New Horizon in Mass Inoculation

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MASS immunization programs are beset with many difficulties, not least of which is the time-consuming operation associated directly with inoculation of the vaccinee. Several years ago, U.S. Army scientists applied the jet injection principle (1) in the development of an automatic multiple-dose syringe (2) for immunizing large groups of people. This instrument, with some improvements, has been employed on a limited scale by the Armed Forces with encouraging results. The time required to vaccinate groups of men was much less when the jet injector was used than when the ordinary syringe and needle method was followed. Moreover, experience indicated that the immunological responses elicited by several types of vaccine administered by jet injection were comparable to those obtained by the usual methods (3-5).

It remained to be determined whether the procedure which seemed practical for largescale immunization of military personnel might be equally useful for civilian groups. The present report describes the results obtained in mass immunization programs in Pakistan in which cholera and typhoid vaccines were administered to the civilian population by means of a Hypospray Multidose Jet Injector (A). This instrument is compact, fitting into a container the size of an overnight suitcase. Vaccine is forced through a minute aperture under sufficiently high pressure so that the jetstream penetrates the skin and enters the subcutaneous tissue. The vaccine, in its course from the reservoir bottle to the aperture, remains in a closed, sterile system. Pressure for injection is applied to a plunger by release of powerful springs. Power for cocking the springs is obtained from a hydraulic system activated by an electric motor. The entire process of loading the discharge chamber with vaccine, cocking the drive springs, and inoculating the immunogen into the patient requires only a few seconds.

East Pakistan is one of the few remaining endemic areas of cholera in the world; the Province usually suffers over 15,000 attacks and 10,000 deaths yearly (6). It is probable that, owing to inadequate reporting of infectious diseases, these figures are not entirely reliable.

But it is known that cholera reaches two peaks during the year, the first in May prior to the onset of the summer monsoon rains and the second starting in September at the end of the monsoon and continuing through the months of October, November, and December.

Immunizations in East Pakistan, except during emergencies such as the 1958 smallpox epidemic, are carried on by the limited staff of the Directorate of Health Services. The population of East Pakistan is approximately 46 million people. There are about 400 sanitary inspectors, or about 1 per 100,000, each supervising 2 to 3 health assistants who are responsible, among other duties, for the complete immunization of the people. This means only 1 vaccinator and inoculator for approximately every 40,000 persons.

Immunization teams are handicapped by travel conditions. There are comparatively few roads, rail service is limited, and air service within each Province is almost nonexistent.

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These limitations, coupled with the fact that most of the land is under water for several months during the monsoon, severely hamper the mobility of the health workers. Within each thana, a political unit of roughly 100,000 population, nearly all local movement is confined to foot or small country boats.

The psychological aspect of the use of the syringe and needle, itself is another obstacle to immunization. In any population of any country, many people actually shrink from not only the sight but the idea of the needle. This is especially true in East Pakistan where so many are comparatively uneducated villagers. In many areas they do not understand the nature of disease or preventive measures. Not understanding, they feel no stimulus to overcome the apprehension against the needle the way people might in other societies. The purdah system among the Moslem peoples further complicates matters by making it extremely difficult to reach the female element of the population.

Even the educated classes have misgivings about immunization because the majority of injections have been given with an unsterilized syringe and needle, with the risk of transmitting malaria, syphilis, or hepatitis, which are common in this part of the world.

Taking these conditions into consideration, the task remained to prove the utility of the machine in different areas and in various situations.

Initially, demonstrations of the machine were given to different groups. This was done to familiarize community leaders with the jet injector and to determine the reaction of the people toward this new method of inoculation. Demonstrations were given to doctors, medical students, civic groups, health workers, the military, students, and various women's groups in Dacca and throughout the Province. In all instances the reaction was highly favorable. The fact that no needle was used seemed to impress the people more than any other factor. Also encouraging were the numerous comments regarding the relative absence of pain and the speed of inoculation.

Although the general response to these numerous demonstrations was completely positive, the majority of these people were of the educated classes. It remained to be seen whether the reaction would be as favorable among the less educated groups, to which most of the population of East Pakistan belong. These were the people exposed to disease, the ones who would determine the effect of immunization efforts.

During the following months, accompanied by a Pakistani team usually comprising a doctor and two sanitary inspectors, I took the injector into many areas of the Province, inoculating for cholera. We inoculated people in areas easily accessible, in some almost completely inaccessible, and in cities, small towns, and market areas. We tried to select places which would give us a cross section of East Pakistan.

Inoculations in Urban Areas

In mass inoculation in city areas, it is thought that the machine proved itself without doubt. In most instances, inoculations were done from a station wagon equipped with a generator which provided electricity for the injectors and a microphone and speaker for publicity. There was no problem in attracting crowds; a constant line waited for inoculation.

An excellent example of the capability of the machines was shown in Dacca during the October-November mass inoculation program



Hypospray Multidose Jet Injector



against cholera. Thousands were inoculated daily, with two injectors in operation. The highest figure for 1 day totaled 6,759. Sanitary inspectors and doctors, working with syringe and needle during the campaign, were reporting about 100 inoculations per inoculator per day. It was clearly indicated that one injector could do the work of 25 to 30 men.

The only experience of inoculating with the injectors outside of East Pakistan was in the first week of July in Karachi, West Pakistan. Owing to excessive rainfall in June, much of Karachi was flooded. Nearly all of the refugee colony areas were under water, and there arose considerable danger of a typhoid epidemic. Thirty centers were set up throughout the stricken area for inoculation against typhoid fever, paratyphoid fever, and cholera. The injectors were brought from East Pakistan to aid in the fight. In 41/2 days, with only one machine operating, approximately 20,000 persons

were inoculated. The entire staff of the 30 centers, inoculating by syringe and needle, were only able to inoculate about the same number during the same period.

As the work in a municipal area is carried on most successfully as an outdoor operation, most of the persons inoculated were men and children. Few women were reached in this situation because of the purdah system and the social restrictions on women moving about in public. To overcome this difficulty, we set up special centers in buildings for women only. Attendance depended greatly on selection of the site, time of inoculation, and adequate publicity.

The experience of inoculating in urban areas was highly encouraging. With adequate planning, there is no doubt that jet injection can be successful in treating most of a population's men, women, and children in a minimum of time, whether in an emergency situation or in routine preventive programs. The hats, or market areas, of Bengal also provide excellent opportunity to reach the maximum number in the minimum period. These weekly markets attract gatherings ranging from a few hundred to as many as 20,000 people, according to their size, location, and importance. In a central location in the hat, even without publicity, it has been comparatively easy to inoculate 500 persons an hour with one machine.

The larger markets, such as the Ghior Hat located in Manikganj Subdivision, Dacca District, provide an excellent opportunity to reach many of the people who would be otherwise comparatively inaccessible and also at the highest risk. People come 40 or 50 miles to a hat to sell or exchange produce and animals. Many come by river boats, which constitute the major mode of transportation in the delta area. As most of these river people live on their boats and are constantly moving, it is practically impossible to reach them at any other time. The river satisfies practically all their needs for drinking, washing, and cooking water. All of the rivers are congested with these riparian ramblers.

People living on or near the rivers, and their animals, use them for all purposes. Latrines overhanging the banks are a common sight. There is a chronic threat of infection therefore to the people living on or near the waterways.

Even though most of the people at the hats

are men and children, it is felt that, by the inoculation of this great mass of transients, it may be possible to break one of the more important links in the chain of disease, by means of the jet injector, the one instrument by which it is possible to inoculate enough of these persons quickly. The duration of these hats is only 1 day per week. If the people are not reached on that day, they may carry infection throughout the Province.

Inoculations in Rural Areas

While there remains little doubt that the injectors can be used successfully in places, such as municipal areas and markets, where a great number of people congregate, the principal question concerns their utility in rural areas. In East Pakistan approximately 90 percent of the population of 46 million live in villages. It is estimated that of this 90 percent, at least 40 percent are using water supplies that are considered unsafe. These therefore are the population at greatest risk.

With this factor in mind we set up experimental mass inoculation campaigns in rural areas in different places throughout the Province.

Some of these were easily accessible by road, some by river in either launches or country boats, and some only by foot. All proved of value and brought many facts to light which will prove of value in future mass inoculation.

Village	Popula- tion	Inoculations					Inocula- tion time	Approxi- mate travel
		Men	Women	Children	Total	Percent	(hours)	time (hours)
Bhoshna	520	104	115	159	378	73	21/2	11/4
Champanagar	510	82	59	150	291	57	1	1
Chhota Alampur	660	57	35	85	177	27	1	3/4
Debidwar	2,020	978	75	193	1,246	62	3	1/2
Binaypar	300	23	49	60	132	44	1	1
Noma Bara	300	43	41	73	157	52	1	1
Balibari	500	59	72	146	277	55	1	1
Bara Alampur	1, 200	126	61	237	424	35	2	1
Kanibil and Biniapara	620	223	154	209	586	95	2	11/2
Marichakandi	. 980	127	144	228	499	51	11/2	1
Bhinglabari	1, 000	58	97	166	321	32	1	3/4
Fatehabad	1, 200	172	218	349	739	62	2	$1\frac{1}{2}$
Shailchar	. 360	40	37	57	134	37	1/2	3⁄4
Total	10, 170	2, 092	1, 157	2, 112	5, 361	52. 7	191/2	13

Mass cholera inoculation, Debidwar Union, Debidwar Thana, Tippera District, East Pakistan

One campaign typical of rural East Pakistan from the standpoint of type of area, concentration of population, and transportation facilities was in Debidwar Thana, Tippera District. This was an area of average-sized villages accessible only by foot. From this thana we selected one union, a political land unit of from 8,000 to 12,000 population, and inoculated on a village-to-village basis throughout the area. The villagers were informed of the expected time of our arrival by the chowkidars, village officials who serve as registrars, night guards, and tax collectors, and the arrangements and selection of sites were left in the hands of the village leaders. The table shows the results of this controlled experiment. As previously stated, this area was typical as to terrain and people, and the results obtained were about the same as in other areas throughout the Province.

Many conclusions are apparent from this table and many more from observation during the inoculation periods. The total time consumed in this operation was approximately $32\frac{1}{2}$ hours, or about four average working days. As only one machine was used in the operation, the average rate of inoculation was 1,340 per day per machine. Inoculators who had previously worked in this area reported the maximum number that could be done by one man with syringe and needle would be 100. So, despite the fact that these figures are small compared with those of urban areas, the injector was still doing the work of 13 men.

Discussion

The data clearly indicate a great variation in the percentages of persons inoculated in different villages, ranging from 27 percent to 95 percent. This could be traced to many dif-In Chhota Alampur, Bara ferent causes. Alampur, and Shailchar, no previous notice had been given by the chowkidars. Because of this, many of the people were away from the village and working in the fields at the time of our arrival. In Bhinglabari, a village which is spread out over a wide area, it was raining hard during the time of inoculation and the villagers had great difficulty in reaching the site. Thus, in the four villages with the lowest percentages of inoculations, the poor showing could be traced to lack of notification, which can be remedied, and to weather, an unavoidable factor.

The cooperation and interest of the village leaders was another element which greatly influenced the success of the program in each village. In the combined villages of Kanibil and Biniapara, the leader was an energetic person who so fully believed in the program that he went personally from house to house through both villages before our arrival and urged the people to come forward. His efforts were rewarded by the inoculation of 95 percent of the population of these two villages. The percentage of inoculation in the other villages seemed to vary proportionately with the interest and efforts of the leaders.

This again is a controllable factor. If these leaders can be called together before a program and fully educated as to the need for inoculation, the success of the campaign will be assured. As these leaders are usually older, highly respected persons, the people of their villages in most cases will follow their advice without serious question. Although total education of all the people in this respect would be the ideal, we can still accomplish our purpose by reaching this small influential group.

As the purdah system is more strictly observed in villages than in the cities, we were concerned whether the women would come forward to be inoculated. In view of this, the selection of the site of inoculation in the villages was of primary importance. We tried to select locations where the women would be protected from the eyes of men by a bamboo matting or screen as they approached to be inoculated. We found that, although they would not present themselves where men were gathered, they apparently had no objections to being seen by the person giving the inoculations, accepting him as a professional person. In most of the villages, there was no great difference in the numbers of men and women inoculated.

The one exception to this was in Debidwar, where the site selected by the officials was on the police station grounds in the center of a large open area. There was no way in which the women could approach with protection from the eyes of the many men gathered there. Consequently few women came forward. This indicated that the site for inoculations must be selected with careful consideration of local customs.

We feel that the experiment was reasonably successful, since 52.7 percent of the population of the entire union were inoculated. We think, however, that the program could have been even more successful. Most of the factors that accounted for the low percentage of persons inoculated are remediable.

The experience at Debidwar is a fairly accurate picture of inoculations in rural areas. Some earlier campaigns were not so successful and a few later ones, through experience, were more successful. In these experimental mass inoculations extending over a period of 9 months, we have learned how to organize a program for the effective use of the jet injector in all sorts of difficult situations. We feel strongly, therefore, that these machines can be used effectively not only in fighting cholera here in East Pakistan but in the prevention of disease in any situation which calls for mass inoculation.

The utility of the injectors having been established, classes have recently been started training sanitary inspectors and doctors, not only in the operation of the machines but also in the complete repair and maintenance of them. It cannot be overemphasized that because of the intricate nature of the injector and inevitable breakdowns during field operations, the operator should not only be a competent inoculator but also a skilled technician. Plans are presently underway to supply injectors in sufficient numbers to enable the men who are being trained to take over the major burden of mass inoculation in East Pakistan. When these plans have been realized, we will find a new horizon in the field of mass inoculation which may in time aid in the elimination of epidemics.

REFERENCES

- Figge, F. H., and Barnett, D. J.: Anatomic evaluation of a jet injection instrument designed to minimize pain and inconvenience of parenteral therapy. Am. Pract. 3: 197-206 (1948).
- (2) Warren, J., Ziherl, F. A., Kish, A. W., and Ziherl, L. A.: Large-scale administration of vaccines by means of an automatic jet injection syringe. J.A.M.A. 157: 633-637 (1955).
- (3) Batson, H. C., Wall, R., and Landy, M.: Active immunization against typhoid with the hypospray jet injector (abstract). Bact. Proc. 49: 100 (1949).
- (4) Elisberg, B. L., McCowan, J. M., and Smadel, J. E.: Vaccination against smallpox. II. Jet injection of chorio-allantoic membrane vaccine. J. Immunol. 77: 340-351 (1956).
- (5) Lipson, M. J., Carver, D. H., Eleff, M. G., Hingson, R. A., and Robbins, F. C.: Antibody response to poliomyelitis vaccine administered by jet injection. Am. J. Pub. Health 48: 599-603 (1958).
- (6) Cockburn, T. A.: The epidemic crisis in East Pakistan April–July 1958. Pub. Health Rep. 75: 26–36 (1960).

EQUIPMENT REFERENCE

(A) Hypospray Multidose Jet Injector, R. P. Scherer Corp., Detroit, Mich.

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