CHAPTER 5

THE COST-EFFECTIVENESS ANALYSIS

5.1 The Effectiveness of the Three Approaches

The different control approaches can lead to different outputs. If there were not any approach in those areas, the prevalence of schistosomiasis would be consistent. After control approach, the prevalence of schistosomiasis would be decreased and the cases of schistosomiasis would be reduced (Table 5.1). Comparing with pre-approach, we can calculate the expected case reduction of schistosomiasis(ED) yearly. In the chemotherapy community for the eight years, 1239.48 cases (cumulative number of cases decrease (CCD)) were reduced.

Table 5.1 The Effectiveness of Chemotherapy

Year	Prevalence (P)	No.of Case (NC)	Expect decease (ED)	Cumulative case decre. (CCD)
0	19.23	307.68	0	0
1	7.98	127.68	180.00	180.00
2	5.79	92.64	215.04	395.04
3	7.17	114.72	192.96	588.00
4	4.94	78.72	228.96	816.96
5	6.21	99.36	208.32	1025.28
6	13.58	217.28	90.40	1115.68
7	11.90	190.24	117.44	1233.12
8	9.37	148.32	159.36	1392.48

P = Annual prevalence of schistosomiasis from annual survey in the field.

NC = Number of case with schistosomiasis in whole community for every year.
= The number of population * prevalence of schistosomiasis

ED = Expected cases of schistosomiasis decrease

annually belong the approach.

= R_{ti} - R_{t0}; R_{t0} is the number of cases before control (Such as in the first year 180 cases were decreased. Before the control, the cases were 307.68, in the first year, the cases of whole community were 127.68, so the approach decreased 180.0 cases in the first year).

CCD = Cumulative case decrease. That is $ED_t + ED_{t+1} ...+ EDt_n$
That is the cumulative number of the cases of schistosomiasis can be decreased until time t.

In the molluscicide and chemotherapy community for the eight years, the cumulative number of cases decrease was 1341.16 (Table 5.2).

Table 5.2 The Effectiveness of the Molluscicide Plus Chemotherapy

Year	Prevalence (P)	No.of case (NC)	Expect decre. (ED)	Cumulative case decre. (CCD)
0	26.23	223.22	0	0
1	7.08	60.25	162.97	162.97
2	3.40	28.93	194.29	357.26
3	4.28	36.44	186.80	544.06
4	3.73	31.74	191.48	735.54
5	4.20	35.74	187.48	923.02
6	6.79	57.78	165.64	1088.66
7	10.34	87.99	135.23	1223.89
8	12.45	105.95	117.27	1341.16

In the environmental change community for the eight years, the cumulative number of expected cases decrease was 3236.24 (Table 5.3).

Table 5.3 The Effective of the of the Environmental Change plus Molluscicide and Chemotherapy

Year	Prevalence (P)	No.of Case (NC)	Expect decre. (ED)	Cumulative case decre. (CED)
0	17.30	483.19	0	0
1	6.88	192.16	291.03	291.03
2	5.31	148.31	334.88	525.91
3	1.61	46.64	436.55	962.46
4	0.91	25.42	457.77	1420.23
5	1.06	29.61	453.58	1873.81
6	1.36	37.98	445.21	2319.02
7	0.50	13.97	469.22	2788.24
8	1.26	35.19	448.00	3236.24

5.2 Cost-Effectiveness Ratio (CER)

In the implementation stage, the cost of cumulative present value of the chemotherapy was 24969.04 yuan, the cost of molluscicide and chemotherapy was 50246.44 yuan and the cost of environmental change was 82807.07 yuan. In the first four years, the cumulative case decrease (CCD) of chemotherapy was 816.96, the cumulative case decrease (CCD) of molluscicide and chemotherapy was 735.54 and the cumulative case decrease (CCD) of chemotherapy was 1420.23. In the implement stage, The CER (cost-effective ratio) of chemotherapy was 30.56, CER for molluscicide and chemotherapy was 68.31 and CER for environmental change was 58.31. In this stage, the most cost effective was chemotherapy, while molluscicide plus chemotherapy was the least cost effective approach.

Table 5.4 The Cost-effectiveness Ratio (CER)of the Three Approaches in the Implementation Stage

	CH	MO	EN
Cost (Yuan)	24969.04	50246.44	82807.07
Effectiveness	816.96	735.54	1420.23
CER	30.56	68.31	58.31

Cost = The cost of cumulative present value for each approach,
CH = Chemotherapy,
MO = Molluscicide and chemotherapy,
EN = Environmental change, molluscicide and chemotherapy,
Effective = Cumulative case decrease,
CER = Cost-effectiveness ratio.

The results of the whole study period are shown in Table 5.5, the cost of the chemotherapy was 57866.02, the cost of molluscicide and chemotherapy was 82807.07 and the cost of environmental change was 118,069.63. The cumulative case decrease (CCD) of chemotherapy was 1392.48, the cumulative expected case decrease (CCD) of molluscicide and chemotherapy was 1341.16 and the cumulative case decrease (CCD) of chemotherapy was 3241. The CER (cost-effectiveness ratio) of chemotherapy was 41.56, CER for molluscicide and chemotherapy was 61.74 and CER for environmental change was 36.48. In whole study period, the most economic approach was environmental change, the least economic approach was the approach of molluscicide and chemotherapy.

Table 5.5 The Cost-effectiveness of the Three Approaches in the Whole Study Period

	CH	MO	EN
Cost (Yuan)	57866.02	82807.07	118069.63
Effectiveness	1392.48	1341.16	3236.24
CER	41.56	61.74	36.48

Cost = The cost of cumulative present value for each approach,
CH = Chemotherapy
MO = Molluscicide and chemotherapy
EN = Environmental change, molluscicide and chemotherapy
Effective = Cumulative case decrease
CER = Cost-effectiveness ratio

5.3 Regression Analysis of the Cost and the Case Decrease in Three Communities

The effect of the number of cases decreased can be directly classified by three different approaches.

The number of cumulative case decrease (CCD) was taken as an independent variable and the cost of Cumulatived present value of each approach as the dependent variables (Table 5.6), and a regression model developed. From the model, the regression coefficient b_i of each approach indicates the cost for one case decrease. That means if we decrease one case, the cost we need to pay for each approach. The smallest coefficient (b_i) will belong the best cost-effective approach.

Table 5.6 Relations Between the Cost of Cumulative Present Value and the Cumulative Case Decrease

Time	COST	CCD1	CCD2	CCD3
1	7967.81	180.00	0	0
2	13908.89	395.04	0	0
3	19422.44	588.00	0	0
4	24969.04	816.96	0	0
5	34355.57	1025.28	0	0
6	40125.99	1115.68	0	0
7	49049.49	1233.12	0	0
8	57866.02	1392.48	0	0
1	14950.44	0	169.97	0
2	26884.65	0	357.26	0
3	38592.17	0	544.06	0
4	50246.44	0	735.54	0
5	57672.03	0	923.02	0
6	63245.95	0	1088.66	0
7	72952.14	0	1223.89	0
8	82807.07	0	1241.16	0
1	32699.70	0	0	291.03
2	45843.87	0	0	525.91
3	58445.27	0	0	962.46
4	70512.98	0	0	1420.23
5	81664.43	0	0	1873.81
6	93437.91	0	0	2319.02
7	105669.32	0	0	2788.24
8	118069.63	0	0	3236.24

COST = Cumulative cost for each approach.
CCD1 = Cumulative case decrease for the chemotherapy,
CCD2 = Cumulative case decrease for the molluscicide and chemotherapy,
CCD3 = Cumulative case decrease for the environmental change, molluscicide and chemotherapy,

A regression model is developed here. In this case the dependent variable is the cost of cumulative present value of each approach, independent variables are the numbers of acCumulative cases decrease for each approach.

The regression equation is

$$COST = a + b_1 CCD_1 + b_2 CCD_2 + b_3 CCD_3$$
$$= 29414.35 + 40.18\, CCD_1 + 56.71\, CCD_2 + 27.65\, CCD_3$$

The adjust R^2 is 0.9899, and F value for test of all goodness of fit is 353.24 with is associated with P < 0.0001. The large F-value for slope rejects the hypothesis $\beta = 0$ and indicated a likely systematic difference among the three approaches.

The coefficients of CCD1 CCD2 CCD3 are statistically significant. CCD1 is estimated to be 40.18 yuan, which means that, if we want to decrease one case of schistosomiasis by chemotherapy, we need to pay 40.18 yuan. CCD2 is estimated to be 56.71 yuan, which means that, if we want to decrease one case of schistosomiasis by molluscicide and chemotherapy, we need to pay 56.71 yuan. CCD3 is estimated to be 27.65 yuan, which means that, if we want to decrease one case of schistosomiasis by environmental change, molluscicide and chemotherapy, we need to pay 27.65 yuan.

Table 5.7 The Regression of Cost of Cumulative Present Value and Cumulative Case Decrease

Parameter	Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT	29414.35 B	12.68	0.0001	2320.176205
CCD1	40.18	13.50	0.0001	2.976674
CCD2	56.71	18.02	0.0001	3.147627
CCD3	27.65	23.25	0.0001	1.189419

5.4 Factors of Individual Getting Infection in Three Communities

In the first four years, the implements of controls were given by the study team. Three communities were given the separate approaches to control. That the people get different of infection with schistosomiasis would be attributed clearly to the different approaches. The logit model was used here to express the probability of infection affected by each approach.

If the approach is effective, the control approach will increase $P(D|X_1,X_2,...)$ and decrease the $P(D|X_1,X_2,...)$. Then a log-odds will be developed. We can

directed compared the log-odds of different approach and other independent variable that we get from the survey.

$$odds = \frac{P(D|x1,x2,...)}{P(\bar{D}|x1,x2,...)} = e^{a+\sum bixi} \quad e^{a+\sum bixi}$$

log-odds = log(odds)=log [$odds = \frac{P(D|x1,x2,...)}{P(\bar{D}|x1,x2,...)}$]

= log[$e^{a+\sum bixi}$]

therefore:

log-odds = $a + \sum bixi$

The from Table 5. , the log-odds regression equation is:

log-odds = - 2.4927** - 0.1985 AGE3
+ 0.4989**AGE10 - 0.2607*AGE20
- 0.0267 SEX - 0.8472**MOLL
- 0.9772**ENVM - 0.1260 DS**
+ 6.7621 IDS**

* P < 0.05
** P < 0.01

Table 5.8 provides the results of logit regression of the probability of individual getting an infection. Eight independent variables enter the model, six independent variables contributed significantly to the individual getting infection.

Table 5.8 The Evaluation of the Probability of the Individual Getting Infection

Variable	Coef.	Standard Error	Wald Chi-Square	P > Chi-Square
INTERCEPT	-2.4927	0.1215	420.8717	0.0001
AGE3	-0.1985	0.1375	2.0833	0.1489
AGE10	0.4989	0.1104	20.4378	0.0001
AGE20	0.2607	0.1160	5.0551	0.0246
SEX	-0.0267	0.0759	0.1241	0.7247
MOLL	-0.8472	0.1045	65.7177	0.0001
ENVM	-0.9772	0.1308	55.8176	0.0001
DS	-0.1260	0.0358	12.3648	0.0004
IDS	6.7621	1.0916	38.3705	0.0001

"-2 LOG L" is 5694.747, χ^2 is 275.321 with DF=8 and P = 0.0001.

A total eight of independent variables enter the model. Two independent variables of Age3 and sex did not have significant effect (P > 0.05). That mean there were no significance different between people getting infection with sex and the age group 3-9 years.

The independent variables age10 (10-19 years age group) and age20 (20-39 years age group) showed big differences with other age groups. For those age groups the coefficient was positive which means the probability of those age groups was higher than the other age groups.

The different approaches can affect individuals getting infection. We cannot evaluate the effects of chemotherapy in the model, because all the three communities get chemotherapy. The approaches of molluscicide and environmental change had a large difference compared with the communities without that approaches because the coefficients of those approaches is negative, that means if we take the molluscicide and environmental approach, the probability for individual getting infection would be decreased.

The density of infected snails had a positive relation with individual of people getting infection. The higher the density of infected snails, the higher probability of infection.