

$$T_{d.r}' = N_{p.b} * C_{d.r}$$
$$= N' * SPR' * C_{d.r} \qquad (4.8)$$

$N_{p.b}$ = the number of positive cases detected in Scheme B

N' = the number of slides examined in Scheme B

$C_{d.r}$ = the cost of drugs for radical treatment of the dosage per positive malaria case

The cost per positive case detected in Scheme B (C_b)

$$C_b = T_{c.b}' / N_{p.b}$$
$$= (T_{c.p}' + T_{p.m.d}' + T_{d.p}' + T_{d.r}') / (N' * SPR')$$
$$= (T_{p.m.d}' + T_{d.r}') / (N' * SPR')$$
$$= (T_{p.m.d}' + N' * SPR' * C_{d.r}') / (N' * SPR')$$
$$= C_{d.r} + (T_{p.m.d}' / N' * 1/SPR') \qquad (4.9)$$

Using the data obtained from County A when Scheme A or Scheme B was carried out, C_a and C_b were obtained when changes of SPR were given between 0.09% to 44%.

4.12 The Relation Between the Changes of the Number of FUO and the Cost per Slide Examined and the Cost per Positive Case Detected

4.12.1 Assumptions

Assume the following were constant in County A.

- the number of personnel whose work is related to passive case detection (diagnoses and treatment) of malaria surveillance(physicians, pharmacists, microscopists and assistants in the township anti- malaria group)
- the total number of typical malaria, suspected malaria fever outpatients
- the total number of outpatient visits
- there is no economy of scale for the radical treatment drugs
- the total number of positive malaria cases (At) detected from typical malaria and suspected malaria fever outpatients
- the SPR of FUO is 0.0003

- only township health centers existed, so patients in the rural areas needed to go to there to get services

- the capacities of microscopists and assistants in anti-malaria teams were not fully used. Even though the number of slides examined and positive cases detected increased, the personnel costs contributed to malaria case detection would not increase.

4.12.2 Variables

- Cost per positive case detected

- Cost per slide examined

- Number of FUO fever outpatients

4.12.3 Formulae for Computing the Cost per Positive Case Detected and Cost per Slide Examined with Changes of SPR

After computing the total direct operating costs of the two counties in order to provide PCD services, we know

$$T = T_t + T_s + T_{fuo} \quad (4.9)$$

$$T_{fuo} = A_1 * X \quad (4.10)$$

- T - the total costs of resources used by three kind of fever outpatients
- T_t - the costs of resource used by typical malaria outpatients
- T_s - the costs of resources used by suspected malaria outpatients
- T_{fuo} - the costs of resources used by FUO fever outpatients
- X - the number of FUO
- A_1 - coefficient (constant)

According to the assumptions, T_t, T_s and A_1 were constant. A_1 would be affected by the total costs of physicians, pharmacists, microscopists and assistants in township anti-malaria groups; the number of outpatients visits; the number of internal-medicine outpatients visits.

The total number of slides examined (N)

$$N = N_t + N_s + X \qquad (4.11)$$

N_t - the number of slides examined for typical malaria fever outpatients

N_s - the number of slides examined for suspected malaria fever outpatients

X - the number of FUO

The total positive case detected (N_p)

$$N_p = N_{t.s} + A'X \qquad (4.12)$$

$N_{t.s}$ - the total number of positive malaria cases detected from typical malaria and suspected malaria fever outpatients

SPR_{fuo} - the SPR of FUO

So the cost per slide examined (C_s)

$$C_s = T / N$$
$$= (T_t + T_s + T_{fuo}) / (N_t + N_s + X)$$
$$= (T_t + T_s + A_1 * X) / (N_t + N_s + X) \qquad (4.13)$$

The cost per positive case detected (C_p)

$$C_p = T / N_p$$
$$= (T_t + T_s + T_{fuo}) / (N_{t.s} + SPR_{fuo} * X)$$
$$= (T_t + T_s + A_1 * X) / (N_{t.s} + SPR_{fuo} * X). \qquad (4.14)$$

Since T_t, T_s, N_t, N_s, A_1, SPR_{fuo} were all constant, C_s and C_p could be expressed as:

$$C_s = (T' + A_1 * X) / (N' + X) \qquad (4.15)$$

$$C_p = (T' + A_1 * X) / (N_{t.s} + SPR_{fuo} * X) \qquad (4.16)$$

T' - the costs of resources used by typical malaria and suspected malaria fever outpatients

$$T' = T_t + T_s \qquad (4.17)$$

$$N' = N_t + N_s \qquad (4.18)$$

N' - the number of slides examined for typical malaria and suspected malaria fever outpatients

Using the data obtained from County A when Scheme A or Scheme B was carried out, C_s and C_p were obtained when (X) is changed.