

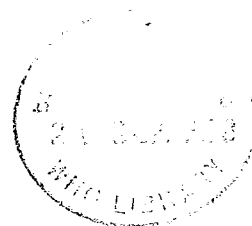


SMALLPOX ERADICATION IN NEPAL

INDEXED

by

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Introduction

In 1962 smallpox control activities were commenced in Nepal and in 1967 an eradication programme was started. The last case of smallpox occurred on 6 April 1975. Eradication of smallpox was declared on the first day of the Nepalese new year 2034, corresponding to 13 April 1977. This paper reviews the important features of the Smallpox Eradication Programme in Nepal.

General information

Nepal is a land-locked mountainous country bordered by China to the north and India to the south. It is about 800 kilometres long and 160 kilometres wide and has an area of 140 080 square kilometres. It can be divided, according to altitude, into three geographical terrains: the mountains, the hills and the plains which are also known as the "Terai". The mountain area which ranges from 4880 metres to 8848 metres above sea level accounts for about 35% of the total land area but is inhabited by only about 10% of the population. The hills ranging from 305 metres to 4880 metres in altitude constitute about 44% of total land area and are inhabited by about 52% of the population. The Terai accounts for about 20% of the land area and about 37% of the population.

The country is divided into four development regions which are further divided into 14 zones, 75 districts and over 3000 panchayats which are the smallest units of the political and administrative structure (Fig. 1).

The population of Nepal according to the 1971 Census¹ is 11 555 983, with the Male to Female Sex Ratio of 1.01. From the same census Crude Birth Rate (CBR) and Crude Death Rate (CDR) were estimated to be 42.87 and 22.80 per 1000 population respectively, with a population growth rate of 2% per annum.² The Infant Mortality Rate (IMR) was estimated to be 172.2 per 1000 live births. The corresponding figures according to the Nepal Health Survey of 1965-1966³ are CBR - 54, CDR - 27, Annual Growth Rate - 2.7% and IMR - 152. The Nepal Fertility Survey of 1976⁴ estimated the CBR to be 43.6 and the IMR 152.

Historical information about smallpox

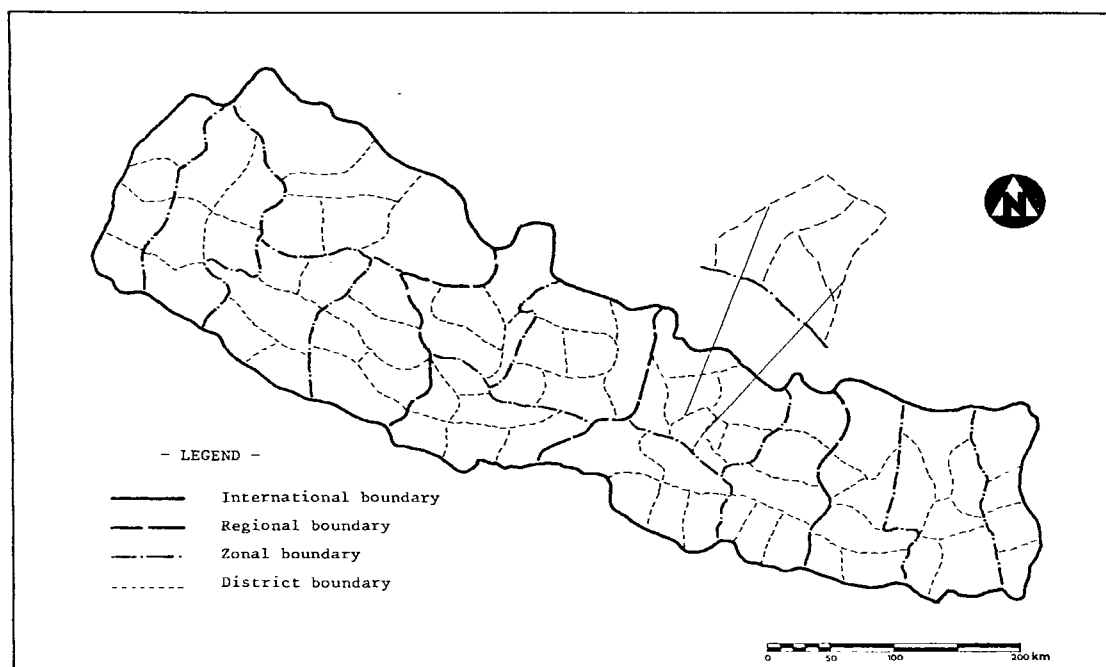
There is no record of the incidence of smallpox in Nepal until the recent past. But since the disease appears to have been occurring in neighbouring India and China from the earliest times,⁵ it can be presumed that smallpox must have existed in Nepal for a very long time. From time immemorial, there has been a temple in Nepal for Sitala, Goddess of Smallpox, although the present temple at Swayambhu in Kathmandu was built less than two centuries ago after the abdication of King Rana Bahadur Shah.⁶

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FIG.1. ADMINISTRATIVE DIVISIONS OF NEPAL



It was observed that epidemics tended to occur in cycles averaging five years and the last major epidemic prior to the launching of Smallpox Eradication Programme (SEP) occurred in 1958 in Kathmandu.⁷ A survey carried out in Kathmandu Valley in 1965 showed that about 16% of the people examined had facial pockmarks. According to the Nepal Health Survey³ the percentages of persons with facial pockmarks in urban Kathmandu were 6, 13 and 24 respectively in the age-groups 0-9 years, 10-29 years and 30+ years. The figures for the rural areas varied considerably from 0 to 43%. It is clear that smallpox has been a major health problem in Nepal.

The disease had affected many royal families of Europe during the sixteenth and seventeenth centuries⁵ and similarly it affected the royal family in Nepal.⁶ King Girvana died of smallpox on 20 November 1816 at the young age of 21. The disease also affected the royal court of King Rana Bahadur Shah. A prominent figure in the court suffered from the disease and his disfigurement and subsequent suicide led to the desecration and destruction of many temples including the previous Sitala temple at Swayambhu.

Variolation was practiced in the rural areas of Nepal until very recently. When it was introduced into Nepal is not known but it had been practiced in China for thousands of years and also in India. In Nepal it was well known during the reign of King Prithvi Narayan Shah, the founder of Modern Nepal more than two centuries ago.⁶

Organization of the Smallpox Eradication Programme

The Smallpox Control Pilot Project (SCPP) was started in the three districts of Kathmandu Valley in 1962 with the aim of vaccinating 80-90% of the population, but due to administrative problems and social and cultural resistance this target could not be achieved. A sample survey in late 1964 in Kathmandu Valley showed that about 65% of the people examined had a vaccination scar.⁸ Field operations were modified in order to achieve a higher vaccination coverage.

In 1965, although vaccination remained the primary objective, reporting of smallpox cases and deaths was emphasized. However, reporting remained incomplete and irregular. Vaccination activities were commenced on local initiative in some districts outside of Kathmandu Valley.

In conformity with the decision of the World Health Assembly in 1966, His Majesty's Government of Nepal decided to launch the Smallpox Eradication Programme by converting the existing pilot project in 1967. The area of operations was expanded gradually each year until the whole of the country was covered by 1973 (Table 1).

TABLE 1. EXPANSION OF SMALLPOX ERADICATION PROJECT

Year	No. of districts under SEP	Year	No. of districts under SEP
1962	3	1970	41
1963	3	1971	50
1964	3	1972	58
1965	3 ^a	1973	75
1966	3 ^a	1974	75
1967	3 ^a	1975	75
1968	15	1976	75
1969	29	1977	75

^a Does not include the districts in which smallpox vaccination was done on local initiative.

Each district had a Smallpox Eradication Programme office manned by four to 13 permanent vaccinators and an assistant supervisor. In 50 of those offices, there was a district supervisor and the remaining 25 districts were administered by the district supervisors of the adjoining districts. There were senior supervisors at the zonal (later regional) level. At the headquarters, the programme director was assisted by technical and administrative staff.

Vaccination

Vaccination was the only objective at the start of the Smallpox Control Pilot Project. The basic strategy was to vaccinate the entire population of the area under operations. Later, as the eradication programme was extended to each new district temporary vaccinators were employed for three months to vaccinate the entire population. This was followed by maintenance vaccination under which the permanent vaccinators went house to house all the year round to vaccinate the newborn babies and those missed during the initial round and to revaccinate everyone every three years.

The number of vaccinations given each year is shown in Table 2. The large increase in the number of vaccinations given in the year 1971/72, as compared to the previous years, was due to a major change in the strategy of the programme in 1971.⁹ Vaccination which was most acceptable to the people during the winter months had been carried out all the year round but from that time was limited to four winter months. During these months temporary vaccinators were employed in all districts under operations and thus permanent vaccinators were made available for surveillance. Many of the population were vaccinated repeatedly. The fall in the number of vaccinations in 1976/77 was due to the fact that after smallpox eradication was achieved in 1975, vaccination was performed in only one third of the country each year.

TABLE 2. NUMBER OF VACCINATIONS BY YEAR

Fiscal year	Primary vaccination	Total vaccination
1962/1963	N.A.*	218 025
1963/1964	N.A.	69 107
1964/1965	N.A.	160 796
1965/1966	N.A.	201 243
1966/1967	N.A.	643 699
1967/1968	13 698	1 246 033
1968/1969	282 613	2 195 942
1969/1970	521 571	2 136 468
1970/1971	503 462	2 823 098
1971/1972	598 958	6 162 478
1972/1973	992 860	6 516 395
1973/1974	1 049 405	6 418 402
1974/1975	367 470	6 187 676
1975/1976	604 240	5 694 195
1976/1977	269 768	2 029 033

* Not available.

Surveillance

There was no reliable record of the incidence of smallpox prior to 1962. In that year the pilot project was established, and records were kept of some of the cases that occurred in Kathmandu Valley. Later, as the programme expanded, reports started coming from other parts of the country but the reporting remained incomprehensive in detail and in geographical coverage and the smallpox situation throughout the country could only be deduced from this limited information. All efforts were being directed at vaccination and no importance was given to surveillance until 1971.

With the major shift in strategy in 1971, top priority was given to surveillance and containment. Surveillance was carried out regularly all the year round by the permanent vaccinators in the villages, markets, schools and households. House to house surveillance was done once a year by the temporary vaccinators. In addition, cooperation was sought from other health workers and panchayat leaders. District Smallpox Eradication Programme staff worked as a surveillance team, reinforced by the central surveillance teams.

After achievement of smallpox eradication in 1975, surveillance was further strengthened by the use of huge numbers of malaria workers. In addition to their usual malaria duties, they were asked to search for smallpox house to house every month. Special searches with additional staff were also organized in certain vulnerable and problem areas.

A cash reward of Rs. 100 (US\$ 1 at that time was equivalent to Rs. 10) was offered to the public in March 1975 for reporting an outbreak of smallpox. It was later raised to Rs. 1000 by which time no smallpox cases were being reported. How much the reward would have helped had it been introduced earlier is open to discussion but since it did generate a huge number of suspect case reports, perhaps its impact would have been significant.

Containment of outbreaks, which improved simultaneously with surveillance, was the responsibility of the district staff aided by the headquarter surveillance/containment teams. Outbreaks were fully investigated (containment vaccination was started immediately) all cases and deaths recorded and the source of infection traced. Nearly all outbreaks were visited by the senior headquarter staff.

When local spread of the disease became a problem in late 1974 and early 1975 due to patients' friends and relatives visiting the infected houses, watch guards were posted to prevent unvaccinated visitors from entering. This limited local spread and so contributed to the eventual achievement of nil incidence.

Regular reporting of smallpox cases by district Smallpox Eradication Programme offices was started in 1971.¹⁰ In the beginning, reports stating the number of cases and deaths were sent by post every month but this involved a considerable delay, of two to four weeks, for the mail to reach Kathmandu. In July 1972, it was replaced by weekly postal reporting with immediate telegraphic reporting of each outbreak. This was further improved later in the same year by routine weekly telegraphic reporting including "Nil" reports. Except in occasional circumstances, this system worked satisfactorily.

Incidence of smallpox

The number of reported cases of smallpox from 1963 to 1975 is shown in Table 3.¹¹ The last case of smallpox occurred on 6 April 1975. Prior to 1971, reporting was virtually limited to those districts under Smallpox Eradication Programme operations and even that was incomplete. Reporting efficiency in other countries during that period had been estimated to be less than 5%.¹² In a study in rural East Pakistan in 1967, only 11% of the cases were known to have been reported.¹³ The incidence in Nepal too must have been considerably higher than reported. Reporting is considered to be sufficiently complete since 1973 and hence detailed analysis will be confined to 1973, 1974 and 1975.

TABLE 3. SMALLPOX CASES REPORTED BY YEAR 1963-1975

Year	No. of smallpox cases	No. of districts infected	No. of districts under SEP
1963	1 105	3	3
1964	135	3	3
1965	70	3	3
1966	164	N.A.	3
1967	110	N.A.	3
1968	249	8	15
1969	163	7	29
1970	76	1	41
1971	215	6	50
1972	399	9	58
1973	277	18	75
1974	1 549	28	75
1975	95	2	75

Age and sex incidence

Out of 1921 cases reported from 1973 to 1975, full information is available for 1286 cases only. The age and sex distribution of these cases is given in Table 4. About three-quarters of the cases were children under 15-years-of-age and infants constituted 10.8% of the total.

There were 662 males (48.5%) and 624 females (51.5%). The difference is not statistically significant even when calculated by different age-groups.

TABLE 4. AGE AND SEX DISTRIBUTION OF 1286 SMALLPOX CASES 1973-1975

	Male		Female		Total	
	No.	%	No.	%	No.	%
Under 1 year	69	10.4	70	11.2	139	10.8
1-4 years	147	22.2	130	20.8	277	21.5
5-14 years	252	38.1	247	39.6	499	38.8
15 years +	194	29.3	177	28.4	371	28.9
Total	662	100	624	100	1 286	100

Vaccination status

The vaccination status of the smallpox cases reported from 1973 to 1975 is given in Table 5. Among the total number of cases, 2.1% possessed a scar of previous vaccination. This proportion remained constant for each of the three years under review. Those smallpox cases who were vaccinated for the first time in their life during the incubation period have been counted as unvaccinated.

TABLE 5. VACCINATION STATUS OF SMALLPOX CASES 1973-1975

	1973	1974	1975	Total
Number of cases	277	1 543	95	1 915
Number unvaccinated	6	32	2	40
Percentage unvaccinated	2.2	2.1	2.1	2.1

Case fatality rate

Out of 1915 cases that occurred from 1973 to 1975, 411 died giving a case fatality rate (CFR) of 21.5% (Table 6). Compared to 1973 and 1974, when the CFR was 20.9% and 22.1% respectively, the CFR in 1975 was only 12.6%. In a study of 100 patients admitted to the Infectious Disease Hospital, Kathmandu in 1963-1964 the CFR was found to be 28%.¹⁴

TABLE 6. CASE FATALITY RATE 1973-1975

	1973	1974	1975	Total
Cases	277	1 543	95	1 915
Deaths	58	341	12	411
Case fatality rate (percentage)	20.9	22.1	12.6	21.5

Source of infection

The source of infection was discovered for 231 (96.5%) out of the total 239 outbreaks that occurred from 1973 to 1975 (Table 7). The remaining eight outbreaks, for which the source could not be found, all occurred during 1974 when the largest number of cases and outbreaks was reported for any single year.

TABLE 7. SOURCE OF INFECTION OF OUTBREAKS 1973-1975

Year	Imported	Local	Unknown	Total
1973	35	8	-	43
1974	115	57	8	180
1975	2	14	-	16
Total	152	79	8	239

Out of the 239 outbreaks, 152 (63.5%) were due to importations and in 1973, 81% of the outbreaks were due to importations. In 1974 a large number of importation and thus outbreaks resulted in more extensive local spread; the proportion of outbreaks directly attributable to importations fell to 64%. Local spread became much more common in 1975 with the result that importations accounted for only 12.5% of the outbreaks.

All importations from 1973 to 1975 were from India. Except for one from Bangladesh in 1972, all other known importations in the past had also been from India.

Importation from India was closely related to the epidemiological pattern of smallpox in the bordering states of India. In 1973, western Nepal was mainly infected from the adjoining Uttar Pradesh, which suffered its worst epidemic for many years (Fig. 2). In 1974, although western Nepal continued to be affected to some extent until the middle of the year, it was mainly the eastern Terai which became infected, from the adjoining state of Bihar (Fig. 3). The origins of importations from India, by state, is shown in Table 8. The two importations in 1975 were both from Bihar and into the eastern Terai.

TABLE 8. IMPORTATIONS FROM INDIA
BY STATE OF ORIGIN 1973-1975

State	1973	1974	1975
Uttar Pradesh	21	89	-
Bihar	13	21	2
Others	1	5	-
Total	35	115	2

Although Nepal has a long border with the Tibet region of China, there has been no report of importation from Tibet. Travel across this border is much more restricted than across the Indian border which is freely open and at which no papers or documents are needed.

After the political change in Tibet in 1959, a large number of refugees have come to Nepal and settled in various parts of the country. A pockmark survey was conducted in nine refugee camps to find out whether they had brought any infection from Tibet. Two thousand three hundred and fifty people of all ages were examined and facial pockmarks found in 43 persons of whom 36 had suffered their infection in Tibet, six in Nepal and one in Bhutan. The last year of infection in Tibet was 1961. There was no evidence of importation of smallpox from Tibet.

FIG. 2. NUMBER OF SMALLPOX OUTBREAKS BY DISTRICT, 1973

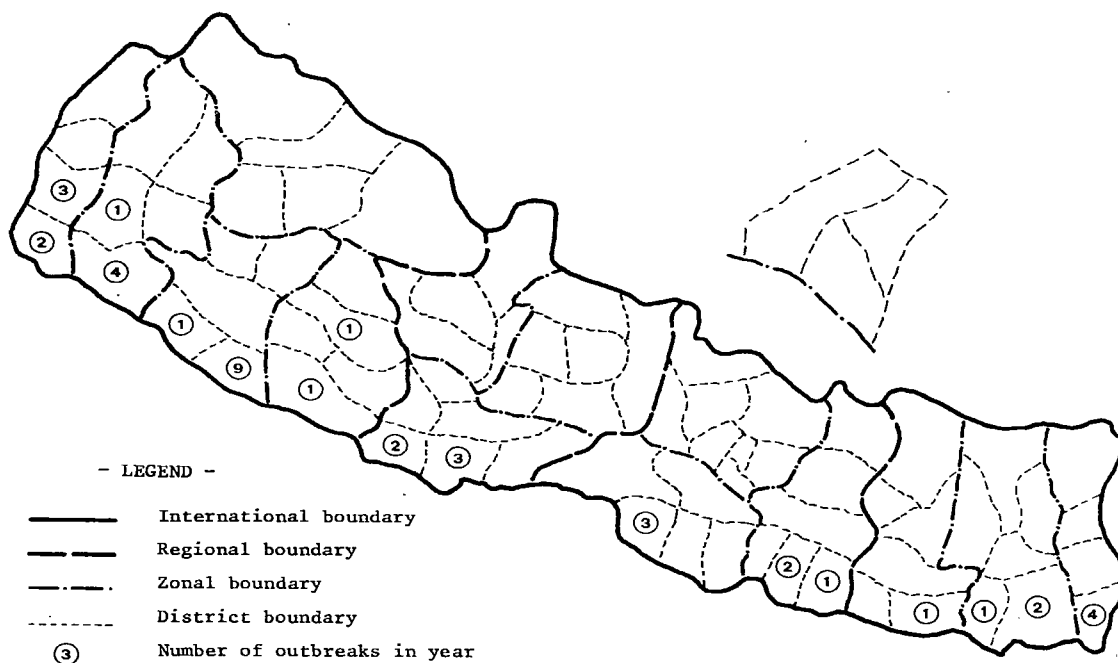
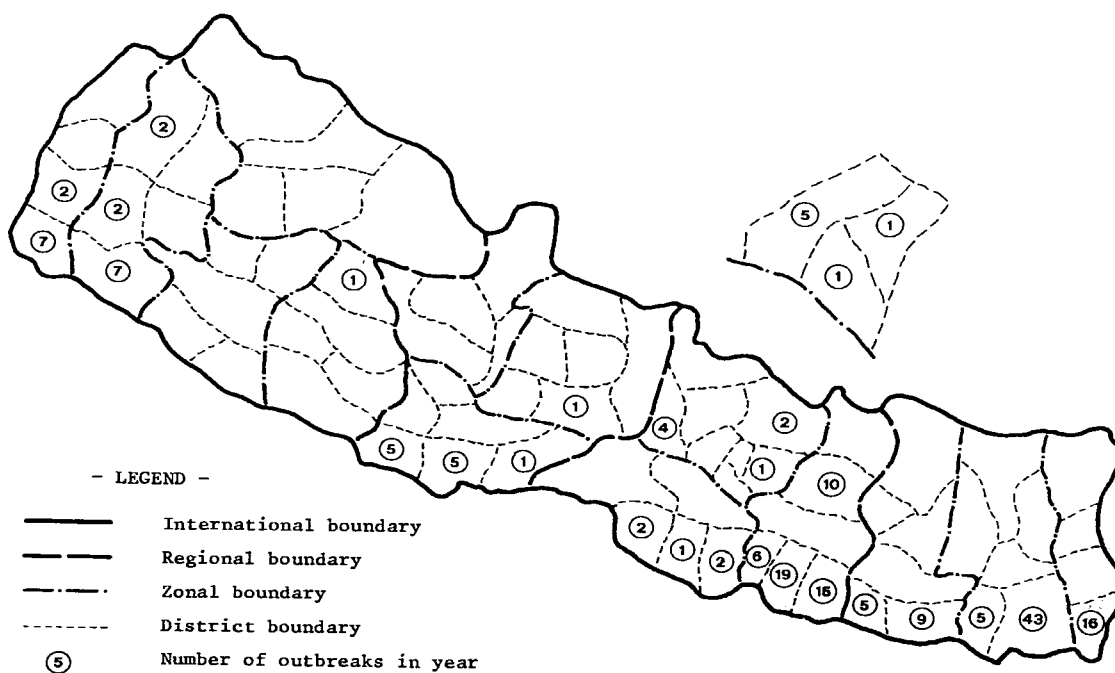


FIG. 3. NUMBER OF SMALLPOX OUTBREAKS BY DISTRICT, 1974

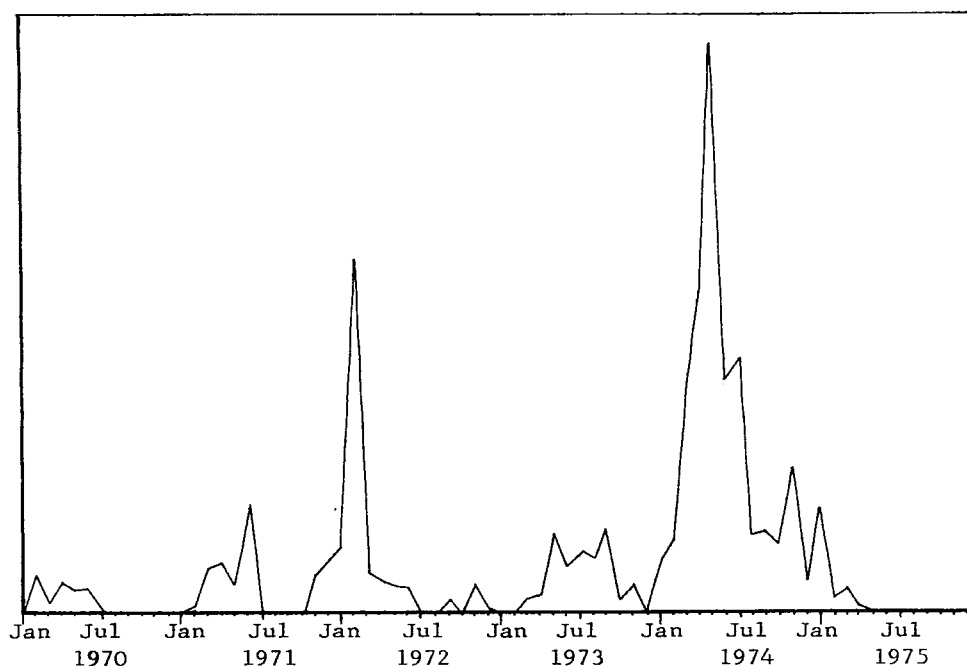


Seasonal and geographical distribution

The number of smallpox cases reported by month from 1970 to 1975 is shown in Fig. 4. The number of smallpox cases reported during the wet season (June to September) was generally less than during the dry season.

Twenty of the 75 districts of Nepal are in the Terai bordering India and were more commonly affected than the districts of the other terrains. Fourteen of 18 districts infected in 1973 (Fig. 2) and 16 of 28 districts infected in 1974 (Fig. 3) were in the Terai. In other words, 70% of the Terai districts were infected in 1973 and 80% in 1974. The two districts infected in 1975 were both in the Terai.

FIG. 4. REPORTED SMALLPOX CASES BY MONTH 1970-1975



Evaluation

Continuous evaluation was an activity integral to the programme. Vaccination coverage was assessed through scar surveys carried out in all panchayats once a year by the district supervisors and in a few randomly selected panchayats by the senior supervisors from the headquarters. Results during recent years consistently showed a coverage of over 90%.

Surveillance was assessed routinely by the district and headquarter staff through spot checks and detailed inquiries. Later a method of quantification was developed in which peoples responses to questions about the visit of surveillance workers, about the smallpox recognition card, about the reward and about where to report in case of an outbreak, were recorded. Although this type of evaluation was subjective and gave widely varying results, overall surveillance was considered to be satisfactory and sensitive enough to detect any outbreak if it had occurred.

The final evaluation was made by an International Commission from 6 to 13 April 1977.¹⁵ After discussions with the national staff and field visits to 25 districts, the Commission concluded that, the requirements established by the WHO Expert Committee on Smallpox Eradication having been fully met,¹⁶ eradication of smallpox had been achieved in Nepal.

Discussions

The majority of smallpox cases in Nepal, almost three-quarters, were children under 15 years. This age incidence is similar to that in many other countries.¹⁷⁻²⁰ Greater emphasis was therefore placed on the vaccination of children including newborn babies.

The CFR of 21.1% in 1973 and 1974 is in broad agreement with the CFR of variola major in the neighbouring countries of India and Bangladesh.²¹⁻²³ The decrease in the CFR in 1975 cannot be explained by the vaccination status nor by modification of the illness by vaccination during the incubation period because only two of the 95 cases were vaccinated and 66 of them already had clinical smallpox when the outbreaks were detected.

Because of a poorly developed transport and communication network, mobility of people, including the programme staff, and social contact is greatly restricted during the wet season. This factor may account for both the reduced incidence and less frequent detection of outbreaks during the wet season.¹² Loss of virulence and poor survival of the virus in hot and humid conditions might have also played a role.

The geographical distribution of outbreaks in Nepal was closely related to the epidemiological pattern in India and to the routes of population movement. As most of the outbreaks since July 1972 occurred directly or indirectly due to importations from India, it is quite natural that the bordering districts of the Terai were the most heavily and frequently infected. There was no evidence of importation from China and hence the northern mountain districts, except those infected from India, remained smallpox free.

Surveillance - containment has been credited with being the most important measure for the success of smallpox eradication.²⁴ The shift in strategy in 1971, laying great emphasis on surveillance-containment, was largely responsible for the success of the Smallpox Eradication Programme in Nepal. Use of temporary vaccinators for vaccination during winter, releasing the permanent vaccinators for surveillance, also played a significant role. Annual refresher training of all staff and regular supervision from all levels resulted in the greater efficiency of the workers.²⁵ With the successful launching of the Smallpox Eradication Programme in India which led to the achievement of zero incidence in May 1975, the reservoir of infection for Nepal finally dried up once and for all.

REFERENCES

1. Central Bureau of Statistics (1974) Statistical Pocket Book, Kathmandu
2. Central Bureau of Statistics (1974) Population Projections for Nepal 1971-86, Kathmandu
3. Worth, R. M. & Shah, N. K. (1969) Nepal Health Survey 1965-66, University of Hawaii Press, Honolulu
4. Nepal Family Planning and Maternal Child Health Project (1977) Nepal Fertility Survey 1976, Kathmandu, pp. 41-49
5. Dixon, C. W. (1972) Smallpox, J. & A. Churchill Ltd., London
6. Shrestha, P. N. (1972) History of smallpox, J. Nepal Med. Ass., 10, 2, 107-111
7. Directorate of Health Services (1969) A report on Health and Health Administration in Nepal, Kathmandu
8. Vaidya, B. N. & Gurubacharya, H. V. (1966) J. Nepal Med. Ass., 4, 339-343
9. Shrestha, P. N. (1972) Present Status and Future Plans for Smallpox Eradication in Nepal, New Delhi (WHO document SE/WP/72.12)
10. Shrestha, P. N. (1972) Development of Reporting System in Nepal, New Delhi (WHO document SE/WP/72.13)
11. Shrestha, P. N., Robinson, D. A. & Friedman, J. S. (1977) The Smallpox Eradication Programme, Description and Analysis, Kathmandu
12. Foege, W. H., Millar, J. D. & Henderson, D. A. (1975) Smallpox Eradication in Central and West Africa, Bull. Wld Hlth Org., 52, 2, 209-222
13. Thomas, D. B. et al. (1971) Endemic Smallpox in Rural East Pakistan II, Amer. J. Epid., 93, 5, 373-383
14. Pandey, M. R., Acharya, I. L. & Moyeed, A. (1964) Clinical Survey of Smallpox, J. Nepal Med. Ass., 2, 1, 8-11
15. Eradication of Smallpox in Nepal (1977) Report of the International Smallpox Eradication Commission (WHO document SEA/Smallpox/79)
16. WHO Expert Committee on Smallpox Eradication (1972) Wld Hlth Org. techn. Rep. Ser., No. 493
17. Smallpox Eradication in India (1977) Central Report to the International Assessment Commission on the Smallpox Eradication Programme in India, New Delhi, 60 pp.
18. Sommer, A. (1974) The 1972 Smallpox Outbreak in Khulna Municipality, Bangladesh I, Amer. J. Epid., 99, 4, 303-313
19. Filho, E. et al. (1970) Smallpox Eradication in Brazil, Bull. Wld Hlth Org., 43, 797-808
20. Azevedo Costa, E. & Morris, L. (1975) Smallpox Epidemic in a Brazilian Community, Amer. J. Epid., 101, 6, 552-561
21. Sommer, A. & Foster, S. O. (1974) 1972 Smallpox Outbreak in Khulna Municipality, Bangladesh II, Amer. J. Epid., 93, 4, 291-302

22. Rao, A. R. (1972) Smallpox, Kothari Book Depot, Bombay, 37 pp.
23. Thomas, D. B. et al. (1971) Endemic Smallpox in Rural East Pakistan I, Amer. J. Epid., 93, 5, 361-372
24. Henderson, D. A. (1972) Epidemiology in the Global Eradication of Smallpox, Intern. J. Epid., 1, 25-30
25. Shrestha, P. N., Sathianathan, M. & Friedman, J. S. (1974) The Smallpox Eradication Programme in Nepal, New Delhi (Document WHO/SE/74.71)