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SURVEILLANCE OF SMALLPOX[a]

by

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The importance of surveillance to smallpox eradication is implicit in the object of the programme itself - "zero" human cases of smallpox. A decision that the objective has been achieved implies a sufficiently sensitive surveillance system to discover cases if they are present.

Fortunately, surveillance for smallpox infection is easier than for most other communicable diseases. Because chronic carriers are unknown and there is no known reservoir in lower animals or insects,[1,2] the presence of smallpox infection in an area can be detected and its prevalence measured by the number of human cases. Detection and diagnosis of such cases is reasonably straightforward. A distinctive rash is produced which is wholly characteristic in the great majority of cases. The rash is most dense over the face and extremities, the unclothed readily visible portions of the body. While smallpox infection without rash is known to occur, such persons do not further transmit infection and thus their detection is of no practical epidemiological importance.[3,4]

At the inception of the intensified global smallpox eradication programme in 1967, the plan for the campaign was foreseen as consisting of two principal components: (1) systematic programmes of vaccination throughout the endemic countries and (2) the development of effective programmes for the detection and reporting of smallpox cases and their containment.[5] Initially, less emphasis was placed on surveillance-containment activities because it was believed that it would first be necessary to reduce smallpox incidence to less than five cases per 100 000 population before the surveillance-containment activities could be effective. It was hoped that systematic vaccination programmes designed to reach 80% of the population would achieve a reduction in incidence to this level. While such vaccination programmes were in progress, sufficient time would be provided for a surveillance system to develop. Surprising, however, was the discovery in Nigeria during the first year of the programme that an extensive area could become smallpox-free even when half or less of the population bore scars of primary vaccination.[6] This observation was soon confirmed in other countries of western Africa[7,8,9] and subsequently in Brazil and Indonesia. Accordingly, the strategy of the programme was altered to emphasize the energetic development of surveillance-containment activities, if necessary, at the expense of the systematic vaccination programme.

The natural pattern of smallpox transmission facilitated the success of the surveillance-containment approach. Since the patient does not transmit virus until rash first develops, early isolation of obviously infected individuals is effective in reducing spread. For contacts, a highly effective and stable vaccine is available which offers virtually complete protection within 10-12 days. Since an incubation period of two weeks intervenes between generations of cases and since the usual patient does not normally infect more than two to five additional persons, prompt intervention through patient isolation and vaccination of actual or potential contacts is most efficient in rapidly stopping further transmission of smallpox. Finally, identification of the source of infection of each case is relatively easy

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since transmission almost invariably requires face to face contact between a patient with rash and susceptible contacts. The specific chain of disease transmission can thus be readily identified and previously unknown outbreaks detected.

Unfortunately, at the beginning of the global programme, smallpox surveillance programmes in the endemic areas were, at best, vestigial to non-existent. Of immediate importance in all areas was the need to develop surveillance programmes of the type best described by Langmuir.[10]

"Surveillance, when applied to a disease, means the continued watchfulness over the distribution and trends of incidence through the systematic collection, consolidation and evaluation of morbidity and mortality reports and other relevant data. Intrinsic in the concept is the regular dissemination of the basic data and interpretations to all who have contributed and to all others who need to know."

The basic techniques which have been employed in the smallpox eradication programme and the experiences involved in implementing the procedures are described in this paper. Because the schemes employed in surveillance have varied considerably in detail from country to country according to differences in health structures and their sophistication, emphasis is given to the more generally utilized approaches. Lastly, the important principles in implementation of the surveillance programme are considered in reference to the development of surveillance programmes for other communicable diseases.

I. Status of routine case detection and reporting - 1967

The basic fabric of a surveillance programme is an established and continuing system for the detection of smallpox cases and their notification through some form of reporting network. The fact that in 1967, 44 of 129 Member countries of WHO reported 131 418 cases of smallpox indicates the existence at that time of some sort of case detection-reporting scheme in many if not most countries. How effective were these?

Early in the global programme, two studies were conducted which endeavoured to assess the completeness of routine report. Keja[11] working in Indonesia in 1968 reasoned that the prevalence of facial scars among infants would provide the basis for an approximation of true smallpox incidence during the preceding year. A cluster sample survey in Java, which involved the examination of 56 000 children, provided data. Having determined the proportion of infants with facial scars and taking into account that 40% of infants afflicted with smallpox would have died and that perhaps 10% would have survived without easily recognizable pock marks, he estimated the numbers of smallpox cases which occurred during the preceding year among those less than one year of age. Utilizing data regarding the age distribution of cases in two areas on the island, he then estimated the probable total number of cases which had occurred during 1967. A number of assumptions were required in developing the estimates but the assumptions erred on the side of understating the "true" incidence of smallpox, thus, providing, if anything, an overestimate of the completeness of reporting. Keja calculated that in 1967, at least 70 000 cases had occurred in West Java and 100 000 cases on the whole island. That year, 4518 cases were reported to the West Java Provincial health authorities and 10 010 cases were reported to Provincial authorities throughout all of Java. In brief, by these calculations, not more than 6% of all cases had been reported in West Java and 10% in Java itself. Later studies, however, revealed that 70%[1] rather than 10% of children in this young age-group survive without recognizable pock marks. Further, it was found that during the preceding four years in Indonesia, only one-third of all cases reported to the Provincial level were recorded at national and at international level. Overall then, prior to 1967, probably less than 1% of all cases in Indonesia were reflected in national reports. Foster found the situation in West Africa to be not dissimilar.[12] Using a similar approach but a larger sample and a more precise method of estimation, he calculated that about 1.3% of cases in rural areas and 8.1% of cases in urban areas were being reported. In retrospect and based on subsequent experience, it is probable that the efficiency of reporting systems in Java and in West Africa could be classified as "average" among the endemic countries in 1967.

Reports of smallpox cases which did come to official notice and which were reflected in the official disease notifications were found to be, almost invariably, those cases which had been seen in a government hospital, health centre or dispensary. In most countries, existing reporting systems required government health establishments to provide weekly, bi-weekly or monthly reports of numbers of cases of various diseases which were seen. Information was often requested in regard to a list of 20-50 or more diseases; follow-up to ensure that reports were consistently submitted was often lacking; only occasionally were these data the basis for taking action such as in outbreak control; rarely were the data employed in any manner in guiding operations of the health services; and almost never was there a mechanism to obtain reports from private practitioners or non-government health facilities. Cases which were discovered during field investigation of an outbreak were frequently not enumerated in the official data since statistical recording procedures often provided only for tabulation of those cases seen in the government health facilities.

These observations, in brief, supported well the observations of the First WHO Expert Committee on Smallpox Eradication (1964) which stated bluntly:[13] "the reporting of smallpox, as of any other communicable disease, is frequently unreliable and the data available to the Committee are not accurate".

II. Actions taken to improve case detection and reporting at field level

A. Primary surveillance system

A first step in improvement of the surveillance system was to progressively increase the completeness and regularity of reporting from all fixed medical units (hospitals, health centres, dressing stations, dispensaries and the like, both government and private). While for many, the image of the developing countries is that of a vast, medically uncharted wilderness area, there are, in all countries, a surprising number of government and private medical units scattered throughout the countryside which provide some form of medical care to ill persons, including those ill with smallpox. Understandably, only a portion of all smallpox cases are seen by such fixed medical units. Nevertheless, because smallpox never occurs uniformly throughout a country but rather as concentrations of outbreaks, it was thought, and so it proved, that this basic reporting network would provide valuable information as to where smallpox existed and its relative prevalence as well as the distribution of cases by age and sex. Based on such data, resources both for outbreak control and systematic vaccination were able to be more effectively deployed.

The usual procedure employed in developing the system was first to prepare a list of all fixed medical units and to coerce, persuade and cajole each unit to submit each week a report indicating numbers of cases of smallpox seen that week and subsequently specific data regarding each case. If no cases were seen, a "nil" report was requested. Interestingly, the concept that a report should be submitted even when no cases were seen (so-called "negative reporting") proved a far more difficult concept to establish than that of reporting only when cases were seen.

Data requested by the programme in regard to each smallpox patient consisted of the following: name, age, sex, village, date of onset of rash and whether or not previously vaccinated (as evidenced by the presence of a vaccination scar).

Development of a reasonably effective primary surveillance system took time. Usually, two full years was required. Experience showed that development was best achieved by establishing for each administrative unit of perhaps two to five million population a surveillance team of perhaps two to four persons with transport. Each team, in addition to its other duties in outbreak containment, visited regularly each reporting unit to explain and discuss the programme, to distribute forms (and often vaccine) and to check on those who were delinquent in reporting. Regularly distributed surveillance reports, as discussed later, also assisted in motivating these units. Undoubtedly, the greatest stimulus to reporting was the prompt visit of the surveillance team for outbreak investigation and control whenever cases were reported. This simple, obvious and direct indication that the routine

weekly reports were actually seen and were a cause for public health action did more, I am sure, than the multitude of government directives which were issued. To facilitate reporting, special report forms were usually required since local tabulation and preparation of the all too common and routine "laundry list of most diseases known to mankind", as one consultant expressed it, interminably delayed the reporting process.

Many examples could be provided illustrating the value and use of data provided by the primary surveillance system. In many countries, these data served to guide the timing for the conduct of the systematic vaccination campaign within the country - the most heavily afflicted areas being scheduled first for vaccination. In Afghanistan, costly and time-consuming plans developed especially to vaccinate women in purdah were abandoned when review of case reports revealed that almost 90% of all cases were in children and only rarely were women afflicted. In countries where smallpox was caused by variola minor (Brazil)[4] or by the so-called intermediate strains (Africa),[7] smallpox cases rarely occurred among those who had ever been successfully vaccinated. In Asia, 75-90% of cases occurred among those with no vaccination scar and in Indonesia[15] and the Asian subcontinent, such persons accounted for only 10-30% of the population in most areas.[1,16,17] Accordingly, emphasis in the vaccination campaign was shifted to primary vaccination with a considerable gain in the efficiency of the programme.

B. Secondary surveillance systems

In addition to the primary network for routine case notification, a variety of systems developed to improve case detection. These became known, collectively, as secondary surveillance systems. Most effective in improving the completeness of reporting were the surveillance teams which, as a point of departure, investigated reports emanating from the primary surveillance network. During the early stages of development of the system, teams frequently discovered 20-50 cases for every case officially reported.[14] As time progressed, these ratios steadily decreased but, in the best programmes, the teams consistently discovered during investigation at least two cases for every case reported by the primary surveillance system.

Assistance in reporting was actively solicited from a variety of other groups. At different times and in different countries, various groups such as agricultural extension workers, block development officers, railway workers, police, security forces and others were approached. Although such groups were of considerable assistance in winning the confidence of villagers when routine or containment vaccination was conducted, none contributed consistently and substantively in case reporting. In explanation, it was apparently that their degree of interest and involvement correlated directly with their frequency of contact with smallpox staff. As the individuals in these different groups were usually scattered widely and rarely convened in meetings, frequent contact with them was impracticable to sustain.

Most widely used of the secondary surveillance systems and most effective for the time expended was the query of teachers and schoolchildren in regard to suspect cases about which they might be aware.[18] Although urban trained physicians not infrequently have difficulties with diagnosis, smallpox with its characteristic rash is remarkably well-known to villagers. A brief visit to a school permitted a surveillance team to inquire about possible cases of smallpox in a considerable number of villages over an extended area. Large coloured pictures of smallpox encased in plastic (WHO Recognition Card) and small postcard sized pictures of smallpox proved invaluable in implementing this scheme. The children, if patiently approached, proved consistently to be a mine of information regarding events and illnesses in their respective villages. School-teachers were usually most cooperative and after a few visits could undertake the questioning themselves and often to better advantage. In some programmes, pre-stamped notification cards were prepared and left with the teachers who once a week were asked to query their pupils. However, as with the primary surveillance system, regular visits by a surveillance team were mandatory to sustain interest.

Almost as useful as the schools was a similar type of query at markets.[18,19] Within a few hours a surveillance agent with a picture and sometimes a megaphone could obtain information about possible smallpox cases in rural villages within at least a 10 km radius of the market. The efficiency of this approach was improved by a practical training programme

for the market searches on how to approach the people (a neutral opening gambit on weather or crops was best), when (usually toward the end of the market day) where (tea shops were useful but often were time-consuming), etc. Monitoring the work of surveillance agents in markets was facilitated in India by the development of a "Market Survey Book". The agent asked each person queried as to which village he was from and noted this on a list in a book, a new village being added to the list each time a new one was named. At the end of a day, scrutiny of the book indicated the geographic area covered by the market search and by the number of "x's" after each village, how many persons from that village had been queried. Information regarding suspect cases was, of course, recorded in detail for later follow-up.

Where malaria programmes were in existence, it was expected that the veritable army of malaria surveillance workers would be of considerable help in case detection. Each such worker is supposed to visit every house once each month in his small assigned area to inquire about fever cases and to take blood smears for diagnosis. Inquiry about smallpox cases at the same time seemed a simple and minimally disruptive additional task and, indeed, in some few areas, this system worked well. More frequently, supervisers were either rigidly resistant to the idea of their workers participating in any other programme except malaria or supervision in the malaria surveillance programmes had so deteriorated that this approach was of no value.

Systematic house by house search, the ultimate in the development of secondary surveillance systems matured in India beginning in 1973 and, soon after, similar approaches were utilized widely in Pakistan and Bangladesh. The accelerated disappearance of smallpox in Asia was closely linked with this development.[20-24] In concept, the plan is simple. Once every four to eight weeks, all health staff in each administrative area devote a week to a planned village by village (later, house by house) search for smallpox. Where health staff are so plentiful as they are on the Asian subcontinent and, at the same time, under-utilized, such a scheme was found to be surprisingly feasible to implement. The requisite planning, organization, training and motivation to insure that each worker knew specifically what to do, where and when, seemed initially to pose a formidable task but the problems proved more soluble than were initially thought.

Training programmes were designed with the plan for each superviser to teach health staff both at the next lower and the second echelon below him. In this manner, each instructor was subjected at least twice to the training programme. Important in development of the scheme were carefully constructed forms which, when properly (and honestly) filled out, guided the worker in execution of his responsibilities. In India, literally tons of forms were required for each search, the printing and distribution of which did constitute a formidable although soluble problem in logistics.

Initially, the efficacy of this scheme was crudely assessed by comparing the numbers of cases detected during search week with the number of cases detected by all other schemes during the inter-search period. As shown in Fig. 1 in the State of Uttar Pradesh, the weekly incidence of reported cases showed an astonishing increase during the first search week and continued to exhibit a sharp increase during each subsequent search. Reports submitted by health staff indicated that virtually every village was being visited during each search period. Investigations of outbreaks, however, showed that many outbreaks persisted for long periods before detection and thus, obviously, were being missed during the systematic search. Clearly, the reported results were at variance with the fact. In order to discover how complete the search activities actually were, independent teams were created and staffed by district and higher level officials which assessed a 5-10% sample of villages. The first assessment revealed that although more than 90% of villages were reported to have been searched, only half of the villages had, in fact, been searched. The results of assessment were compiled each month, distributed to and discussed with the health staff supervisers for corrective and disciplinary measures. Assessed coverage in subsequent searches rose rapidly to the level of 80% and later to more than 90%.

As smallpox incidence fell and it became increasingly important to detect such cases as might still be present, the periodic special searches were supplemented by similar, specially organized searches in problem areas such as slum areas of cities and these, on occasion, were

conducted not house-by-house but room-by-room. Further facilitating the interest of the public in the reporting of cases and the motivation of health workers in their discovery, was the offer of a reward initially of 50 Rupees (about US$ 6.00) to the person who reported a case and a similar sum to the health worker who received the report. As incidence fell, this was gradually increased in India to 100 Rupees and, later, to 1000 Rupees (with similar progressive increases in Pakistan and Bangladesh). The benefits which accrued through more rapid detection of outbreaks more than repaid the small sums disbursed in reward payments. The reward was widely advertised by radio, loud speakers in markets, pamphlets, house visits by search workers, and by stencilled announcements on house walls. Posters were also sometimes employed but their "half-life" on most walls was so brief and the costs of their production so great that other methods of advertising were favoured.

Not surprisingly the secondary surveillance systems in the final intensive phase of work largely replaced the primary system in case detection. As the number of cases diminished and surveillance improved the completeness of notification rose steadily and in most areas almost certainly exceeded 95%. Although independent direct measurement of the completeness of notification, such as was done in 1968, was not feasible with the small number of cases occurring, the fact that the source of each newly discovered outbreak could be traced to already known outbreaks indicated clearly that few cases were being missed.

III. Collection, collation and dissemination of data within country

The establishment of procedures for the routine submission of reports of smallpox cases from the most peripheral reporting units to the next higher level (e.g. district level) was the most difficult and always proved the least efficient link in the surveillance programme. However, at all levels, surprising problems were initially encountered in assuring that reports were rapidly collected, collated and submitted to higher authority. In general, it was evident that the more effective the supervising authority at whatever level, the more efficient was the reporting system in his area. However, even with effective supervisers who utilized well the data submitted to them, it often proved difficult to persuade them of the need to provide accurate reports promptly to higher levels. Frequent personal contact was most effective in improving procedures but distribution of a weekly (or sometimes bi-weekly or monthly) surveillance report was of great help in providing perspective to the programme and in encouraging the prompt and regular submission of notifications. The surveillance reports assumed a variety of different forms but, as a minimum each contained data regarding cases reported weekly from each reporting unit plus interpretative comment. Each included, variably, epidemiological reports, schedules for search weeks, procedures for submitting specimens, information regarding other programmes, etc. Common to all was that they were mimeographed, prepared and distributed promptly so as to contain the latest data and were mailed to a large number of persons directly and indirectly associated with the programme. In most cases, preparation required but a few hours work each week by the programme director or an epidemiologist and the assistance of a part-time clerk for stencilling, addressing and mailing.

A difficult problem in some countries, especially at national and state/provincial levels, was to break away from the organizational system in which all data were dealt with by a statistical unit usually working in splendid isolation, effectively without responsibility to or contact with any other part of the health structure. Such units sometimes insisted on retaining all reports from an area until notification from all reporting units had been received even if weeks or months were required. At the same time, none of the statistical units with which I was acquainted, considered it their responsibility to assure that reports were received from the reporting units. Many statistical units refused to accept reports of numbers of cases discovered by surveillance teams on the grounds that cases could only be submitted by fixed medical units. Almost never did the statistical units query "unusual" reports such as the report perhaps of several hundred cases of smallpox in one week from an area which had reported no cases whatsoever for a year or more. In many countries, available data at higher administrative levels were frequently misleading. Often it was found, for example, that 100 cases of smallpox registered by units at a sub-district level, diminished to 70 cases in the report from the district level, to 40 cases at provincial level and to 25 cases officially registered nationally. Sometimes this occurred because of deliberate suppression of case reports but more frequently, the problem was simply a wholly inept data handling

system to which operational public health staff paid not the slightest attention. By insisting that programme officers responsible for smallpox activities assume primary responsibility for smallpox case reporting and by helping them to see the use for and importance of the data, most of the enumerated difficulties were resolved.

A seemingly incidental question which, however, assumed major dimensions in more than one programme was the question as to which week of report a case should be assigned. In one programme, the statisticians insisted it should be assigned to week of onset of the case. The result was that each week, cases with onsets scattered over 10-12 weeks had to be laboriously entered in records according to the appropriate week and new summaries and running totals prepared for each sub-unit reporting. In the system noted, it was common practice to omit from the records those cases for which no date of onset was provided. Chaos in the system multiplied at each higher reporting level. After considerable effort, the policy was fixed throughout the programme that all cases reported to state/provincial level (sometimes national level in smaller countries) during a given week were recorded officially in that week.

IV. International data collection and dissemination

While the national reporting of cases of smallpox at the inception of the programme was recognized to be woefully deficient, it was considered important nevertheless to try to improve the regularity and rapidity of reporting at all levels of the system while endeavouring at the same time to improve the system throughout so as to get the "best available count" of smallpox cases worldwide. At WHO headquarters there were problems no less than elsewhere.

The International Sanitary Regulations explicitly set forth a reasonable system for prompt and regular telegraphic reports of smallpox cases from all Member countries direct to WHO, Geneva. The unit dealing with the International Sanitary Regulations, as they were called at that time, recorded these data concurrently and forwarded the reports to a separate Statistics Division. Current data, without analysis or summary, were published by the International Quarantine Unit in the Weekly Epidemiological Record. Annual summaries of data regarding smallpox, as well as other diseases, were published by the Statistics Division, an entirely separate group, employing annual summary information submitted separately by the national governments.

The quality of data reflected the interests and responsibilities of those concerned. In regard to smallpox the International Quarantine Unit was concerned primarily with whether or not a defined local political area was or was not infected with smallpox and should or should not appear on the published list of locally infected areas. Whether two or 2000 cases were reported was of little concern. The Statistics Division received and faithfully published in the World Health Statistics Annual, data based on special statistical summaries provided each year by national governments. With no technical officer knowledgeable of the global smallpox situation to query "strange or unusual reports", numerous anomalies appeared in the World Health Statistics Annual. As later experience revealed, reports of a few smallpox cases are received two or three times each year from countries thought to be smallpox-free. Since 1967 when such reports have been specifically queried, most have turned out to be simple clerical errors and not the result of smallpox importations as the data might suggest. As an example, the 1967 World Health Statistics Annual[25] records for Columbia seven deaths due to smallpox but no cases; for São Tomé and Principe, one smallpox death but no cases. Neither country on subsequent verification with the governments concerned, experienced smallpox that year. Conversely, although respective government records show that Lesotho, Ivory Coast, Senegal and Ceylon experienced cases in 1967, the World Health Statistics Annual records no cases for these countries. Notably, a well-documented case of smallpox imported into Czechoslovakia from India in March 1967 is not recorded. And, finally, the total of cases shown in the records is 122 949, over 9000 fewer cases than were confirmed from official government records after review with WHO staff.

In brief, smallpox data which were available to and published by WHO through much of the 1960s, bear only a vague resemblance to the smallpox situation as it actually was. Underlying problems in the system at WHO, however, were essentially no different than the

problems in each of the countries. With no responsible and knowledgeable public health official actively utilizing the data and doing all possible to assure that it was of the best possible quality, one could expect little more than that which emerged.

Beginning in 1967, a number of measures were initiated which improved the data system. Utilizing the reporting system required under the International Sanitary Regulations and the statistical unit of the International Quarantine unit as the central data registry, governments were asked and often repeatedly reminded directly or through WHO project staff to submit reports of smallpox cases (or no smallpox cases), promptly each week. All reports were scrutinized by Smallpox unit staff and strange or unusual reports promptly queried. Conflicting reports from whatever source were reconciled through contacts with government and project staff.

The problem of official suppression of reports of smallpox cases was eventually found to pertain to comparatively few countries. These were reasonably readily identified through an unofficial smallpox information network comprised of university scientists, embassies and a variety of national and international contacts. Most governments responsible for case suppression quickly reversed their policies when approached diplomatically but frankly with a full explanation of the need for reporting and made aware of the fact that suppression on their part was most harmful to the programme's credibility and damaging to the reputation of their own health service. Since 1972, no known deliberate suppression of reports has taken place.

As a base measurement for future comparisons of incidence, it was decided in 1967 to recheck with governments data which had been reported to the Organization over the preceding five years in order to assure that complete reports had been received. It was recognized that gradually more complete notification of cases from improving national surveillance programmes would make direct comparisons of incidence from year to year problematical. However, it was hoped that trends would be more intelligible if past data could be as complete as possible. WHO project staff and those on tour undertook this review during the early phase of the programme. Changes in data as a result of this simple exercise were remarkable. For example, the total of cases for 1964 increased from 57 867 cases (1964 World Health Statistics Annual) to 75 910 cases and for 1965 from 54 430 cases (1965 World Health Statistics Annual) to 112 173 cases.

Until 1969, all recording and tabulation of incoming data at WHO was done by hand employing a variety of data books and cards. With so many reports being received from so many political divisions and subdivisions compounded by problems of frequent revisions of data, the task was laborious and access to current data for analysis was limited. Computerization of records resolved this problem.

A more difficult problem was the development of a functional international surveillance report which could be distributed regularly to national and international staff concerned with smallpox and which would include information regarding the current status and trends of smallpox incidence, interpretative summaries and information regarding programme developments and findings. Although this represented the essential last link in the surveillance process, it was difficult to persuade WHO senior officials. The first surveillance reports were distributed in 1967 but after only two issues were terminated. After considerable discussion, it was decided finally to modify the format of the Weekly Epidemiological Record to permit such reports to be included therein as a regularly recurring feature. The first such report appeared on 30 May 1968 and subsequent reports appeared at intervals of two to four weeks thereafter. Report number 120 was published on 16 September 1975 and distributed to the Weekly Record's 5000 subscribers while an additional 2900 reprints of the Smallpox Surveillance portion were distributed to national and international field staff throughout the world.

V. Relevance of the Smallpox Surveillance Scheme to the surveillance of other communicable diseases

The mechanics of the scheme for smallpox surveillance gradually evolved and were adapted specifically to fit the needs of the smallpox eradication programme. Effective surveillance systems for other diseases inevitably must differ in many details. For example, case

detection for smallpox is comparatively simple and laboratory confirmation of cases is required only when incidence is very low, but for other diseases, considerably greater support from the laboratory may be required. The nature of the data to be collected and the quality required will necessarily depend on the ecology of the disease and the decision as to what is important to know for operational purposes. Although the mechanics of the smallpox surveillance scheme cannot be transcribed unmodified to deal with surveillance of any other disease, there are a number of principles intrinsic to the smallpox surveillance programme which do seem applicable in the development of surveillance programmes for other communicable diseases.

The first and most important principle, I feel, is recognition that progress in a disease control programme ultimately must be monitored in terms of disease incidence. While to many this would seem obvious, it has been our experience until quite recently that health authorities, the press and the public at large have sought to gauge progress in the smallpox programme primarily in terms of numbers of vaccinations performed. When epidemics occurred, numbers of cases were cited and sometimes changes in incidence from year to year were noted but attention was directed primarily to the vaccination figures. If these were high, it was concluded that the programme was proceeding well. Little thought was given to the possibility that the vaccine might be impotent (as so much was in 1967) or that large numbers were being vaccinated repeatedly and many persons not at all. The measurement of progress in terms of vaccinations performed seems to be an all too common failing of immunization programmes today both in developed as well as developing countries. However, once the commitment is made to monitor progress in terms of disease incidence, attention is necessarily focused on means to improve the measurements of incidence and thereby on surveillance systems. Inevitably attention is directed to age, geographical and other characteristics of those cases which do occur - the "failures" of the programme - and thereby on mechanisms to minimize such failures by appropriate changes in the programme itself.

Once a commitment is made to undertake a surveillance programme, some sort of mechanism is required for the systematic collection of data so as to provide a continuing flow of information regarding trends and relative incidence - in brief, a primary surveillance system. A frequent obstruction in the development of such a system are colleagues from university environments especially statisticians, who often find it impossible to accept as worthwhile any surveillance system which provides less than a total count of all cases or a precise estimate of total incidence. All too often the attitude seems to be, better no system at all than an "imperfect" system. And yet, although our primary system of smallpox surveillance provided neither a total count of cases nor a precise estimate of the total problem, it provided immensely valuable information sufficient to indicate the need for a number of significant operational changes in the programme. In implementation of other communicable disease control programmes, a reporting network, preferably based on the existing health structure, should provide a most valuable continuing flow of information to indicate whether or not the millions of vaccinations, for example, are actually having an effect on incidence of the disease in question. Data from a primary surveillance system so established can subsequently be elaborated by various secondary surveillance systems of varying sophistication based on the needs of the programme. It should be cautioned, however, that the "needs" for purposes of programme operation may be quite different from the "needs" of the university research worker or the conventional statistician.

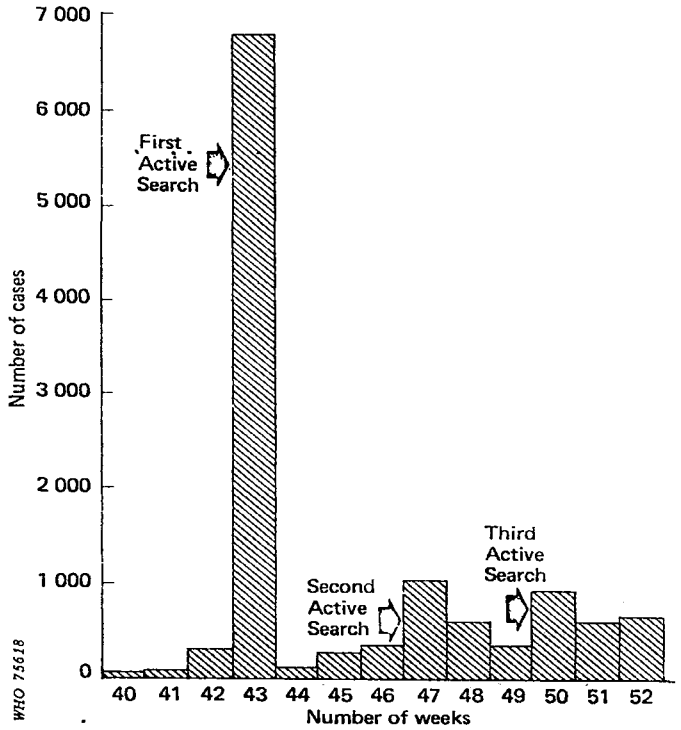
Improvement in the quality of smallpox surveillance correlated most closely with the interest of operational staff at each level in obtaining the best possible count of smallpox cases. Demonstrable evidence that the data were being scrutinized and employed in planning and decision making provided a most important stimulus to the detection, collation and reporting process. Regularly issued surveillance reports at international and national level were of considerable help and inexpensive both in cost and professional time. More important perhaps was the response to notifications by surveillance teams and higher level officials who visited those units reporting cases to discuss the situation and to assist in taking appropriate action. One wonders how effective or meaningful a surveillance programme could be, say for varicella, for which no effective control procedures are available or, for poliomyelitis, in a country which does not offer poliomyelitis vaccination. And yet, in how many countries today, are health units asked to report cases on their traditional "laundry

list of most diseases known to mankind". The experience in smallpox surveillance would suggest that surveillance and routine reporting might profitably be restricted to those diseases for which intervention would be implemented were disease incidence to reach some defined level or in which some form of continuing programme, such as routine vaccination, was in process.

Not to be underestimated in the surveillance process is the value of well-designed reporting forms which serve a dual function - (1) in providing the absolute minimum, necessary identifying and descriptive data required for monitoring programme operations and (2) in requiring data which if obtained by the person submitting the form will guide him in the collection of appropriate information to make a correct clinical and/or epidemiological diagnosis and in taking appropriate action. In the smallpox programme, poorly designed forms and those designed by the more academically than operationally inclined usually proved more damaging than constructive.

In conclusion, it seems to me that the most powerful, effective and under-rated tool in communicable disease control is the technique of surveillance. In essence, it represents organically the brain and the nervous system in a management process. As we in preventive medicine begin to understand and employ some of the more modern approaches in management, the surveillance mechanism, I am sure, will assume an increasing if not dominant role not only in monitoring disease incidence but in monitoring the operation of the programme as a whole.

FIG. 1. SMALLPOX CASES BY WEEK (WEEKS 40-52, 1973) - UTTAR PRADESH[20]



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