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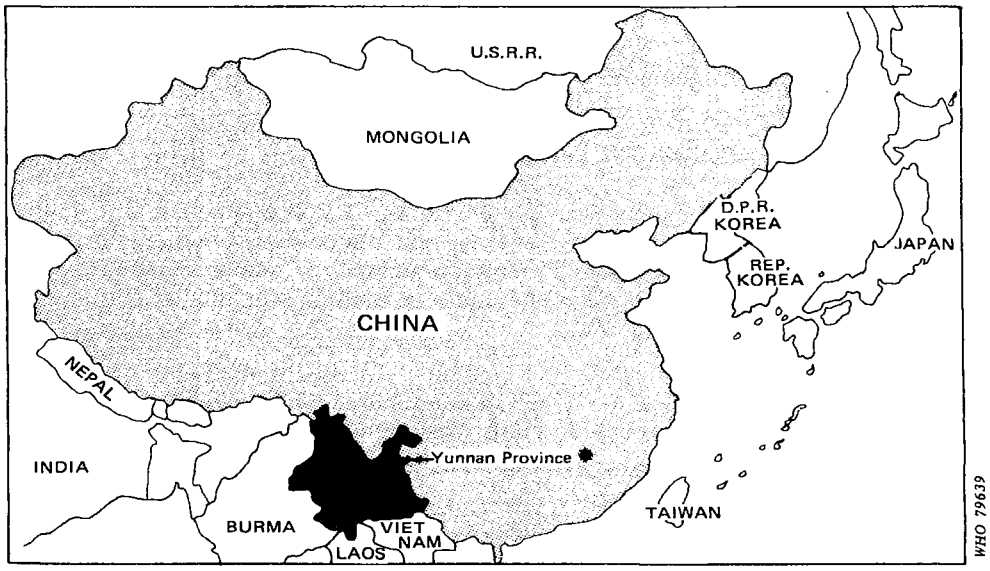
SMALLPOX ERADICATION IN CHINA

This report on the eradication of smallpox in the People's Republic of China was submitted by the Government to the Director General of WHO through a visiting WHO team. The report was received in Geneva on 31 July 1979.



* Province of last reported smallpox case in China, March 1960

1. BACKGROUND INFORMATION

Geography

The People's Republic of China covers 9.6 million square kilometres in the eastern part of Asia, and is in the WHO Western Pacific Region. Korea is to the east and Viet Nam, Laos and Burma to the south. On the southwest and west are India, Bhutan, Sikkim, Nepal, Pakistan and Afghanistan. To the northwest and northeast is the USSR, and Mongolia is to the north.

The terrain is generally high on the west and low on the east. However, the topography is complicated and varied. Mountains, hilly lands and plateaux occupy about two thirds of the total area of the country. Altitude divides the country into 3 main regions from west to east:

- the plateau of Chinghai and Tibet;
- the plateau of Yunnan and Kweichow, the plateau of Kansu and Shansi, the plateau of Inner Mongolia, as well as Szechuan Basin;
- the plains of the north-eastern provinces, north China, the middle and lower Yangtze valley and the hilly lands of the south-eastern provinces.

China has a monsoon climate which varies considerably over her vast territory and complex terrain. In the summer the temperature is usually high with abundant rain. In the winter the temperature difference between north and south China is great.

Railways are the main channels of communication and transportation, and exist in all provinces and autonomous regions, with the exception of the Autonomous Region of Tibet. The highway system has greatly increased in length in the course of 30 years forming a network throughout the whole country. There are more than 50 internal air routes connecting about 70 cities or towns. International airlines connect China with many countries in Asia, Europe, Africa and the Americas.

Population

The population of the country is 975.23 million. The majority of the population, comprising 94% of the total, is of Han nationality and distributed in all the provinces and autonomous regions. Mongol, Moslem, Tibetan, Uygur (Uighur), Miao, Yi, Chuang, and about 50 other ethnic minorities comprise the remaining 6% of the total population, distributed mainly in the north-western, south-western, north-eastern and south-eastern provinces, as well as in the province of Taiwan. The Han language is that most widely used, although people in the regions inhabited by the minorities speak their own national languages.

Administrative Division

For administrative purposes, the country is divided into 22 provinces, 5 autonomous regions and 3 municipalities, all directly under the Central Government (Table 1 and Annex 1).

Organization of Health Services

After liberation of the country in 1949, the health services have been greatly increased and their work has improved substantially. There are general hospitals, special hospitals, infectious disease hospitals, anti-epidemic stations, maternity and child health organizations, and special preventive institutes in large and middle sized cities. In the districts of the municipalities there are district hospitals, district epidemiological stations and maternity and child health services; in the sectors and subdistricts there are polyclinics and medical stations. In the districts (or counties) of the provinces there are also district hospitals, epidemiological stations, maternity and child health services. In the communes there are health centres, and in the production brigades barefoot doctors and other paramedical personnel work. The barefoot doctors are responsible for the majority of medical and related health work in the peripheral and provincial land areas, while the regional and municipal hospitals and epidemiological stations are the centres for medical, hygiene and anti-epidemic

TABLE 1

ADMINISTRATIVE UNITS IN PEOPLE'S REPUBLIC OF CHINA

	Peking	Shanghai	Tientsin	Hopei	Shansi	Inner Mongolia	Heilungkiang	Kirin	Liaoning	Shantung	Kiangsu	Anhwei	Chekiang	Kiangsi	Fukin	Honan	Hupei	Hunan	Kwangtung	Kwangsi	Shensi	Ninghsia	Kansu	Chinghai	Sinkiang	Szechwan	Kweichow	Yunnan	Tibet	TOTAL	
Provinces[a]																															22
Autonomous Regions																															5
Municipalities[b]																															3
Quarters				10	7		8	3	2	9	7	9	8	6	7	10	8	10	7	8	7	2	8		9	12	6	7	5	175	
Administrative Quarters																			1											1	
Autonomous Quarters								1										1	1				2	6	5	3	2	8		29	212
Mong						4	1	1	1																					7	
Municipalities				9	7	5	13	10	11	9	11	10	3	8	6	14	6	10	10	6	5	2	4	1	7	11	4	4	1	187	187
Districts	9	10	5	137	101	16	63	39	44	106	64	70	65	80	62	110	73	86	94	72	92	16	66	32	74	181	70	106	71	2014	
Autonomous Districts				2			1	2	2									4	3	8			6	5	6	3	9	15		66	
Chi						27	9	7	7													1	2							53	2137
Autonomous Chi							3																							3	
Towns																												1		1	

[a] Taiwan: data not available

[b] Under central government

work. They have the responsibility to help the lower medical and preventive services in technical and administrative activities throughout the provinces, autonomous regions and municipalities. Free medical care is enjoyed by all staff of government offices and institutions, university and college students and factory and mine workers. The production brigades in rural areas have their own cooperative medical services. Prophylactic biological preparations including all vaccines are given free of charge.

The number of hospitals, hospital beds and health personnel in various categories are presented in Table 2.

TABLE 2

Numbers of hospitals, hospital beds and health personnel, China, 1978

HOSPITALS AND HOSPITAL BEDS

Category	Hospitals	Beds
General hospitals	7,539	873,310
Chinese medicine hospitals	447	33,973
Hospitals attached to medical colleges	138	57,258
Infectious diseases hospitals	106	16,064
Mental hospitals	219	42,195
Tuberculosis hospitals	107	25,420
Maternal and child health centres	112	8,993
Pediatric hospitals	23	4,712
Rural commune hospitals	55,016	747,349
Other hospitals	714	47,117
Total	64,421	1,856,391

HEALTH PERSONNEL

Category	Number
Chinese medicine physicians	251,088
Chinese medicine pharmacists	94,854
Western medicine physicians	358,520
Pharmacists	16,749
Laboratory technicians	7,005
Other technicians	8,447
Felchers	423,410
Nurses	406,649
Midwives	70,552
Assistant pharmacists	67,633
Assistant lab. technicians	51,541
Other assistant technicians	44,924
Assistant nurses	180,711
Junior pharmaceutical personnel	87,334
Junior laboratory personnel	40,260
Other junior health personnel	354,254
Total	2,463,931

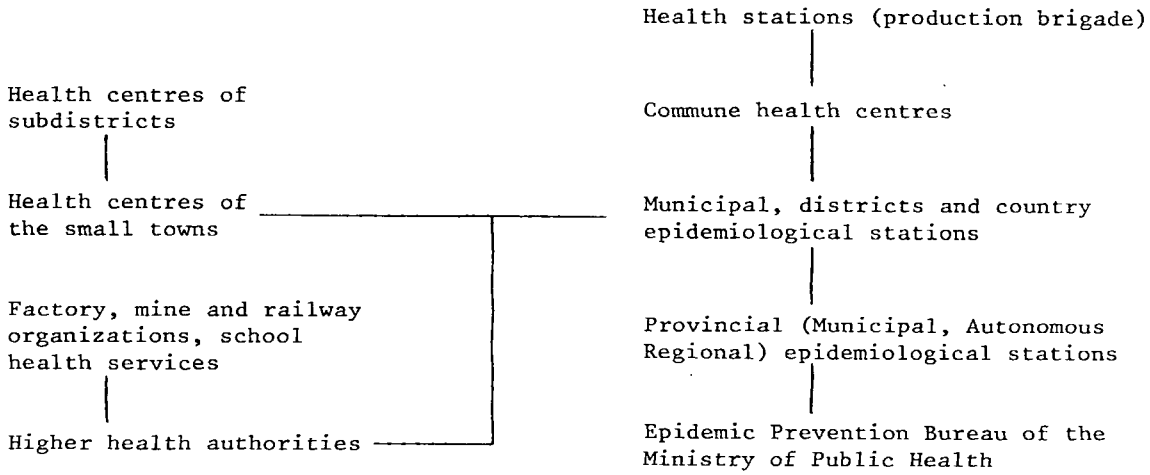
2. NOTIFICATION AND CONTROL OF COMMUNICABLE DISEASES

For the enforcement of the notification and control of communicable diseases, the Ministry of Health, in 1955, announced "Methods of Control of Communicable Diseases", having received the endorsement of the State Council. "Regulations for the Control of Acute Infectious Diseases in the People's Republic of China", issued in 1978, classified smallpox as an infectious disease requiring urgent action. Practitioners of traditional Chinese medicine, medical doctors, laboratory workers, health inspectors, barefoot doctors and factory paramedical personnel have the duty of reporting smallpox cases if encountered. Whenever a smallpox patient or a suspected case of smallpox is seen, it should be immediately reported to the higher medical authorities by telephone or telegram; at the same time the notification card for acute infectious diseases should be submitted. The higher medical authorities must examine the case and report it to the local health authorities. In the case of smallpox the report should be sent within 6 hours in the city and within 12 hours in the rural areas. The local health authority, upon receiving the notification, should report the case to the municipal or district epidemiological station concerned and the latter should carry out the emergency containment measures; these include isolation and care of the patient, collection of specimens for virological examination, disinfection, quarantine of contacts, surveillance in the locality for new cases, epidemiological investigation of the smallpox case and emergency vaccination. This work is done by the local and higher level epidemiologists and their assistants.

The sequence of reporting in this system is shown in Figure 1.

Figure 1

Sequence of Reporting of Communicable Diseases



In addition, the Institute of Epidemiology and Microbiology of the Chinese Academy of Medical Sciences is responsible for assisting the provincial, municipal and regional epidemiological stations in performing investigations and anti-epidemic work.

The Institute for the Control of Biological Preparations and the Institute for the Production of Biological Preparations, under the Ministry of Health, aid the provincial and municipal epidemiological stations in immunization activities.

As chickenpox is not a notifiable disease, no data about its prevalence is available. Table 3 shows the number of cases and deaths due to selected infectious diseases in China in 1978.

TABLE 3

Number of Cases and Deaths due to Infectious Diseases
China, 1978 [a]

		Cases	Deaths
1.	Smallpox	-	-
2.	Diphtheria	20,084	1,697
3.	Meningococcal meningitis	107,337	4,313 [b]
4.	Pertussis	595,174	982 [b]
5.	Scarlet fever	139,783	106
6.	Measles	1,112,600	6,162 [b]
7.	Influenza	2,658,877	468 [b]
8.	Dysentery	2,640,313	6,242 [b]
9.	Typhoid and paratyphoid fever	80,986	345 [b]
10.	Infectious hepatitis	411,312	1,068 [b]
11.	Poliomyelitis	10,408	259
12.	Epidemic encephalitis B	18,082	2,578 [b]
13.	Malaria	3,096,240	132
14.	Kala Azar	99	1
15.	Tiga Encephalitis	178	14
16.	Tutsugamushi disease	999	3
17.	Haemorrhagic fever	15,029	996
18.	Leptospirosis (Weil's disease)	20,384	545

[a] Figures include number of outpatients

[b] Incomplete statistics

3. EPIDEMIOLOGICAL DATA ON SMALLPOX

In 1950, there were 67,021 reported smallpox cases distributed in all provinces, municipalities and autonomous regions. Mass vaccination in many provinces and municipalities, as well as containment measures, decreased the number of provinces having smallpox to 17 by 1954, when the annual number of cases reported was 446 (Table 4). After 1954, no more smallpox cases occurred in the large and medium sized cities. In 1960, the last cases were reported in rural areas, and no cases have been reported in the country since that time.

The Last Outbreak of Smallpox*

Monglian and Cangyuan districts are in the western border of Yunnan province adjoining the territory of Burma (Figure 2). In the 1950s, the boundary lines between China and Burma were not yet defined. Contact between civilians of both countries was very frequent. In 1958, in the Monglian district, there was an outbreak of smallpox, following its introduction from Burma, with 333 cases and 59 deaths. In the next year, another outbreak occurred in

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* Refer to "Special Report on Smallpox in Yunnan Province." (SME/79.10)

TABLE 4

Reported Smallpox Cases by Administrative Division by year,

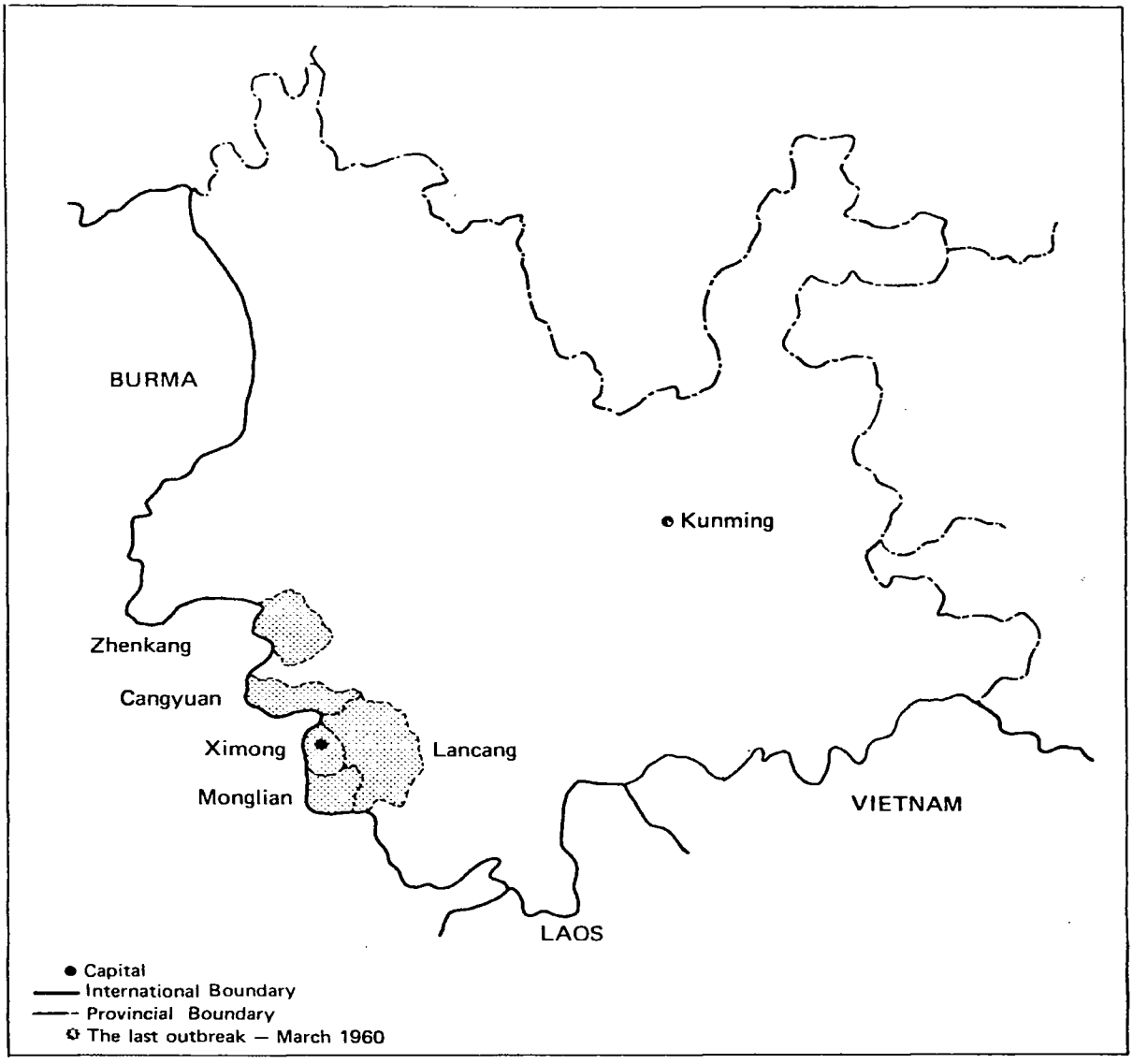
China 1950-1979

Division	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961-1979
Inner Mongolia					4	2	8					
Liaoning					3							
Kirin					6	2						
Heilungkiang					8							
Anhwei					2	1						
Shensi					9	6						
Kansu					7	5	2	1				
Chinghai												
Sinkiang					112	423	433	114				
Honan					31		6		1			
Hupei					7							
Kwangtung					2							
Szechwan					152	18	138	108	166			
Kweichow					2							
Kiangsi					1							
Yunnan					100	32	3	92	333	743	28	
Tibet						23	4				16 [a]	
TOTAL	67021	68094	11311	3425	446	512	594	317	500	743	44	0

[a] Details not available. Refer to comments in document SME/79.11, sections 6 and 8.

FIG. 2

YUNNAN PROVINCE : LOCATION OF DISTRICTS AFFECTED BY SMALLPOX IN 1959 - 1960



Cangyuan which was also associated with a smallpox outbreak in Burma; there were 672 cases and 96 deaths. In both 1958 and 1959, there were some sporadic cases in the adjacent districts including Zhenkang and Ximong Districts.

The causes for the 1959 outbreaks in Cangyuan were the frequent contact between the civilians of both countries, by crossing of the temporary boundaries, the harassing activities of the remnants of the Kuomintang troops in the border regions and the incompleteness of mass vaccination efforts in these regions. In 1959, there were an estimated 12,518 unvaccinated persons in Cangyuan, and in the sector of Danjia of the same district, the rate of vaccination coverage was only 39.7%. It is documented that, in 1959, 6 infected immigrants came home from Burma to Jiada village, Danjia subdistrict in Cangyuan district. Some time later, another two civilians named Li Legao and Yang Laoer, suffering from smallpox, came back to the villages Banmo and Bankao respectively. These importations resulted in the transmission of the disease throughout the whole district. The outbreak began in January and reached its peak in March with decreased incidence in April. Sporadic cases continued to occur from May and through June and July. In August the number of cases again increased, to fall again from September to November as anti-epidemic and other containment measures were carried out by the local health services with assistance from members of the provincial epidemiological station (Table 5).

TABLE 5

Reported Smallpox Cases by Month, Cangyuan District, Yunnan Province, 1959

Month	Cases
January	7
February	45
March	413
April	108
May	9
June	2
July	4
August	9
September	33
October	25
November	17 [a]
December	--
Total	672

[a] No case after 18 November.

All of the six subdistricts in this district had been affected by smallpox with the exception of Yanshuai subdistrict which was separated from the others by high mountains. In the five affected subdistricts, all 24 sectors were involved. The highest incidence was seen in Danjia subdistrict (Table 6). Of a total of 672 cases of smallpox reported from Cangyuan District in 1959, 270 (40.2%) were 10 or less years of age (Table 7). Epidemiologically related to this outbreak was the occurrence of 20 cases of smallpox with 2 deaths in a village of Monghai District early in 1960.

TABLE 6

Reported Smallpox Cases and Deaths by Subdistrict, Cangyuan District, 1959

Subdistrict	Population	Cases	Deaths
Yonghe	4302	48	6
Danjia	3355	447	39
Bonhong	8518	36	1
Nuo Liang	15500	83	36
Mongjiao	7080	58	14
Yanshuai	19910	0	0
TOTAL	58665	672	96

TABLE 7

Age and Sex Distribution of Reported Smallpox Cases Cangyuan District, 1959

	Age Group (years)	Cases	Percentage
A. Age:	<1	25	3.7
	1-10	245	36.5
	11-18	102	15.2
	19-30	212	31.5
	31+	88	13.1
	TOTAL	672	100.0
B. Sex:	Male	360	53.6
	Female	312	46.4

The last episode of local smallpox transmission

Ximeng district is a border district adjoining Burma (Figure 2). In December 1959, a girl, 9 years of age, came with her father from Banyue village in Burma to Dai Cao La village, Jingkan commune, Xinchang subdistrict, Ximong district to visit her uncle. She was suffering from smallpox at the time and beginning to develop the rash. In Dai Cao La village, she infected another girl, La Hausa, aged 11, who subsequently along with her father visited an aunt in another village, Yong Bing, in the same commune. As a result 5 individuals were infected in Yong Bing village. Later, another commune named Li Sao was infected and two cases of smallpox occurred. From December 1959 through March 1960 there were altogether 8 cases of smallpox with one death. A man named Hu Xiaofa, then 23 years of age, was the last case in the outbreak and the last locally infected case of smallpox in China. He was infected in March 1960.

The last imported smallpox case

At the same time, March 1960, in Jingxin subdistrict of Monglian district, there was also another case of smallpox, a young man named Ya Ah, who was infected in Burma and came back after the onset of the illness. He was the last case of imported smallpox in China; he died in 1974 from unrelated causes. No secondary cases occurred following this importation due largely to the massive vaccination in this area in 1960, as well as the enforcement of other containment measures. Also, there had been an outbreak of 333 smallpox cases with 59 deaths in the area in 1958; the herd immunity was probably still high.

Suspected smallpox cases after the last outbreak

In 1962, a total of 42 cases of rash disease, suspected as being smallpox, were reported from Monghai, Monglian and Ximong Districts of Yunnan Province. On investigation, it was found that 32 cases had smallpox vaccination scars. There were 2 deaths, but the other 40 cases recovered without facial scarring. It was concluded that the cases were part of a chickenpox epidemic occurring in the region at that time.

In May 1963, in Ehshan district of Yunnan province, one suspected case of smallpox was reported. The patient, Chang Xiru, was a girl of 6 years old. Her illness began on 14 May and she developed a skin rash. One week later, her brother and another child of her neighbour's developed skin rashes. The preliminary diagnosis was suspected smallpox. All three patients were isolated and containment methods were enforced as if for smallpox. Following receipt of the report, the epidemiological station of Yunnan province organized a group of experts and public health personnel who visited the area. Clinical diagnosis of the cases was made by this group and an epidemiological investigation conducted. All evidence pointed to a final diagnosis of chickenpox. There were 28 similar cases, none of which had any history of chickenpox in the past, and all had been vaccinated against smallpox. Specimens from vesicles of the first 3 cases were taken and microscopy of the stained smears, inoculation of cornea and testis of rabbits and inoculation of chorioallantoic membrance of chick embryo were performed. No evidence of variola virus was found in any of these tests. Follow-up examination showed that none of the 28 cases developed pockmarks.

There were six suspected smallpox cases in other areas from 1961 to 1967, from which specimens were collected for laboratory testing. None of them proved to be smallpox (Table 8).

TABLE 8

Results of Testing of Specimens from
Suspected Smallpox Cases, China, 1961-1967

Patient's Name	Age	Sex	Clinical [a] diagnosis	Examination		Testing		Result for variola virus
				Place	Year	Material	Method	
HAI SHENG-BAO	23	M	? Chickenpox ? Smallpox	Peking	1961	pus	CAM	Negative
YAN SAN-NU	8	F	Suspected Smallpox	Nei-Zhu	1963	pus	CAM,cell culture	Negative
LI SI-XIAO	12	M	Suspected Smallpox	Nei-Zhu	1963	pus	CAM,cell culture	Negative
N.Z. No5			Suspected Smallpox	Nei-Zhu	1963	pus	CAM,cell culture	Negative
WANG ZHENG-LI			Drug reaction (SPX to be [b] excluded)	Peking	1966	pus	CAM	Negative
LIN WEN-BIN			Pox type virus infection (SPX to be excl.)	Fukien	1967	pus	CAM,cell culture, rabbit inoc.	Negative

[a] As recorded [b] SPX = smallpox

4. SMALLPOX VACCINATION AND VACCINES

Policy

Immediately after liberation in 1949, all the health organs in the country began the first of several campaigns for general mass vaccination against smallpox. In October 1950, the State Council of the Central Government issued a "Notice on the Campaigns for Smallpox Vaccination of Autumn 1950" which expressed the formal decision to execute a generalized mass vaccination campaign for all of the people. At the same time, the Ministry of Health announced "Temporary Regulations for Smallpox Vaccination", ruling that all infants should be vaccinated 6 months after birth and revaccinated at the ages of 6, 12 and 18 years. Smallpox vaccinations were given to 500 million people from 1949 to 1952.

In 1959, because several outbreaks of smallpox had occurred following importation of cases from the neighbouring countries into China, it was decided to implement another general mass vaccination campaign. This began in 1960 and aimed to reinforce the achievement made to date in the reduction of the incidence of smallpox, to raise the level of herd immunity against smallpox and to prevent transmission of smallpox in the event of its importation into the country. In this campaign, smallpox vaccination in the border areas was given first priority.

In 1962, the "Regulations for Smallpox Vaccination" were revised. It was decided that in addition to the primary vaccination of all newborn infants at the age of 6 months, the rest of the population would be revaccinated once every 6 years, one sixth of the population each year. Revaccination would not be required for people older than 55 years. The population living within 50 kilometers of the borders of China with other countries would be vaccinated once every 3 years.

In 1978, because of the progress of global eradication of smallpox, the regulations for smallpox vaccination were again revised. A decision was made that after the primary vaccination of infants at one year of age, revaccination was to be given only to children between 7 and 10 years of age. High risk personnel, such as the laboratory workers handling variola and vaccinia viruses, physicians and health officers dealing with infectious diseases, were to be revaccinated every 6 years.

The method of implementation of the campaigns of general mass smallpox vaccination amongst the people, both in 1949-1952 and in 1959, was as follows. A directing committee of leaders was organized by the joint efforts of the health authorities and epidemic prevention departments in every province, municipality, and autonomous region. They were responsible for the organization of local health personnel and training of medical and paramedical workers to form vaccination teams and perform the vaccinations. The teams went to each village or courtyard to vaccinate all the people, using the list of names of all the members of the brigade or courtyard. Children in kindergartens and the schools were vaccinated at these locations. During the first visit nearly 90% of the people could be vaccinated. Others were vaccinated in the health centres or polyclinics. The members of governmental organs, institutions, factories, etc., were vaccinated in the health services located where they worked. Vaccination was done by multiple pressure or scratch (2 insertions) methods.

Every new born infant is registered and has a vaccination card. All vaccinations, including poliomyelitis, measles, DPT, TAB and smallpox are recorded on the card, which is kept in the health centre in the institution, or by the barefoot doctors in the villages.

Vaccines

There are 8 institutes for the production of vaccines and other biological products; they also conduct research to improve the quality of their products. To improve the quality of smallpox vaccines, meetings were held on the production of smallpox vaccine every three years from 1955-1964, and in 1970 and 1974. Experiences were discussed and regulations in regard to production and control of vaccines were revised.

At present, the smallpox vaccine used is of the fluid form, the stability of which is raised by the addition of protease peptide as a preservative. The vaccine is packaged in capillary tubes and can be kept at 4°-8° C for at least 6 months or at 20° C for 3 months. Lyophilized vaccine with an expiry time of one year has been made for the subtropical areas along international borders in the south and southwestern provinces. The quantities of vaccine issued for use yearly from 1950-1963 ranged from 84 to 264 million doses (Table 9). In the years from 1964, between 100 and 160 million doses have been issued annually.

TABLE 9

Smallpox Vaccine Issued by Year, China, 1950-1963

Year	Doses (Millions)	Year	Doses (Millions)
1950	129	1957	100
1951	160	1958	99
1952	264	1959	118
1953	165	1960	84
1954	99	1961	170
1955	96	1962	110
1956	107	1963	100

5. INVESTIGATIONS OF POCKMARKS AND VACCINATION SCARS

An investigation was carried out in Monglian, Lancang and Ximong districts and Kunming municipality in Yunnan province in the spring of 1979: a total of 37,318 individuals were examined in the 3 districts, of which 33,974 (91%) were found to have vaccination scars (Table 10). The lowest rates were 65.5% in the rural areas and 89.0% in the cities or towns; the unvaccinated were all younger children. For example, in Monglian, there were 1,586 children of 0-4 years examined, and 487 (30.7%) of them were not vaccinated.

TABLE 10

Results of Vaccination Scar Survey, Yunnan Province, 1979

Age Group	3 Rural Border Districts [a]			Kunming Municipality [b]		
	Persons examined	Persons with vaccination scar	Per cent	Persons examined	Persons with vaccination scar	Per cent
0-4	3493	2287	65.5	773	688	89.0
5-19	6502	6232	95.8	12323	11412	92.6
20+	7221	6549	90.7	7006	6806	97.1
TOTAL	17216	15068	87.5	20102	18906	94.1

[a] Monglian, Lancang and Ximong Districts

[b] Provincial capital

At the same time, persons were examined for facial pockmarks. Overall, 764 persons with pockmarks were found among the 37,318 examined in 4 localities (Table 11). Of 20,102 individuals examined in Kunming Municipality, 56 bore pockmarks. In Ximong District, a rural border area, 420 of 2,174 persons had facial pockmarks (290 aged 20-49 years, and 130 aged 50 years and over). In Monglian District 7,157 persons (almost 10% of the population) were examined and 256 found with facial pockmarks. Of these, 158 suffered smallpox before liberation, while most of the remainder were attacked during the 1958 epidemic. The age distribution of these 256 persons is shown in Table 12; none was below 22 years of age.

TABLE 11

Results of Pockmark Survey, Yunnan Province, 1979

Locality	Persons examined	Persons with pockmarks
Kunming	20102	56
Monglian	7157	256
Lancang	7885	32
Ximong	2174	420
TOTAL	37318	764

TABLE 12

Age Distribution of 256 Pockmarked Persons, Monglian District, 1979

Age group	Persons with pockmarks
0-21	0
22-29	64
30-39	63
40-49	62
50-59	36
60+	31

TABLE 13

Age Distribution of 764 Pockmarked Persons, Yunnan Province, 1979

Age group	Persons examined	Persons with pockmarks
0-4	4266	0
5-19	18825	0
20+	14227	764
TOTAL	37318	764

It is shown in Table 13 that all of the 764 persons found with pockmarks during the survey were 20 or more years of age.

CHINA – ADMINISTRATIVE DIVISIONS