ANALYSIS, INTERPRETATION, USE, AND DISSEMINATION OF SURVEILLANCE INFORMATION[1]

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Systems for the surveillance of communicable diseases either exist or are being developed in most parts of the world. The purpose of this paper is to describe methods for making the best possible use of the information obtained.

The Reliability of Surveillance Data

The first issue to deal with when considering the handling of surveillance data (particularly morbidity data) reported by physicians is whether or not the data are reliable, since in most places not all physicians report. Furthermore, those reporting do not necessarily constitute a representative sample of physicians in the community, and they do not necessarily report every case they see. In some countries, only those physicians involved in government services are expected to report; and it may be argued that this circumstance is another factor mitigating against use of the data.

It is my belief, however, that morbidity data are indeed usable and useful, even in the face of underreporting. Of course, one must be careful not to over-analyze these data or to place too great a reliance on small changes.

One way of indicating whether morbidity data are reflecting true occurrences is to verify the trends shown by observation. This can be accomplished in a variety of ways, one of the simplest being to ask practitioners how the current level of a given illness compares to its level in previous seasons or previous years. Or, in the case of diseases requiring hospitalization, hospital records can be used to show incidence trends.

Further insight into the reliability of morbidity data as indicators can be gained by comparing them to data provided by other reporting mechanisms. For example, one might compare the reported incidence of tuberculosis with reported deaths caused by this disease. (Death reporting, done through a separate mechanism, is generally felt to give a reasonable reflection of reality.) Such a comparison in New York State revealed that in the past there has been good agreement between these two types of reports. That is, the ratio of the reported death rate to the reported case incidence remained generally constant until the intro-

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duction of effective chemotherapeutic agents in the late 1940's, when it began to show a steady decline.

One can also make direct comparisons between the reporting of a disease and the "real" occurrence of that disease. For example, in Israel a comparison was made between cases of viral hepatitis reported by physicians in private practice and the recorded incidence of the disease in a population covered by an insurance plan which required recording the diagnosis of each illness resulting in a physician visit (*1*). This study showed that although the reporting by private physicians was only about 37.4 per cent complete, the distribution of reported cases by season and age closely paralleled that recorded for the insured population. The country's private physicians were then contacted every two weeks and asked whether or not they had seen any cases of viral hepatitis. This active canvassing raised the number of cases reported, resulting in a reporting level thought to be 96 per cent complete (in terms of comparison with the insurance data). The seasonal and age trends obtained with this active surveillance technique also paralleled those indicated by the insurance data.

Another relevant study was a nationwide survey of venereal disease reporting carried out by the American Social Health Association and the U.S. Center for Disease Control. The survey, first conducted in 1963, was repeated in 1968 with similar results (*2*). In this study, all U.S. physicians were asked to state the number of infectious syphilis and gonorrhea cases they had actually treated over the preceding three months. The numbers obtained were then compared to the number of reports which had been received by health departments during the same period. The 1968 study showed that the physicians had reported only 18.7 per cent of the infectious syphilis cases and 16.9 per cent of the gonorrhea cases that they had treated.

A study with a somewhat different focus was conducted in Upstate New York (New York State exclusive of New York City) in 1971 (*3*). This focused on the specialties of physicians who reported particular disease conditions. For example, only 0.63 per cent of the state's licensed physicians had reported one or more measles cases in 1971. Although this could have reflected growing control over the disease, such an explanation seemed unlikely. Since many specialists (psychiatrists, orthopedic surgeons, etc.) would not be expected to see measles, an analysis was made in terms of the cases reported by physicians in different specialties. This showed that only 3.2 per cent of the pediatricians had reported one or more measles cases that year. It is clear that a much higher percentage of pediatricians actually saw measles, but what that percentage was is not truly known.

This same study also analyzed the data provided by physicians reporting cases of gonorrhea, a disease which is epidemic in New York. This analysis showed that the following percentages of physicians reported one or more cases of gonorrhea in 1971: 25.0 per cent of the public health physicians, 21.1 per cent of the obstetrician-gynecologists, 17.7 per cent of the general practitioners, 13.8 per cent of the urologists, and 8.83 per cent of all physicians. Although these data do not indicate the true incidence of measles and gonorrhea, they do give some indication of the great need to educate physicians about the purposes of reporting.

Morbidity Reports

To be used effectively, morbidity reports should state not merely the diagnosis of each case but also, as a minimum, the subject's sex and age (or age group), the day (or week) of onset, and the relevant geographic area involved. The nature of the geographic area indicated should be appropriate for the

reporting level concerned. For example, at the city, county, or district level, the patient's exact address may be needed, but at higher levels the relevant political subdivision should suffice. Additional information that can prove extremely useful at times includes the patient's marital status, whether or not the patient was pregnant, whether or not the patient was hospitalized, his or her race and/or socioeconomic status, and the outcome of the case.

Data Collection

The ten commonly accepted elements of data collection (*4*) are as follows:

1) Mortality registration
2) Morbidity reporting
3) Epidemic reporting
4) Epidemic field investigations
5) Laboratory investigations
6) Individual case investigations
7) Epidemiologic surveys
8) Animal reservoir and vector distribution studies
9) Data on utilization of drugs and biologicals
10) Demographic and environmental data

The first two of these have already been discussed, and the next two are specifically applicable to epidemic situations. The remaining six, however, are applicable to a wide range of situations, and a brief description of these would seem appropriate.

Laboratory Investigations

This is naturally a very important part of surveillance, and the data obtained can be of very great benefit. For example, the salmonella surveillance system in the United States is based almost exclusively on laboratory reporting of salmonella isolations. As might be expected, most of the isolates are *Salmonella typhimurium,* followed by *Salmonella enteritidis* and *Salmonella newport.* Nevetheless, some of the most important findings are those involving infrequently observed serotypes rather than common ones. In 1965-1966, for instance, U.S. laboratories reported 29 isolates of an extremely rare serotype, *Salmonella new brunswick,* from 17 states throughout the country. Further information was obtained about each person from whom the organism was isolated. Investigation revealed that nearly one-half of those affected were children under the age of one year. Further investigation revealed that the illness resulted from ingestion of contaminated nonfat dried milk. As a result of this investigation, a very detailed survey was made of dried milk processing procedures, and some basic nationwide changes in processing techniques were introduced (*5*).

Individual Case Investigations

Investigations of this kind are particularly important with regard to diseases which are disappearing. For example, it is obviously important to investigate individual malaria cases in countries where malaria has nearly been eradicated. In the United States, the reported incidence of malaria rose sharply in the mid and late 1960's, with a maximum of 3,102 cases being reported in 1969. Investigation of these cases confirmed that over 90 per cent were occurring among servicemen returning from Southeast Asia. Instances of transmission within the United States have been quite rare, and have been primarily associated in recent times with needles shared by users of illicit drugs. Nevertheless, in 1972 investigation of a reported malaria case in New York State revealed that the case had been locally transmitted by mosquitoes, the state's first recorded instance of such transmission in over 30 years.

Epidemiologic Surveys

Surveys are also an important element of surveillance, malariometric surveys being a classic example. Other types of surveys may not involve direct contact between the patient and the surveyor. For example, New York State has a law requiring all children entering school for the first time to be protected against polio, measles, rubella, and diphtheria. In 1972, a survey of all the state's elementary schools showed, as might be expected, that immunization was incomplete. In fact, on a statewide basis only 83 to 87 per cent of the entering students were immunized against any given disease, and there was great variation from place to place. This survey enabled corrective action to be undertaken.

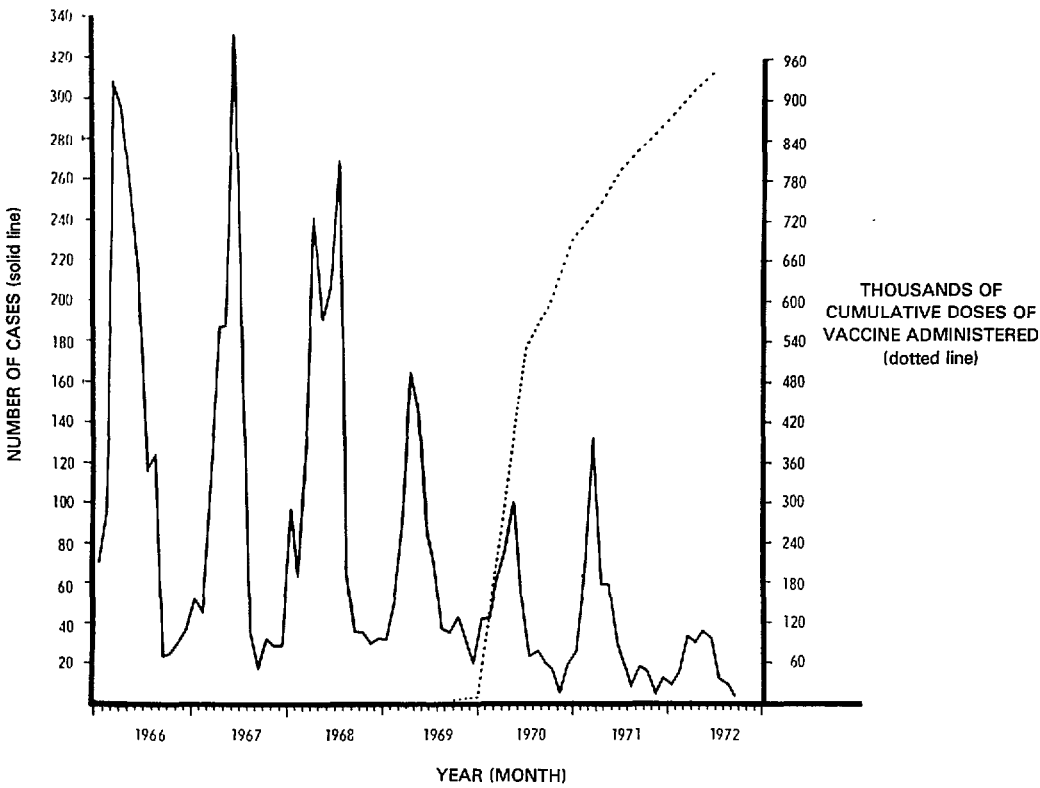
Reservoir and Vector Studies

Studies of reservoirs and vectors are obviously important in planning vector control measures. This applies especially to the planning of intermittent control measures—such as adulticiding—for areas of arbovirus activity where source reduction techniques are not used.

Data on Utilization of Drugs and Biologicals

These data may frequently supplement or take the place of information which might be more difficult to gather from other sources. For instance, knowledge about the distribution of a particular vaccine can give

Figure 1. Reported incidence of rubella and cumulative rubella vaccine use in New York State, exclusive of New York City, 1966-1972.



Source U S Center for Disease Control.

a rough idea of the population's immune status, although it does not tell what age groups have been immunized or how much of the distributed vaccine has been used. Data on the actual administration of vaccines can be much more helpful in this regard, and can be correlated with the reported incidence of disease. For example, Figure 1 correlates the use of rubella vaccine with the incidence of rubella in Upstate New York. As might be expected, the number of cases reported has declined with increasing vaccine use.

Demographic and Environmental Data

These play an essential role in defining the populations from which surveillance data are received. We have used one demographic variable (socioeconomic status) in showing the immunity level of children entering New York State schools in several cities in 1972. These data, contained in Table 1, clearly indicate a need to improve immunization activities in areas with low socioeconomic levels in order to protect children against these preventable diseases.

Environmental data are particularly important when dealing with vector-borne diseases but may also be relevant in other settings, e.g., when a sudden spell of cold weather leads to crowding indoors.

Use and Dissemination of Surveillance Data

The primary purpose of surveillance data, as regards communicable diseases, is to provide a basis for action—either immediate remedial action or longer-term action performed by ongoing preventive programs. This refers not only to action by government agencies, but also to action within the private sector.

Clearly, mere collection of surveillance data is useless. Such data, once collected, must be analyzed and used to plan action. All too frequently, the information obtained is allowed to gather dust in some corner of a statistical clerk's office, leaving those responsible for establishing priorities in communicable disease control and other health programs unaware of the true situation. To prevent this, it is the duty of the communicable disease epidemiologist to thoroughly analyze surveillance data and to make sure that each policy-maker involved is aware of their significance.

In this same vein, the information obtained through surveillance should be disseminated as widely as possible, consistent with practicality. It is absolutely essential that those who submit reports receive some indication that those reports are being seen. The most direct way to ensure this is to follow up on reported cases. For instance,

Table 1. Percentages of fully immunized children among school entrants in Upstate New York and in four large cities* by socioeconomic area. September 1972.

Disease	% fully immunized			
	In: Four large cities, by socioeconomic area:	Socioeconomic area		In: All Upstate New York (total)
	high	medium	low	
Diphtheria	75	65	58	86
Measles	72	66	52	84
Poliomyelitis	73	62	55	83
Rubella	67	63	55	85

*Albany, Buffalo, Rochester, and Syracuse.

health department investigation of a case reported by a physician is concrete proof to the physician that his reports are important. As a side-benefit, the investigation thus becomes a very valuable means of retaining his collaboration. Obviously, however, not all disease cases could be investigated. For this reason, it is important that the reporting source receive at least some sort of minimal, less individualized form of feedback.

In Upstate New York, a monthly communicable disease newsletter is sent to all licensed physicians as well as to radio and television stations, newspapers, and any other interested parties. This newsletter, patterned after the Center for Disease Control's *Morbidity and Mortality Weekly Report,* contains a table summarizing the number of cases of different diseases reported during the current month; it also shows the cases reported during the year to date and compares those figures with the preceding year's experience. There is also a narrative section which discusses vaccine recommendations, treatment recommendations, recent disease outbreaks, recent developments in communicable disease control, etc. As the State Health Department is not a federal agency and does not have franked postage, the cost of this newsletter is significant. However, during the first two years of the newsletter's existence the number of physicians who reported cases of communicable disease to the health department increased by more than 25 per cent. The results thus appear to far outweigh the requisite expense.

SUMMARY

Surveillance data lay the groundwork for effective large-scale health actions. Sometimes, however, it is hard to obtain surveillance data, to determine the reliability of collected data, or to ensure that the data will be used to maximum advantage. This article provides a basic review of these three problems and ways to approach them, drawing illustrative examples from various sources, including the author's own experience.

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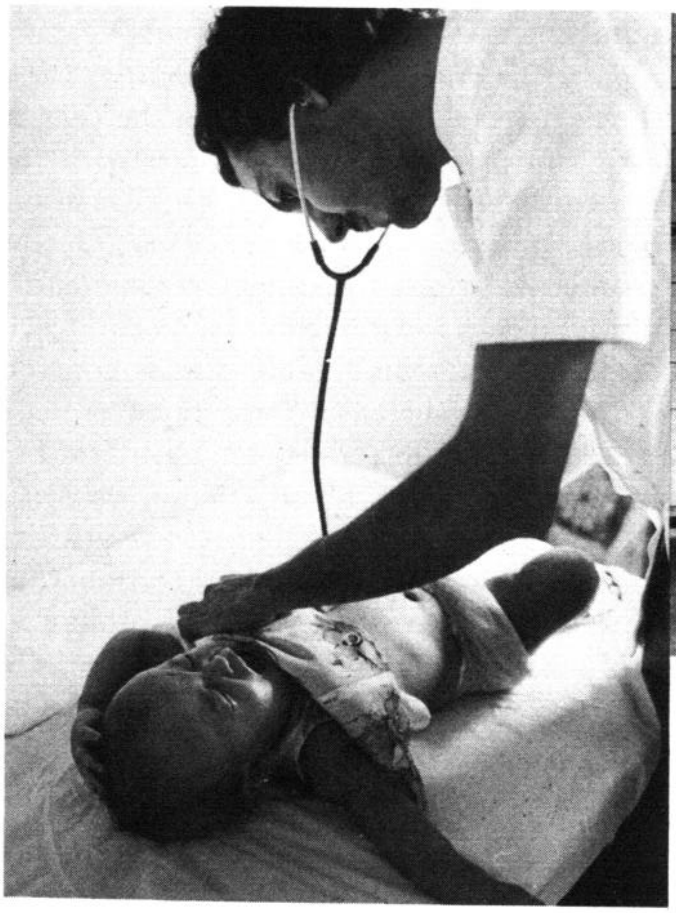

Facilities providing ambulatory care (*above*) make access possible and help solve many health problems. The home visit (*below*) ensures direct patient contact.

(Photos: WHO/J. Littlewood)