

## REVIEW

# FILARIASIS SURVEILLANCE AT THE POST-CONTROL STAGE IN CHINA

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**Abstract.** From 1956, when filariasis control was first listed in our national program, up to 1991, a cumulative total of 677,931,521 person-time blood examinations and 217,472,045 person-time diethylcarbamazine treatments were made in the whole country, and 835 (96.6%) out of the 864 endemic counties achieved the criterion for control of filariasis. Surveillance data collected in various provinces, autonomous regions and municipalities starting from the second year after they reached the criterion for control of filariasis demonstrated that in 1991 the microfilarial rate in human populations and natural infection of filarial larvae in mosquito vector populations in previous endemic areas had already declined to a very low level, even zero, without resurgence in quite a number of villages. In some places where filariasis was brought under control relatively early, the anti-filarial antibody positive rate of the human population has fallen to a level the same as or similar to that in nonendemic areas. Therefore, the data suggest that in most places where filariasis has been controlled, the transmission of bancroftian filariasis and periodic malayan filariasis has been interrupted. However, filariasis is still endemic in 29 counties in China at present, the danger of introduction of sources of infection by the floating population hasn't been extinguished yet, and there are still a few areas with weak links in filariasis control. Therefore, control work still needs to be strengthened and systematic surveillance must be pursued until the elimination of filariasis in the whole country.

## INTRODUCTION

Lymphatic filariasis is one of the major parasitic diseases in China. It is distributed in the temperate zone, subtropical zone and tropical zone in China from Lelin County of Shandong Province in the north (37° 48' N) to Sanya City of Hainan Province in the south (18° 10' N), and from Zhoushan Archipelago of Zhejiang Province in the east (122° 30' E) to Yaan City of Sichuan Province (103° E) in the west, covering 864 counties in 15 provinces, autonomous regions and municipalities. It was estimated that the total number of filariasis cases before the initiation of the control program was about 30,994,000, of which 21,962,000 were bancroftian filariasis and 9,032,000 were malayan filariasis (Shi and Sun, 1991).

Since 1956, when filariasis control was first included in the national disease control program, a large scale anti-filariasis campaign has been

carried out extensively throughout the endemic areas in China. This campaign has adopted elimination of the source of infection as a main intervention measure, and significant results have been achieved. According to the statistics, a cumulative total of 677,931,521 person-time blood examinations and 217,472,045 person-time diethylcarbamazine (DEC) treatments (including selective treatment, selective treatment in combination with mass chemotherapy or DEC-medicated salt) were carried out in 1956-1991. By the year 1991, 835 endemic counties in the whole country had reached the criterion for control of filariasis (Mf rate less than 1% by the administrative village after the control program), representing 96.6% of the 864 original endemic counties (Table 1). All the previously endemic provinces except Anhui Province had reached the criterion for province-wide control of filariasis early or late in 1983-1990.

In areas where filariasis has been controlled, extensive surveillance is now under way for understanding the post-control fluctuation pattern of transmission and to predict the trend of transmission, thereby to provide a scientific basis for

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Table 1  
Number of counties where filariasis is under control.

Year	Number	Cumulative number	Cumulative rate (%)*
1961-1969	1	1	0.1
1970-1978	70	71	8.2
1979	62	133	15.4
1980	58	191	22.1
1981	75	266	30.8
1982	78	344	39.8
1983	113	457	52.9
1984	120	577	66.8
1985	83	660	76.4
1986	79	739	85.5
1987	42	781	90.4
1988	18	799	92.5
1989	4	803	92.9
1990	20	823	95.3
1991	12	835	96.6

\* Based on 864 endemic counties

working out strategy and intervention measures for ultimate elimination of filariasis (Li and Shi, 1985).

## SURVEILLANCE SYSTEM

### Surveillance areas

**1. Horizontal surveillance:** Stratified cluster sampling for spot selection by the endemic county has been adopted. The principle for spot selection is "more spots, wide coverage in different directions". Special surveillance is conducted in areas where there might be weak links in filariasis control.

**2. Longitudinal surveillance:** This is done by the prefecture in different provinces. In each unit, one village with a population of 1,000-2,000 is selected as a longitudinal surveillance spot, where the Mf rate of the human population and the microfilarial density in positive cases were/are relatively high before/after the control program. Then consecutive longitudinal surveillance is carried out at regular intervals (same season) and fixed places.

### Surveillance methods

**1. Parasitological surveillance:** Peripheral blood is

taken at night (21:00) and 2 blood smears prepared each. Each smear contains 60  $\mu$ l blood. The smears are examined for microfilaria with a microscope after hemolysis and staining.

**2. Mosquito vector surveillance:** Whole village collection and random sampling are used for catching the local predominant mosquito vectors. The target mosquito species are *Culex quinquefasciatus* and *Cx. pipiens pallens* in endemic areas of bancroftian filariasis and *Anopheles anthropophagus* and *An. sinensis* in endemic areas of malayan filariasis. Individual dissection is performed for examining the natural infection of filarial larvae in each mosquito.

**3. Serological surveillance:** Indirect fluorescent antibody test (IFA) with *Brugia malayi* adult worm or microfilaria as antigen or ELISA with *B. malayi* adult worm as antigen are employed for detecting anti-filarial antibody.

Generally, only parasitological surveillance is performed in horizontal surveillance spots, but all the three parasitological, serological and mosquito vector surveillance operations are carried out in longitudinal surveillance spots.

In order to find out whether floating populations would bring in the source of infection of filariasis, laborers coming from filariasis endemic areas in other provinces are sampled for parasitological examination.

#### PRELIMINARY RESULTS OF SURVEILLANCE

According to the surveillance data collected in different provinces (autonomous regions and municipalities) starting from the second year after they reached the criterion for control of filariasis, from 1984 (the earliest was 1983 when Shandong Province announced the control of filariasis in the whole province) to 1991, the cumulative number of blood examinations was 6,585,134 person-times, and the cumulative number of microfilaremia cases detected was 2,621 person-times (Table 2). The mean Mf rate in different provinces confirmed by parasitological surveillance showed a tendency of decline year by year except in Henan Province where the microfilaremia cases increased slightly in 1991 due to the presence of a few villages with weak links in filariasis control. In Shanghai parasitological surveillance has stopped for 3 years since 1989. The result of parasitological surveillance in 1991 showed that among 1,709 villages investigated in 14 provinces (autonomous regions and municipalities), Mf rate = 0 occurred in 1,535 villages, representing 89.8%; Mf rate < 1% occurred in 170 villages, representing 9.9%; and Mf rate > 1% occurred in 4 villages (Table 3). Further investigation revealed that the reason for the Mf rate > 1% in the 4 villages might be that some patients did not receive effective treatment or did not take sufficient DEC-medicated salt (Chang *et al.*, 1992). Therefore, it could not be considered as a real resurgence.

Mosquito vector surveillance in different areas also showed the tendency of decline in natural infection rate of filarial larvae in mosquitos. In 386 villages from 14 provinces (autonomous regions and municipalities) surveyed in 1991, among 342,067 mosquitos dissected and examined, 78 were found to be filarial larva positive, the average natural infection rate being 0-0.3%. Infective filarial larvae were only found in a few individual villages in Henan and Fujian provinces (Table 4).

Serological surveillance for detecting the anti-filarial antibody positive rate in different areas also showed the tendency of decline. The results

of investigations in some areas in 1991 demonstrated that in Shandong, Shanghai, Guizhou, Guangxi and Hunan provinces (autonomous regions, municipalities) where filariasis was brought under control relatively earlier, the antibody positive rate of the human population has already dropped down to a level the same as or similar to that in nonendemic areas (Table 5).

In some areas, parasitological surveillance was carried out in 1991 among the floating population coming from other places. A total of 40,007 persons were examined. In Jiangsu Province, only 8 (0.005%) microfilaremia cases of bancroftian filariasis were found from the 15,343 floating population coming from the adjacent Anhui Province (Table 6).

#### DISCUSSION

The preliminary results of surveillance at the post-control stage in different areas demonstrated that in all surveillance spots except a few individual villages with weak links in the control program, the Mf rate and natural infection rate of filarial larvae in mosquito vectors kept decreasing without resurgence (Tao *et al.*, 1987; Wang *et al.*, 1989; Liu *et al.*, 1989; Wei *et al.*, 1990; Ou *et al.*, 1990; Wu *et al.*, 1990; Li *et al.*, 1990; Liu *et al.*, 1990; Liu *et al.*, 1991). In a number of villages under investigation, the Mf rate and natural infection rate of filaria larvae in mosquito vectors have decreased to zero (Zhong *et al.*, 1989; Ji *et al.*, 1991; Pan *et al.*, 1992). In areas where filariasis was brought under control relatively earlier, the positive rates of IFA or ELISA have already dropped down to a level the same as or near to that in nonendemic areas of filariasis. It is therefore considered that the transmission of bancroftian filariasis and periodic malayan filariasis have been virtually interrupted in most of the areas reaching the criterion for control of filariasis. This opinion conforms to that raised by Shi *et al.* (1988), who suggested that in endemic areas of bancroftian filariasis and malayan filariasis, when the Mf rate of the human population in a village dropped below 1% and the average microfilarial density fell to about 5 mf/60 ml, the remaining microfilaremia cases could become negative successively within 3-5 years even if parasitological treatment stopped. In reality in many areas where filariasis is already under control, the Mf rate and mean Mf density in

Table 2

Preliminary results of parasitological surveillance of filariasis in 1984-1991.

*Province/ Autonomous region/ Municipality	1984			1985			1986			1987			1988			1989			1990			1991		
	No. exam	Positive		No. exam	Positive		No. exam	Positive		No. exam	Positive		No. exam	Positive		No. exam	Positive		No. exam	Positive		No. exam	Positive	
		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%
Shangdong	104,649	87	0.08	135,220	52	0.04	124,680	24	0.02	47,778	2	0.004	19,446	8	0.04	3,093	6	0.09	18,422	4	0.02	7,294	2	0.03
Guizhou				79,000	121	0.15	198,500	84	0.04	107,800	20	0.02	98,094	25	0.03	44,626	18	0.04	35,613	2	0.006	32,345	2	0.006
Shanghai				414	0	0	25,390	1	0.004	202,997	2	0.001	1,907	0	0	0	-	-	0	-	-	0	-	-
Guangxi							92,290	2	0.002	256,577	0	0	216,737	0	0	218,338	0	-	204,378	1	0.0004	172,738	0	0
Sichuan										119,181	10	0.008	90,687	7	0.008	42,856	0	-	29,759	0	0	54,321	0	0
Hunan										28,886	2	0.007	37,436	1	0.003	71,705	0	-	58,627	1	0.002	91,723	0	0
Henan													238,733	85	0.004	150,607	83	0.06	281,890	16	0.006	10,496	35	0.33
Guangdong													189,062	637	0.34	149,139	160	0.11	151,348	132	0.09	67,433	70	0.10
Hainan													4,347	10	0.23	58,439	35	0.06	48,804	15	0.03	34,132	9	0.03
Hubei																190,118	54	0.03	212,301	52	0.02	201,074	15	0.007
Fujian																269,279	218	0.08	313,028	157	0.05	328,520	131	0.04
Zhejiang																			93,392	3	0.003	60,085	9	0.01
Jiangsu																			224,981	91	0.04	154,723	32	0.02
Jiangxi																						79,696	88	0.11
Total	104,649	87	0.08	214,634	173	0.08	440,860	111	0.03	763,219	36	0.005	896,449	773	0.09	1,198,200	574	0.05	1,672,543	474	0.03	1,294,580	393	0.03

\* Anhui not included

Table 3  
Parasitological surveillance of filariasis by village in 1991.

*Province/ Autonomous region/ Municipality	No. villages examined	Microfilarial rate (%)		
		0	< 1%	> 1%
Shandong	26	24	2	0
Guizhou	40	38	2	0
Shanghai	0	-	-	-
Guangxi	161	161	0	0
Sichuan	93	93	0	0
Hunan	106	106	0	0
Henan	14	13	0	1
Guangdong	166	138	28	0
Hainan	44	37	7	0
Hubei	196	187	9	0
Fujian	416	327	89	0
Zhejiang	88	81	7	0
Jiangsu	283	270	13	0
Jiangxi	76	60	13	3
Total	1,709	1,535	170	4

\* Anhui not included

remaining microfilaremia cases are already below those levels. Since there is no reservoir host for *Wuchereria bancrofti* and periodic *Brugia malayi* and filariasis transmission occurs relatively slowly when a large amount of the source of infection is eliminated, the chance for man and mosquito to become infected will be reduced greatly (Sun, 1990). Therefore, in areas where transmission has been interrupted, the remaining few microfilaremia cases would continue to become negative (Zhang *et al*, 1991).

Although an optimistic prospect could be predicted by the available surveillance data, some points are still worth attention, such as: (1) In Shandong Province which reached the criterion for control of filariasis in whole province early in 1983, very few remaining microfilaremia cases and positive mosquitos could still be found in 1991; (2) there might still remain a few areas with weak

points for carrying on the control program, where the Mf rate is still above 1%; (3) since in some areas (29 counties) filariasis has not been brought under control yet, it is still possible to import an exotic source of infection to areas where filariasis is already under control along with the population movement. Therefore, control activities still need to be strengthened and systematic surveillance should be pursued. The coverage of horizontal surveillance should be expanded. Besides, in order to cope with the needs of post-control surveillance, immunological surveillance techniques which are highly sensitive and specific, cost-effective and easy to be applied widely should be developed, so as to substitute the present routine nocturnal blood examination and mosquito investigation methods, in order to raise the efficiency in filariasis surveillance in this country with such a huge population and quicken the process of eventual elimination of filariasis.

Table 4

Results of mosquito vector surveillance of filariasis in 1991.

*Province / Autonomous region/Mu- nicipality	No. of villages surveyed	No. of mosquitos dissected	No. of positive mosquitos	Average infection rate (%)	No. L3 positive mosquitos	Average L3 infection rate (%)
Shandong	6	21,062	20	0.09	0	0
Guizhou	6	7,543	0	0	0	0
Shanghai	0	-	-	-	-	-
Guangxi	69	107,531	0	0	0	0
Sichuan	6	12,052	0	0	0	0
Hunan	6	5,793	0	0	0	0
Henan	8	34,706	32	0.09	20	0.06
Guangdong	9	18,672	1	0.005	0	0
Hainan	2	2,215	7	0.32	0	0
Hubei	6	4,650	0	0	0	0
Fujian	247	101,658	5	0.005	2	0.002
Zhejiang	8	1,443	0	0	0	0
Jiangsu	11	24,190	13	0.05	0	0
Jiangxi	2	552	0	0	0	0
Total	386	342,067	78	0.02	22	0.006

\* Anhui not included

Table 5

Results of detection of antifilarial antibody in 1991.

Province / Autonomous region / Municipality	No. of villages examined	Method		No. of persons examined	No. of antibody positive	Positive rate (%)	
		IFA	ELISA			Max	Min
Shandong	6	+		943	6	0.64	0
Guizhou	3	+		1,503	99	6.60	6.10
Shanghai	9	+		3,011	42	5.61	0
Guangxi	46	+		25,124	583	3.12	1.39
Hunan	9	+		4,027	115	5.45	1.03
Henan	4	+	+	328	86	26.20	15.50
Hainan	4	+		1,514	120	13.13	2.33
Fujian	12	+		5,998	247	8.85	1.03

Table 6

Results of parasitological surveillance of filariasis in floating population (1991).

Province / Autonomous region	No. of persons examined	No. of persons positive	Positive rate (%)
Shandong	1,236	0	0
Guizhou	358	0	0
Guangxi	5,363	0	0
Henan	1,970	0	0
Hubei	1,284	0	0
Fujian	14,026	0	0
Zhejiang	427	0	0
Jiangsu	15,343	8	0.05
Total	40,007	8	0.02

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