

The mechanism of active immunization in cholera is not yet fully understood and in this connexion Burrows et al.,⁴ on the basis of their results with mouse-protection tests, have offered the following comments:

"It may well be that protection is a manifestation of more than one kind of antibody, possibly O agglutinin, bacteriolysin, immune opsonin and the like, as well as antibody to the vibrio endotoxin; at least present evidence does not justify the assumption that protective antibody is homogeneous."

It will be thus seen that the production of immunity against cholera needs a good deal of further investigation. However, considering the knowledge at present available, one is tempted to conclude that

the recommendation of the Cholera Advisory Committee, made about twenty years ago, to use Inaba strains for the manufacture of the vaccine, is the correct one.

In conclusion, it may be well to point out that the existing system of bacterial classification may have to be reconsidered in the light of recent work on bacterial genetics. The competence for genetic transfers among strains with different virulence characteristics may be responsible for a combination of immunogenic factors within a single strain. Thus, in the near future, the genetic factors may also have to be taken into consideration in deciding upon characteristics of strains suitable for the production of cholera vaccine.

Cholera in Nepal, 1958-60 *

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Outbreaks of cholera have occurred annually in Katmandu, but the first epidemic to be bacteriologically confirmed and to be the subject of an international report occurred in 1958.^a Two years later, in 1960, the present author had an opportunity to study the cholera situation in Katmandu and a number of other areas of Nepal, and this note briefly reports some of the salient findings.

There are no arrangements in Nepal for the keeping of vital and health statistics, and such statistical information as could be obtained was therefore sought from various sources, including national, international and voluntary bodies. Epidemiological investigations, supplemented by bacteriological work, were carried out in Katmandu, Bhatgaon, Dhankuta and elsewhere. Description of the work is arranged in the order in which the areas were visited.

Katmandu and Patan

Katmandu is the only place in Nepal where there are facilities for isolation and treatment of cholera

* This study was undertaken during the author's tenure of a WHO Fellowship.

^a Pollitzer, R. et al. (1958) Unpublished report to the WHO Regional Office for South-East Asia on cholera and cholera prevention in Katmandu.

CHOLERA CASES AND DEATHS REPORTED
IN KATMANDU, 1958-60

Month	1958 ^a		1959		1960 ^b	
	Cases	Deaths	Cases	Deaths	Cases	Deaths
January	...	...	0	0	0	0
February	...	...	0	0	2	0
March	...	...	2	0	4	2
April	13	1	36	2	20	3
May	28	0	55	7	57	1
June	30	5	40	8	100	8
July	271	68	109	13	104	8
August	872	136	48	5	70	0
September	492	48	35	3	10	0
October	648	76	27	3	...	...
November	84	8	0	0	...	...
December	14	0	0	0	...	...
Total	2 452	342	352	41	367	22

... = No data available.

^a From 14 April 1958.

^b Until 11 September 1960.

patients. From the Infectious Diseases Hospital, which has 50-60 beds, it was possible to collect the records on cholera cases and deaths by locality of residence over the period between 14 April 1958 and 11 September 1960. These are summarized in the accompanying table.

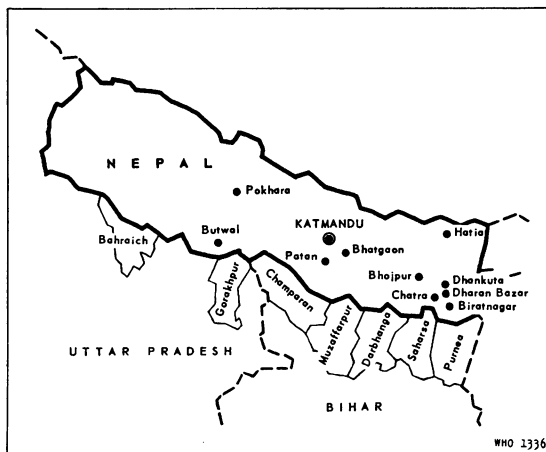
In 1958 there were two waves, with peaks in August and October. Anti-cholera inoculations administered to the public coincided with the 6-week duration of the earlier epidemic wave. The distribution of the cases by locality was 55.4% (1359 cases) from Katmandu, 30.4% (745) from Patan, 13.7% (337) from the rural outskirts and 0.4% (11) from Bhatgaon. The incidence in Katmandu and Patan during the observed period was 9.06 and 14.90 per 1000 inhabitants, respectively.

During 1959 and 1960 the seasonal waves were protracted and of low intensity and were preceded and followed by sporadic cases. The distribution of the cases from Katmandu, Patan, rural outskirts and Bhatgaon was, respectively, 48.0% (169 cases), 16.7% (59), 34.1% (120) and 1.1% (4) during 1959; and 29.6% (109), 20.4% (75), 47.7% (175) and 2.2% (8) during 1960. Thus, the proportion of Katmandu cases in 1960 is relatively lower than in the two preceding years. In 1959 the incidence in Katmandu and Patan was 1.13 and 1.18 per 1000 inhabitants, respectively. Anti-cholera inoculations were performed on a small scale during four weeks in late April and May of 1959.

Cholera in Katmandu Valley in relation to the adjacent territories of India. Nepal lies to the north of the Indian States of Bihar and Uttar Pradesh, which harbour endemic centres of cholera (see the accompanying map). Katmandu Valley is liable to imported infection, particularly from Champaran and Muzaffarpur districts in Bihar, which are connected with the valley by the sole surface route. The cholera records in Katmandu (see the table) indicate that transmission continued over at least nine months in 1958 and eight months in each of 1959 and 1960, with seasonal epidemic trends of varying magnitude.

In the adjacent districts of Bihar and Uttar Pradesh the situation was different as cholera infection appeared only occasionally in certain districts and then over short, interrupted intervals. Again, when these districts did become infected, that always happened later than in Katmandu. Thus, while there were reported cases in Katmandu during April 1958, Darbhanga and Muzaffarpur districts in Bihar were not infected until May and Champaran

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until August. In Gorakhpur a single case appeared late in June and Bahraich was infected in September. In 1959 Muzaffarpur and Darbhanga were infected late in April and in August, respectively. In 1960 Gorakhpur, Bahraich, Champaran and Darbhanga were infected in June, September, November and December, respectively. Apart from these, all the other adjacent Indian territories remained free from infection during the period under consideration.

The present author has suggested elsewhere^b that there exists in this part of Nepal an endemic cholera focus which is independent of the neighbouring Indian endemic centres. This view is based on the fact that over a period of 17 years the average time elapsed without cholera cases in Nepal was only 2.65 months per year, whereas during the same period the observed seasonal fluctuations and periodicity revealed a different pattern of epidemic behaviour in Bihar and Uttar Pradesh.

Laboratory investigations. Between 28 June and 15 July 1960, the author collected 20 stool samples from 20 patients with clinical cholera, of whom nine were passing typical rice-water stools. These were subjected to bacteriological examination by recognized methods for the isolation and identification of vibrios, as had been done in a previous study.^c Five *V. cholera* strains were isolated (three smooth strains of the Ogawa subtype and two with rough characters) from two patients from Katmandu, one

^b Abou-Gareeb, A. H. (1959) *Indian J. publ. Hlth*, 3, 20.

^c Abou-Gareeb, A. H. (1960) *J. trop. Med. Hyg.*, 63, 122.

patient from Patan and two patients from surrounding villages. Investigations carried out among the family contacts of these patients did not reveal either earlier or fresh cases. No infected newcomers to the area were found and none of the known cases were interrelated.

As soon as the diagnosis of cholera had been bacteriologically established, the results were reported to the Nepalese authorities and the WHO Regional Office for South-East Asia in Delhi.

Between 28 June and 20 July 1960, 23 water samples in 5-litre quantities were collected from a variety of sources—including open wells in Patan, localities which had been found heavily affected during the 1958 epidemic and tap and river water in Katmandu—and were subjected to the kieselguhr filtration technique with slight modification^a for vibrio isolation and identification. No agglutinable vibrios were isolated. In one instance a NAG vibrio strain was isolated from a water sample collected on 15 July from an open well in Patan.

Anti-cholera measures in Katmandu and Patan. During 1958 the main anti-cholera measure adopted in Katmandu and Patan was anti-cholera inoculation, a total of 11 456 inoculations being given to children and 54 559 to adults. During this campaign the accessible community numbered roughly 200 000. Inoculations began in late July during the first epidemic wave and were stopped at the end of August during the second epidemic wave. Some open wells and affected houses were disinfected by bleaching powder. An anti-fly campaign was carried out during the first epidemic wave and was encouraged by rewards to the operators. Bleaching powder was sprayed in the vehicles and on the heaps of refuse and faecal matter. As a chemoprophylactic measure, sulfaguanidine tablets were distributed among the public. As many cases as possible were isolated and treated in the Infectious Diseases Hospital, which was labouring under the major difficulties of limited capacity and shortage of staff and medical supplies. This led to a rapid turnover of patients in the hospital.

During April-May 1959, 15 586 anti-cholera inoculations were performed in Katmandu, and 2409 March-May 1960.

Environmental sanitation. In 1958 some open wells and houses in which cholera had broken out were disinfected with bleaching powder. An anti-fly campaign was organized during the first epidemic

wave and rewards were offered to those taking part as an incentive to efficient work. Bleaching powder was sprayed on vehicles and on heaps of refuse and faecal matter.

Some attempts were also made to increase the quantity and quality of filtered water in Katmandu. These have resulted in a 25% increase in the water supply; 14 Imperial gallons *per caput* per day are now piped intermittently. The use of chlorine gas has been introduced, but this sometimes does not reach the water mains in adequate amounts. Moreover, as adequate voltage is often not available, the filter rate is on occasion so reduced that it is necessary to bypass the filter and to use raw water in order to maintain supply in the mains.

Apart from these measures, little improvement has been achieved in environmental sanitation.

Bhatgaon

The available records for 1957-59 provide no evidence that cholera was prevalent in Bhatgaon (or Baktapore) before or after the 1958 epidemic, which affected the town late in the year. The town was protected by check-posts and 50 000 persons were given anti-cholera inoculations during July-August. Drinking-water supplies were chlorinated by bleaching powder.

Early in August 1958, a case from Katmandu was transferred to Thimi (about 2 km out of Bhatgaon) where she died. A few days later, 23 cases, among whom there were 8 deaths, were detected in the town. An important festival was celebrated during the outbreak and foods exposed for sale at the temples were eaten by the public. An isolation camp was established from 29 September to 8 November where 412 cases (63 deaths) were attended to. The prevalence in the town was 12.14 per 1000 inhabitants; 11 cases were from the surrounding rural area. Among 263 patients, 58 (22.05%) gave a history of contact with earlier cases with similar symptoms. Among the 412 admissions to the isolation camp, 16 (3.88%) had received recent anticholera inoculations before their attacks; 7 of the total of 72 fatal cases had been inoculated.

In August 1960, stool samples for bacteriological examination were taken from 14 hospitalized patients with gastro-intestinal symptoms. No vibrio isolations were made.

Eastern Nepal

Morang district. During May and June 1960 there were five known deaths from choleraic disease in

^a Abou-Gareeb, A. H. (1960) *J. Hyg. (Lond.)*, **58**, 21.

Biratnagar. The cholera records of the adjacent Indian districts indicate that cholera did not appear in Purnea district except late in June and in November in Saharsa. Past experience shows that on certain occasions cholera has been absent from these adjacent Indian territories while present in Morang district. On request from the Government of Nepal anti-cholera teams were recruited from Bihar in India to control outbreaks in Nepal.

The town of *Dharan Bazar*, with a population of 11 000, is an important trade centre. Its water supply is obtained from a small river, through a high-lying reservoir which is unprotected and therefore subject to contamination by coolies who wash in it. Moreover, dead bodies and their clothing are thrown into the river without adequate burning. During May-August 1960, there were 67 cases with clinical symptoms of cholera, including seven among Indian labourers who had not returned home during the past 12 months. Twelve cases proved fatal. All the early cases were among Nepalese, including a fair number of coolies. Among the heavily affected outskirts were Ghopa, Tapu, Kalabanzar, Bogjhora and Chatra.

Dhankuta district. During August 1960, news was received in Katmandu of an outbreak of a disease accompanied by vomiting and diarrhoea and resulting in several deaths in Dhankuta and Bhojpur districts in eastern Nepal. The author went to the area to investigate this outbreak but Bhojpur district unfortunately proved inaccessible owing to heavy floods.

The first victim in *Dhara Pani* was a coolie who developed cholera on the trail in June and succumbed. After four days, nine cases with four deaths appeared in the village, among whom was one person who had dealt with the dead body of the first coolie victim. During the same month, cases with similar symptoms appeared in the adjacent villages of Attaley, Hardy and Tanaran, but Chowbisey, which is an important centre of supply of professional coolies, was the most heavily affected.

Although the village of *Moolghat* relies solely on raw river water for all purposes, no cases with the symptoms of the current epidemic are known to have occurred there.

The capital of the district, *Dhankuta town*, has about 3000 inhabitants. The water supply is drawn from a reservoir accessible to the coolies, and the 2-inch pipe-line was cracked and leaking. In view of the poor crops in 1960 many inhabitants worked as

coolies. During May-August 18 cases with clinical symptoms of cholera were observed, the first case being a coolie who had been out of the town a few days before his attack. Rectal swabs were taken from a convalescent, who was attacked on 18 August, and from four of his family contacts for vibrio isolation and identification. A strain of *V. cholerae* of the Ogawa subtype was isolated from a 9-year-old contact, and NAG vibrios were recovered from the convalescent.

The epidemiological information collected pointed to the occurrence of several other cases and deaths in various parts of the district; indeed, the disease made its appearance as far north as Hatia, which lies about 12 km from the Tibetan border. About 900 deaths known to have occurred in the district (with a total population of 514 216) were reported to the police officer during the last three months of the year, as against 300 during the same period in the previous year.

Pokhara

Pokhara lies in a small valley to the west of Katmandu. During the previous eight years cholera was not a problem there. The supply of pure water is adequate and well protected. In 1960 there was only one case with severe diarrhoeal symptoms suggestive of cholera, and it proved fatal.^e The patient was a coolie from Butwal (about 35 km to the south), where cholera was prevalent. Coolies here are severely affected every summer.

Summary and conclusions

The findings outlined above constitute additional evidence that transmission of cholera is still taking place in Katmandu Valley, where the disease appears to have established a foothold, and that this endemic centre seems to be independent of the Indian centres to the south.

In Katmandu itself, such control measures as were adopted may have contributed, probably to a rather slight extent, to some lessening of the epidemic in 1958; on the other hand, the premature cessation of certain measures may have aggravated matters. Further improvement is still needed in environmental sanitation, particularly as regards the supply of safe water and the sanitary disposal of sewage. It is difficult to say how far the present measures for water filtration contributed to the lower number of cholera cases reported in 1960.

^e Personal communication (1960) from Dr J. Watson, Medical Superintendent, British Mission Hospital, Pokhara.

In Bhatgaon the epidemic wave started late and, probably owing to the onset of the cool weather and low humidity, was of short duration. It seems clear that direct contact was an important mode of spread.

No control measures were taken to counter the outbreak in eastern Nepal in the summer of 1960 and the epidemic consequently took a natural course.

There is no evidence that the infection was imported from neighbouring territories. It appears that in the Terai region localities lying along the line between the plain valley and the hills (such as Dharan Bazar, Chatra, Ghopa and Butwal) constitute sites in which small endemic foci may become entrenched. These would seem to be suitable areas for further detailed study and investigation.

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