

Current Status of Smallpox in the World

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ABSTRACT

Smallpox eradication appears in sight with fewer than 400 cases in the whole world. There appears to be no technical problem to this achievement. India is on the threshold of becoming a smallpox free country. The incidence of smallpox is declining rapidly in the remaining two infected countries i.e. Bangladesh and Ethiopia.

Means by which man might again be infected after stoppage of human to human transmission have been discussed. Probability of reintroduction of smallpox in the smallpox free countries through monkeypox, variolation and escape of variola virus from a laboratory has been highlighted.

INTRODUCTION

With India's entry this summer on the lengthening roster of smallpox-free countries, only two smallpox endemic countries remain—Bangladesh and Ethiopia. Smallpox is now restricted to its smallest geographic area in history. In fact, as of early July, data provided by field staff indicated that there were almost certainly fewer than 400 smallpox patients at that time—more specifically, fewer than 400 persons in the entire world who were able to transmit infection to another susceptible individual and so sustain the chain of smallpox transmission. To discover new patients, to isolate them and to vaccinate contacts in order to stop further spread of the disease, the two remaining infected countries with the World Health Organization have marshalled the largest force of health workers to date. The objective, quite simply, is to stop transmission in both before December, 1975. When the last case has occurred, we can then begin the necessary and important two year period of intensive search to make sure that no hidden focus exists anywhere. Global eradication will then be a reality.

In the eight and one-half years since the intensified global eradication programme began¹, the rate of progress towards eradication has surprised even the most optimistic.

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India's achievements during the past 12 months², even for those who participated in field operations as recently as last summer, are regarded almost with disbelief. Yet, the seemingly impossible has been accomplished in a country whose size and population virtually qualifies it to be a continent alone.

While we may take considerable pride in what has been done, our focus of attention understandably must rest on the task which remains (1) the elimination of smallpox in the still infected areas, (2) the execution of an effective two year programme of surveillance after the last known case has occurred to be certain that the disease has been eliminated and (3) appraisal of other means by which man might again be infected with smallpox after human to human transmission has been stopped. What is the status of progress in each of these areas?

1. *Status of smallpox in the still infected areas :*

The programme in Bangladesh³, now operating on an emergency basis and under a special presidential directive, is making excellent progress. Only a major and unforeseen catastrophe might prevent Bangladesh reaching zero by autumn—but, as the country has been beset by so many catastrophes in recent years, none can relax until transmission has been definitely stopped. As recently as the autumn of 1974, Bangladesh appeared to be nearing its goal. The number of infected villages had decreased steadily throughout the summer months—from 587 at the end of June to 280 at the end of August and, finally, to 91 at the end of October. The infected villages were confined primarily to two subdivisions in the north of the country and additional personnel had been assigned to these areas to facilitate the work. These areas, however, were the two most seriously affected by the devastating floods that summer. As food stocks diminished hundreds of thousands from this area began to move about the country in search of food and employment. Families carried smallpox-afflicted children from place to place, infecting others as they moved. Repeatedly, stories were told of a beggar with smallpox who in a market or on a railway platform for hours or a few days infected persons from 5, 10, even up to 30 different villages. All sorts of measures were devised to try to stop the spread. Special vaccination and case detection programmes were conducted in slums of cities, at feeding stations, ferry ghats and on trains. These programmes, however, seemed to have little effect on slowing the spread of the disease. In late January, the slum areas of Dacca were cleared by bulldozers, displacing several hundred thousand persons. Only small areas of Dacca were then infected but smallpox contacts in the incubation period dispersed to districts throughout the country. By early March, all but two districts of the country had become infected, some for the first time in a year or more. From these foci, further spread occurred. Health workers were mobilized for mass vaccination but, as elsewhere, it was soon discovered that the established strategy of surveillance and containment, as was employed in India, was the more effective means to stop transmission. By late April, the peak in the numbers of infected villages was reached—1,280—the highest figure in two years. More national and international health staff joined the effort and rapidly thereafter, the problem began to come under control. The number of infected villages dropped to

939 at the end of May and to 386 at the end of the first week in July. With many fewer infected villages than a year before and decreasing more rapidly than a year ago and a far larger national and international staff engaged, prospects seem good for detecting the last case sometime between late August and early October. But recognizing that unanticipated catastrophes are themselves almost epidemic in the country, none will feel confident until a confirmed zero has been reached.

Ethiopia presents a far less optimistic picture. The programme there began in 1971, some two to four years after programmes in other countries and has had far more difficulties to overcome. Communication and transport are among the most difficult of any area in the world, trained health staff are few and health facilities scarce, the population is estimated to be only 25 million persons but they are scattered over an extensive mountainous highland plateau, in deserts and jungles in an area fully one-third the size of India. In 1971, vaccination was almost unknown in most parts of Ethiopia and a reporting system existed in name only. To cope with these problems, a staff numbering less than 100 persons was all that could be mobilized. The progress which has been made, however, has been extraordinary. Fully, 26,329 cases were discovered during the first year of the programme and operations, at that time covered less than half the country. The incidence fell to 16,999 cases in 1972, to 5,414 cases in 1973 and to 4,439 cases in 1974. Despite steadily better case detection, the total of cases this year is again 40 per cent below the total of a year ago. During this period, more than 11 million persons have been vaccinated. While vast areas of the country have become smallpox-free, smallpox has stubbornly persisted in remote mountainous highland areas, comprising perhaps one-tenth of the land area of the country. A large proportion of the residents of these areas resist the new vaccination; many, instead, employ the ancient practice of variolation which frequently serves to facilitate spread of the disease. In November 1974, two helicopters were deployed to assist in transport of teams and the staff was increased to almost 200 persons. Through April, the results were encouraging and it was hoped that transmission might be interrupted by late summer but civil disorder and shortages of petrol have hampered the operations. Only 144 village areas were known to be infected as of early July but some of these were located in areas which no longer could be approached. Experience has shown that in some areas, smallpox will die out naturally during the summer rainy season when movement is severely restricted but with the large number of villages still infected, it is clear that an intensive autumn campaign will be mandatory. Prospects for success then will depend heavily on the capability of the teams to move freely throughout the country.

2. International certification of smallpox eradication after two years of surveillance :

Eradication can only be confirmed when two years have elapsed since the last case⁴. Confirmation is performed by a specially convened International Commission who must themselves be convinced that surveillance during the two years since the last case was sufficiently thorough to have detected cases had they been present. Two

of the areas which were endemic in 1967 have, so far, been confirmed as having eradicated smallpox—South America which was confirmed in August, 1973 and Indonesia which was confirmed in April, 1974. In 15 countries of western Africa, special programmes are now in progress and data are being assembled in the hope that a Commission can be convened in January, 1976. Following the last case in Bangladesh, special continuing programmes of surveillance and search will be required in Afghanistan, Pakistan, Nepal, Bangladesh and, of course, India so that documentation can be made available to an International Commission which hopefully will be able to meet in the autumn of 1977.

3. *Appraisal of means by which man might again be infected after human to human transmission has been stopped :*

Since the earliest days of the global programme, the question as to whether smallpox by some conceivable mechanism, could reappear from some natural source has been under study. Some persons postulated that infection might occur as a result of contact with old scabs or other material which had lain dormant in a house where a case had occurred. Efforts to document even one such episode over the past eight years have proved fruitless. As it is known that the virus dies rapidly after being shed from the body, especially in tropical climate, it is believed that this risk is nil for both epidemiological and biological reasons. Three other possible mechanisms deserve special mention, however—(a) Monkeypox (b) Variolation (c) Spread of smallpox from laboratories.

(a) *Monkeypox :*

Cases of infection due to a similar but distinctly different virus, called monkeypox virus, were first discovered in Africa in 1970⁵. The cases clinically resembled smallpox. To date, 20 such cases have been found in Africa but infection appears to spread from one person to another only with greatest difficulty. Only twice have secondary cases been discovered in family members. Repeated and extensive surveys have shown no other smallpox-like infections for many miles around. Monkeypox is now felt to be little more than a biological curiosity with man only rarely infected by a virus which is transmitted from a lower mammal and which cannot be sustained by man-to-man transmission.

(b) *Variolation :*

Concern has been frequently expressed that a variolator with preserved material might utilize the material after many years, thereby reintroducing smallpox into an area where human to human transmission had been interrupted. Only in Pakistan and Afghanistan material is normally preserved for long periods and utilized by traditional variolators. These areas, therefore, have been of special concern to us. WHO staff in both areas have endeavoured to identify variolators, to collect material and to learn from them what their experience has been in regard to long-term preservation of scabs or pustular material. As the practice of variolation is known by the public to be officially

frowned upon, this has been a difficult task but, to date, 10 specimens have been collected for study.

Country	Type of Specimen	Date of Testing	Age of Specimen	RESULTS		
				EM	Virus Isolation	Titre of Virus*
Afghanistan	Fluid	March 1969	?	ND	+	2500/mm ³
"	Scabs	May 1969	9 months	ND	+	10000/mm ³
"	Scabs	Sept. 1969	4 months	ND	+	30/mm ³
"	Scabs	April 1970	?	ND	+	14/mm ³
"	Scabs	Jan. 1972	?	—	—	
Ethiopia	Fluid in honey	March 1974	4 months	ND	—	
Pakistan	Scabs	April 1975	12 months	ND	—	
"	Scabs	April 1975	?	+	—	
"	Scabs	June 1975	?	+	—	
"	Scabs	June 1975	?	Herpes	—	

*For vaccinia virus, a titre of 300/mm³ induces 50% takes in unvaccinated persons.

It is notable that no isolations have been obtained from material tested since April 1970. Since smallpox was endemic in Afghanistan during 1969 and 1970, isolations of variola virus in high titre from specimens collected during this period is not surprising. Identification of variola virus by electron microscopy was possible in two recent Pakistan specimens but it is assumed that the virus was not viable as no isolate could be obtained despite repeated attempts at isolation. Notably the last specimen contained herpes virus, suggesting that the variolator was either desperate for material or a poor diagnostician.

Although these studies will continue as the opportunities present, these data plus information from the variolators themselves that collected material loses potency in 3 to 12 months suggest that variolation poses no serious threat to eradication.

(c) *Escape of variola virus from a laboratory :*

In 1972, a laboratory technician in the United Kingdom became infected in a laboratory doing experimental work with smallpox^a. Subsequently, the disease spread to three other persons. While only one other instance has been documented and one additional suspected in which laboratory infection occurred, this rate of spread obviously poses a risk once global eradication has been achieved.

To counter this threat, the World Health Organization has begun work with national health authorities to register all laboratories which work with smallpox virus

or which presently retain smallpox virus in their freezer. Eventually, it is expected that most will destroy their stocks of virus and those that do continue limited work with the virus will be only those which are specially equipped to handle one of the world's most dangerous pathogens.

CONCLUSION

Although smallpox eradication has not yet been achieved, the fact that almost certainly less than 400 persons are infected today indicates that the task should be able to be achieved quickly and expeditiously. There are no technical barriers to this achievement—possible obstacles in the limited remaining areas relate solely to natural or human calamity. Once eradication has been achieved, it appears most unlikely that there is any natural biological reservoir which should subsequently result in the disease becoming reestablished.

That this remarkable achievement has been possible in such a short space of time necessarily causes one to ask—are there not other health problems which might be rapidly and efficiently overcome by a concerted, determined effort employing national and international resources effectively pooled in a common effort?

REFERENCES

1. Henderson, D. A. (1974). Genesis, strategy and progress in the global smallpox eradication programme. *J. Com. Dis.*, 6 : 155-159.
2. World Health Organization (1975). *Weekly Epid. Rec.*, 50 : 254-255.
3. World Health Organization (1975). *Weekly Epid. Rec.*, 50 : 185-193.
4. World Health Organization (1972). Expert Committee on smallpox eradication—Second Report—*Tech. Rep. Ser. No. 493*, Geneva.
5. Henderson, D. A. and Arita, I. (1973). Monkeypox and its relevance to smallpox eradication. *WHO Chronicle*, 27 : 145-148.
6. Report of the Committee of inquiry into the smallpox outbreak in London in March and April 1973. HMSO, June, 1974.