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MORBIDITY STATISTICS

Twelfth Report of the WHO Expert Committee on Health Statistics

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CONTENTS

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Geneva, 7-13 November 1967

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MORBIDITY STATISTICS

Twelfth Report of the WHO Expert Committee on Health Statistics

A WHO Expert Committee on Health Statistics met in Geneva from 7 to 13 November 1967. Dr N. F. Izmerov, Assistant Director-General, opened the meeting on behalf of the Director-General. Dr. P. Densen was elected Chairman, Dr V. K. Ovčarov Vice-Chairman, and Dr K. C. Patnaik Rapporteur.

1. USES OF MORBIDITY STATISTICS

In the sixth report of the WHO Expert Committee on Health Statistics, morbidity was defined as " any departure, subjective or objective, from a state of physiological well-being ".[1] From the viewpoint of the individual, sickness is a state that prevents his meeting social, occupational, or other demands, or that threatens such dysfunction. If the meaning of morbidity statistics is to be completely clear, it is usually necessary to specify the operational or diagnostic criteria by which cases are included or excluded. For example, the definition of sickness used in admitting patients to hospital will differ from that used by general practitioners. Similarly, the meaning of terms such as chronic bronchitis, hypertension, and neurosis will vary widely, depending on the criteria and techniques used to define and diagnose them. For these reasons, morbidity statistics are indicative of the health of a population only if their sources are fully known.

The principal use of morbidity statistics is the description and investigation of patterns of occurrence of illness and of the use of medical care, to the end that available resources may be most effectively directed towards the maintenance and promotion of public health. All countries, whether their resources are great or small, must carefully study the extent of their health problems, so that available health and medical care can be used with maximum effect. Although the ways in which such services are used will vary widely from one country to another, depending upon local circumstances and traditions, there is a universal need for the most precise possible understanding of the health problems that are to be tackled.

[1] *Wld Hlth Org. techn. Rep. Ser.*, 1959, **164**, p. 5.

1.1 Ascertainment of population health status

Since population health can be easily measured only in terms of the prevailing amount of ill-health, morbidity statistics provide one means of measuring the health of communities and the extent to which they make use of medical-care services. In ascertaining the health of a population, the objectives should be (*a*) the description of health status, (*b*) the early detection of changes in health, and (*c*) the prediction of future trends in health.

1.1.1 *Description of current health status*

If administrators are to evaluate the effectiveness of health services, they should be aware of the health status of the communities they serve. This involves the collection and reasonably prompt analysis of morbidity data, so that information is available while it remains useful.

1.1.2 *Detection of changes in health*

Early warning of the imminence of disease outbreaks is necessary for two reasons. First, early detection of outbreaks of certain diseases is desirable if procedures are available that might permit such outbreaks to be averted or contained. For this reason, certain communicable diseases are usually made notifiable. Second, it is necessary that new hazards that may arise from the continually changing environment (e.g., the risk of thalidomide-induced limb malformation) be detected at an early stage. Since there is usually no way of foreseeing such hazards, continual scrutiny of up-to-date information on disease occurrence is necessary. Suitable procedures for analysing data are available, but appropriate data on morbidity are not yet generally available on the scale and with the speed that is required.

1.1.3 *Prediction of trends*

Much of the value of morbidity statistics lies in the fact that they can be used to predict health trends that may affect the need for medical services. Although all prediction calls for caution, it is nevertheless necessary to health-service planning. Examples of such a use of morbidity statistics include the study of changes in (*a*) the frequency of diseases that require separate hospitals or services; (*b*) the frequency of diseases in different age and sex groups; and (*c*) the relative proportions of diseases that are preventable and those that will inevitably call for treatment. Some such trends must be predicted over a long and some over a short period; in either case, extrapolation from soundly based historical series is the most efficient method of prediction.

1.2 Study of the determinants of population health

Where detailed planning and administration of health services are important, population health must be investigated in more detail. In order to understand the factors that determine the extent and patterns of occurrence of disease in a community, detailed numerical data are necessary on the frequency of disease in different population groups; the type of population, the place, and the time should be fully specified. Such data may be applied to three distinct types of inquiry : investigation of the causes of disease in individuals; identification of the social and environmental factors that determine the characteristic patterns of disease in communities; and study of the factors that determine the effect of diseases that have arisen and that cause them to persist.

1.2.1 *Study of disease causation*

The investigation of ways in which disease is caused and the identification of pathogenic agents are traditional applications of epidemiology. In the study of many urgent etiological problems, data are necessary on such a large scale that the use of national morbidity statistics is the only practical solution. Since governments are in a particularly good position to collect and analyse suitable data, they incur the responsibility of doing so, and such responsibilities have been accepted by government health statistical agencies for many years. An example of the type of inquiry that can be based on suitable morbidity statistics is the investigation of the pathogenic effects of (1) occupational or other environmental hazards, (2) procedures used in medical diagnosis and treatment, and (3) social and economic factors.

1.2.2 *Study of factors influencing the incidence of disease*

The occurrence of disease in populations is influenced by a number of factors that include individual exposure to disease agents. Such factors can often be effectively studied only by means of representative data from large populations. Furthermore, the necessary control measures can frequently be taken only by government health agencies, which therefore have the responsibility for such studies of etiology.

In countries whose medical resources are limited, it may be desirable to concentrate health programmes in particularly vulnerable sections of the population, which may be identified by the analysis of morbidity data.

1.2.3 *Study of factors influencing the natural history of disease*

Since the prevalence of disease depends on its incidence and its duration, the factors that affect incidence and duration also affect prevalence, and they are particularly important in the study of chronic diseases.

Statistics on the prevalence of morbidity can, therefore, be used to investigate the factors that determine the course and duration of disease and the severity of the associated disability. Since medical care is an important determinant of the course of disease, studies of the prevalence and duration of disease are important for the planning of medical services, particularly in view of the fact that such services are, to an increasing extent, provided by government agencies.

Another important application of the study of the course of disease is the identification of presymptomatic features of diseases that may permit earlier diagnosis. Although many chronic diseases cannot easily be prevented, their course may be substantially modified if they are detected and treated at an early stage. Since early detection techniques will almost certainly require organization at national or regional government levels, it is natural that they should be based on the study of morbidity statistics collected and analysed at a comparable level.

1.3 Evaluation of effects of services

The acceptance by health authorities of responsibility for the management of health and medical services involves the duties of planning such services as effectively as possible and of continually evaluating their effectiveness. Such evaluation may be assisted by continual scrutiny of routine morbidity statistics or by special statistical studies of specific health and medical care programmes. Although both types of study are covered by the term " morbidity statistics ", they require different techniques, depending upon the nature of the factor that is to be evaluated (e.g., the effect of preventive services on incidence, the effect of therapeutic services on prevalence and outcome, and the effect of the provision of medical care on the severity of the disability associated with disease).

1.3.1 *Effect of preventive procedures on incidence of disease*

The use of morbidity statistics permits continuing evaluation of the broad effect of preventive techniques. For example, trends in the notification of cases of tuberculosis, poliomyelitis, or diphtheria (or in the rates of death from these diseases) may confirm the effectiveness of preventive techniques, and may indicate groups in which prevention has been less effective than in others. More elaborate statistical studies of certain diseases, taking into account the many factors that determine their rates of occurrence, are necessary. It is particularly important to identify groups in which special preventive activity may be required. For example, the acceptance of poliomyelitis vaccination has been shown to vary considerably in groups having different social and educational backgrounds.

1.3.2 *Effect of therapeutic procedures on prevalence of disease*

Whereas incidence is a measure of the frequency of new cases of disease, prevalence is the total number of cases at a particular point in time or within a given period of time; it is, therefore, particularly useful in the statistical study of chronic disease. As noted above, prevalence is determined partly by incidence (and is, therefore, influenced by preventive techniques) and partly by the duration of disease. Among the factors that affect the duration of disease are medical treatment and rehabilitation, and the influence of these factors on chronic disease is often evaluated by means of prevalence studies.

1.3.3 *Effect of medical care on disease severity and disability*

An example of the way in which morbidity statistics can be used to study the influence of medical care on the severity of disease is the comparison of the rates of survival of cancer patients receiving different forms of treatment. Similar studies of other diseases might also be useful. A particularly important area for study in many countries is mental illness, which usually accounts for a large proportion of hospital utilization. The severity of mental illness, and the disability it causes, may usefully be measured in terms of total duration of hospitalization. Therapeutic changes may greatly change the need for hospital accommodation and thus the need for providing special hospitals and other services.

2. METHODS OF DATA COLLECTION

Morbidity data may be derived either from the basic records maintained by health, medical, and related services or from special studies. For statistical purposes, data of the former kind are usually collected by systems of continual reporting (e.g., the notification of certain diseases and statistics from hospitals and other medical-care services, social security agencies, and established registers of various diseases). Such systems of continual reporting are the main source of morbidity statistics at present, although surveys have been gaining in importance during the past decade (see page 16).

A given source can furnish only partial data on total morbidity, and statistics from a wide range of sources are necessary in order to achieve a comprehensive account of morbidity.

2.1 Continual reporting

Many different sources of statistics may be used for continual reporting. The principal sources now in use in the Member States of WHO are described in the following sections.

2.1.1 *Notification*

As used in this report, notification implies the mandatory reporting of certain prescribed diseases whenever they are encountered. Lists of such notifiable diseases exist in most countries and, although they vary widely, usually include communicable diseases that are considered to be serious menaces to public health. In some countries, certain noncommunicable diseases (e.g., some industrial diseases) are also notifiable.

Although the primary purpose of notification is not statistical, health statistical agencies have usually made use of it as a source of data. Furthermore, it may be argued that the detection of significant changes in the level of occurrence of disease is a statistical problem. Although notification may be a valuable source of data, the extent to which it can be used as such is limited by a number of inherent disadvantages, the most important of which is the restricted number of diseases that can be made notifiable. Because of the labour involved, the list of such diseases must be kept small if co-operation in notification is to be maintained. Another disadvantage is the fact that notification data are often incomplete, and their representativeness is variable and often unknown. For many purposes, this consideration renders notification data unsuitable.

However, despite these disadvantages, it seems clear that for many years notification has successfully fulfilled its primary purpose, in that fluctuations in the level of notification have provided useful indications of the imminence of disease outbreaks. For some diseases, at least, it has provided valid long-term data on trends in occurrence.

With a view to improving the usefulness of notification data for statistical and other purposes, the Committee recommends that the reporting of notifiable diseases be as complete and representative as practicable. Since the longer the list of notifiable diseases the less likely it is that reporting will be complete, it further recommends that such lists be reviewed periodically, so as to ensure that they remain strictly relevant to the disease problems of the localities, regions, or countries concerned. The Committee notes with approval the following experimental developments, and suggests that they be more widely adopted.

(1) Sampling methods based on particular areas, periods of time, or physicians to provide notification data of better quality than might be obtainable by large-scale procedures.

(2) The use of trained paramedical personnel for notification.

(3) Specification of the diagnostic criteria used in deciding whether to report a given case, so that such criteria could be included in statistical reports.

(4) The use of special procedures in defined areas so as to identify the causes of incomplete notification and to develop improved systems of reporting.

(5) Regional studies of comparability, possibly by means of establishing minimum common lists of notifiable diseases.

2.1.2 *Hospital in-patient statistics*

Apart from notification of disease, the most readily available source of extensive data on morbidity is statistics on hospital in-patients. Most countries have hospitals, which almost invariably keep records of each in-patient. Statistical abstraction from such records is fairly readily possible.

There are two principal ways in which reports can be made to central statistical agencies : tabular returns from hospitals or groups of hospitals, and individual returns which may be analysed and tabulated centrally. Many countries use a return on which the data are presented in such a way that central agencies may process them either as individual records or as tabular returns. Such returns usually present all the data on each hospital patient on one line, but the lines are arranged so that totals and subtotals can be inserted at suitable intervals.

The fifth [1] and eighth [2] reports of the WHO Expert Committee on Health Statistics discussed the uses, value, and limitations of hospital statistics. In the latter report, it was recommended that " hospital statistics be regarded in all countries as an integral and basic part of the national statistical programme and be developed from both the administrative and the public health points of view to supplement those statistics obtained from mortality and other morbidity sources ".[3] In discussing hospital morbidity statistics, the same report recommended :

(1) that countries compile hospital morbidity statistics, giving, as a minimum, a count of patients discharged and of their hospitalization days since admission, by diagnosis and sex;

(2) that such statistics be produced at least annually;

(3) that the data be collected through an individual statistical report completed at the discharge of the patient;

(4) that the International Classification of Diseases be used for the classification of diagnoses;

(5) that in long-stay institutions these statistics be supplemented, wherever possible, by statistics based upon admissions and patients resident in the hospital as of a given day (for example, the first day of the year).[4]

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[1] *Wld Hlth Org. techn. Rep. Ser.*, 1957, **133**.

[2] *Wld Hlth Org. techn. Rep. Ser.*, 1963, **261**.

[3] *Ibid.*, p. 8.

[4] *Ibid.*, p. 20.

The present Committee endorses the above recommendations and makes the following comments.

(1) The statistical unit will usually be the discharge of a patient from hospital.

(2) Hospitals will be more apt to co-operate in reporting the data if the statistical abstracts, or tabulations from them, are useful to the hospitals as well as to the central statistical agency (e.g., the abstract might be designed so that it could serve as an index entry or even, for long-term use, as the case record itself).

(3) Many systems for the reporting of hospital statistics have the defect of not distinguishing between multiple hospital stays of a single patient and stays of several different patients. If statistical abstracts are adequately identified, they can be combined into series that are related to patients rather than hospital stays and can be analysed accordingly. The difficulty may be partially overcome if it is possible to distinguish between first and subsequent stays.

(4) For many purposes, the use of samples may be more rapid and less expensive. There are advantages in a sampling procedure that is based on persons rather than events (e.g., the use of the date of birth or a personnel identifying number as the sampling frame), so that it is possible to distinguish data on multiple hospital stays.[1]

In evaluating hospital morbidity statistics, it should be borne in mind that they refer to a selected population. However, such statistics may afford a useful account of the occurrence of severe morbidity when hospital services are readily available and sick persons are both willing to undergo and able to afford hospital treatment. If the size of the population served by the hospital is known and data are available on its social and demographic features, hospital morbidity statistics may be very valuable for epidemiological research, including studies of health-service utilization and medical economics.

Even where population data are not readily available, hospital morbidity statistics may provide information on the following important factors : (1) the geographical sources of patients; (2) the age and sex distribution of different diseases and durations of hospital stay; (3) distribution of diagnoses; (4) associations between different diseases; (5) the period between disease onset and hospital admission; (6) the distribution of patients according to different social and biological factors; and (7) the cost of hospital care. Such information may be of great importance in the planning of hospital services.

[1] For further information on the use of samples, see *Wld Hlth Org. techn. Rep. Ser.*, 1966, **336**.

2.1.3 *Other medical-care statistics*

Apart from hospital in-patient services, the principal sources of medical-care statistics are hospital out-patient departments, polyclinics, primary health centres, special clinics, and personal physicians. However, since the function, the relative importance, and even the names of these services and persons vary from one country to another, it is difficult to generalize about them as sources of morbidity statistics.

In some countries out-patient departments provide the primary access to general medical care, whereas in others their use is confined to patients referred for consultation or for consideration for admission. Many hospitals use out-patient departments for the continued care of patients after discharge. Whatever their function, however, out-patient departments can furnish useful data on population morbidity.

In presenting out-patient statistics, many countries distinguish between first and subsequent attendances. Where such a distinction can be made, it is useful. However, it is important that " first attendance " be defined. It is also important, in relation to the " first attendance " of a given patient at a given hospital, that distinction be made between (*a*) first attendance for a particular episode of illness, (*b*) first attendance at that hospital, and (*c*) first ever out-patient attendance of that patient.

It has proved difficult to obtain statistics from general practitioners, particularly in countries where private practice is widespread. If continual reporting were required, it would usually be an unacceptable clerical burden on the physician. However, sampling methods that make reporting acceptable have been devised in some countries. For example, if each physician in a country reports, at suitable intervals, the cases seen on one day, a comprehensive picture may be built up of the total morbidity dealt with by personal physicians.

In whatever way the system is organized, there will be problems involved to the choice of statistical units (see section 4.1).

The usefulness of statistics derived from the sources noted above depends partly on the extent to which it is possible to define their coverage — i.e., the population at risk. For example, if child health clinics take care of all the children in a given population, their statistics will describe the morbidity pattern in these children. Similarly, if medical care can be obtained only in public clinics, whether general or specialized, statistics from such clinics may give a good picture of the general morbidity of the population (general morbidity being defined in terms of morbid conditions for which medical care is sought).

A special source of morbidity statistics from medical-care services is periodic health examinations that may be performed routinely on different population groups (e.g., schoolchildren). The results of such examinations are usually recorded and filed at the institution concerned,

and may be used for the preparation of periodic reports, which can be a valuable source of information on morbidity in the examined groups.

2.1.4 *Medical insurance systems*

Many countries have medical insurance systems that provide certain specified benefits to particular population groups. Both the range of medical care provided and the groups eligible to receive it may vary quite widely from one country to another and within a given country. However, all such systems have an important statistical attribute in common — the denominator populations are in principle definable and are often listed in an accessible file in the office that handles statistical data on claims. The use of such statistics therefore makes it possible to study the occurrence of (and to compute rates that are specific for) illnesses occurring in the insured population. In some countries, such computation is rendered difficult by the circumstances in which files are maintained (e.g., they may be kept in different offices); consideration should then be given to bringing the information in the files together.

In some countries, all types of medical-care benefits are provided by such insurance systems, and the denominator file is in effect a population register that contains numerous data that may be relevant to morbidity or to the use of medical care. Such systems are an important and useful source of morbidity statistics.

2.1.5 *Other social security data*

Statistics on illnesses that cause temporary or permanent incapacity for work can be obtained from social security or health insurance systems. Such statistics usually refer to workers who are incapacitated for work by a morbid condition.

The total population to which such data refer must be strictly defined and their characteristics (e.g., sex, age, and occupation) must be established. If the population belongs to a social security fund or institution or a health insurance system, this information can be obtained from its files. The extent of the medical care provided or paid for by such systems varies widely from one country to another, making it difficult to compare the statistics produced by different health insurance systems. To make such comparison possible, it is necessary to define incapacity for work because of illness. The most common variation in the definitions adopted by social security and insurance systems is in the duration of incapacity that entitles a person to compensation. Such systems commonly limit compensation to illnesses of a certain duration, and cases involving absence for shorter periods are not included in the statistics.

Statistics on temporary incapacity for work, if adequately organized, can give useful information on morbidity in the insured population.

Such information may be valuable for improving the efficiency of the preventive activities of the responsible health services. The Committee therefore believes that the organization of services for the provision of such statistics should involve collaboration between the authorities responsible for social health insurance and those responsible for health services.

The basic source of such statistics is usually reports for each case of absence from work because of illness or injury that are prepared by physicians recommending "sick leave". The statistics therefore apply not to persons but to periods of absence from work.

It is important to study the relationship between the duration and diagnosis of illnesses and various characteristics of incapacitated persons. To permit this and other epidemiological studies, it is necessary to know the pertinent characteristics (e.g., age, sex, and occupation) for the period for which the data are to be analysed.

Permanent incapacity for work (i.e., invalidity because of illness or injury) is usually investigated separately from temporary incapacity. It is commonly defined by legislation or by the regulations of sickness and accident funds. However, since permanent incapacity can be of different degrees, the greatest problem is how to measure its severity.

2.1.6 *Registers*

Statistics derived from registers are useful for (*a*) statistical follow-up studies, and (*b*) the study of certain diseases that may be reported by more than one source, where it is important to prevent multiple inclusion of the same cases in the statistics. (An example is congenital disorders, whose diagnostic problems necessitate multiple sources of ascertainment.) Useful statistics may also be obtained from special registers that are compiled in connexion with the medical care of particular groups of patients.

In maintaining registers, the handling of extensive data may cause great problems. Registers of treatment centres entail less difficulty, but national or other large-scale registers may be impracticable in large countries. A further problem is the maintenance of long-term contact with patients.

It may be possible to establish sample registers or to take samples for statistical purposes from an existing register. The sampling procedure should be based on persons, not on events (see p. 12).

2.1.7 *Limitations of continual reporting*

Most morbidity statistics collected through continual reporting systems are related less to morbidity than to the use of medical care, since they cover only morbidity in patients who seek medical care from

reporting agencies. As a result, the interpretation of such statistics may be difficult, since the probability that a person will seek medical care depends on many factors apart from the severity of his illness. Differences are demonstrable for different illnesses and for persons of different age, sex, and social and educational background. Since the probability may be subject to secular change, apparent changes in morbidity rates may reflect no more than changes in public attitudes to medical care; for example, it is well established that such a situation is responsible for many of the recent apparent changes in morbidity rates for mental illness. The difficulties noted above are widespread in countries at different stages of development, although the diseases involved may differ widely.

2.2 Surveys of sickness

2.2.1 *General morbidity surveys*

The objective of a general morbidity survey is to determine the total extent of sickness in a community. Information on morbidity may be obtained by interrogation or by physical examination, and the survey may be current, retrospective, or prospective or may involve a combination of two or all of these approaches. Since the data obtained in such surveys are usually related to a short interval in the lives of the surveyed individuals, they provide estimates of the prevalence of morbidity.

In conducting a general morbidity survey, it is first necessary to decide which persons are to be included. The next problem is that of formulating usable definitions of morbidity. Many diseases do not represent simple qualitative departures from " normal " health, but involve only the exhibition of greater or lesser values for some factor that is shown by all people. Obvious examples include hypertension, malnutrition, and mental retardation; however, diseases such as bronchitis or neurosis may be equally arbitrary when defined. The definitions that are adopted will depend not only on the purposes of the survey but also on the techniques that are used. For example, if the survey is conducted by interview the definitions required will be quite different from those required if it is conducted by clinical or laboratory examination. Despite such problems, however, it is important to define morbidity in as exact terms as possible for the purposes of the survey.

A further problem is the diagnostic classification of morbidity. Most existing classifications, including the *International Classification of Diseases*,[1] are based on the assumption that the terms they include are diagnostic terms as used by physicians. Where morbidity is defined in terms of direct verbal reporting by the patients, special classifications

[1] World Health Organization (1967) *Manual of the international statistical classification of diseases, injuries, and causes of death, 1965 revision*, Geneva.

may be required; as far as possible, such classifications should be derived from or compatible with the *International Classification of Diseases*.

A particularly difficult problem in surveys is incomplete co-operation on the part of the population. Lack of response is unlikely to be representatively distributed, and this may lead to difficulties in interpreting the resulting morbidity data. Studies of the effects of such lack of response have been carried out in some countries.

Surveys may be continuous, periodic, or occasional, depending on the resources of a given country and on the number of data required. Continuous and occasional surveys, at present undertaken in several countries, have both advantages and disadvantages. Continuous surveys may make more economic use of the large investment in organization, training, and experience that is necessary in any survey, but they may produce more data than are required unless some flexibility is permitted in the direction of emphasis or in the population groups covered. Occasional surveys may be more closely tailored to current needs and may actually cost less than continuous surveys.

Surveys based on clinical and laboratory examination are expensive, require large numbers of skilled personnel, and may be difficult to organize. In such surveys it is usually necessary to limit the scope of the examination. For example, surveys based on a limited number of blood and urine tests have been developed in Sweden. The selection of a set of " key " tests will ultimately be based on accumulated experience. From the point of view of the tests that are carried out, the US health examination survey is relatively unrestricted in scope, but it is concentrated on special population groups of particular interest. It involves extensive clinical, biochemical, and serological tests that are performed by mobile teams. In many countries, surveys are limited to simple clinical examination and may be effectively carried out with modest resources, particularly if the examination is selective in scope.

The objective of interview surveys is usually to obtain data on current or recent morbidity. Experience in many countries suggests that such surveys may yield valuable data if interview techniques are carefully developed and if validation studies are carried out. For example, the influence of defective recollection can be estimated by comparing morbidity reported for periods successively more remote from the date of the interview. It is also valuable to compare the frequency of morbidity reported by patients as having been treated with data obtained from treatment agencies; such a comparison is, furthermore, important in any evaluation of the extent to which persons seek medical care.

Techniques have recently been devised for prospective studies of morbidity. Such techniques may involve the use of diaries for the day-by-day recording of illnesses; the diaries are distributed with instructions for their maintenance and are collected after a suitable interval. If inter-

viewers are available to supervise the recording periodically, this method may yield informative data. Several countries have experimented with such methods on a sample basis. It would be useful to compare the data obtained from retrospective and prospective surveys of the same population.

2.2.2 *Surveys of particular diseases*

Surveys of particular diseases have a considerable advantage in that the establishment of definitive criteria of disease is usually much simpler for them than for surveys of general morbidity. Several diseases have been studied in this way, to the point where the criteria are widely established as being diagnostic, or at least adequately diagnostic for population surveys. For example, the prevalence of malaria can now be reliably determined by simple survey methods. More recently, diseases such as chronic bronchitis have been studied by questionnaire methods aimed at supplying definitive symptomatic data, and the symptomatic criteria have come to be widely accepted as defining the disease condition.

In addition, surveys of particular diseases are usually cheaper and easier to organize, making their large-scale use feasible in countries having relatively limited resources. The widespread use of such methods for measuring the prevalence of tropical infectious diseases such as malaria, hookworm, and trachoma demonstrates their practicability and relative economy.

A further advantage of surveys of particular diseases is the greater accuracy of diagnosis they can achieve by means of more specifically directed examinations. For this reason, some countries may prefer a series of special surveys rather than a single general survey; however, the two types of survey should not be regarded as alternatives.

2.2.3 *Hospital morbidity censuses*

Hospital morbidity censuses are a valuable source of data where continual reporting procedures do not exist or where they do not permit the estimation of residence rates or numbers of residents. Such a situation may arise when data are not available for both admissions and discharges or when there is a long interval between admission and discharge, as occurs for some mental hospital patients. Once a census has been carried out, it is easy to maintain an up-to-date register of patients in hospital, so that the subsequent preparation of current statements will be simpler.

2.2.4 *Surveys of existing records*

Where sufficiently complete medical records are available, surveys may be based on them. Such surveys have several advantages. Since medical records are derived from medical sources, the diagnostic data

they contain are usually more specific than those obtained from interview surveys (the data may, however, be less specific than those obtained from examination surveys). Such surveys may eventually be developed into regular statistical reporting systems. However, they have certain disadvantages, among which is the probability that medical records will be incomplete, often in ways that may result in the exclusion of subjects from the survey; it cannot be assumed that incompleteness will be unrelated to the items under study. Medical records other than those of hospitals are often inadequately maintained for survey purposes. Finally, since the data included in such records are not generally recorded with statistical purposes in mind, they may not be suitable.

In spite of these limitations, however, it seems important that statistical use should be made wherever possible of the very large number of clinical data that are recorded in the day-to-day practice of medicine. If record systems could be improved and redesigned with such applications in mind, record-based surveys would be particularly economical and informative. For such purposes, all records should contain a basic minimum of items that have common definitions.

The redesigning of medical record systems is generally being undertaken in connexion with the introduction of computer-based systems. Such systems should be organized in such a way that record surveys could be undertaken by means of computer programmes for the retrieval and analysis of recorded data. National health statistical offices in several countries have been studying the problems involved in such automated record and statistical systems. The simplest approach is by means of computer-based indexes to record libraries, each index entry being designed as a case summary suitable as a unit for statistical analysis.

3. DATA-HANDLING TECHNIQUES

In general, the problems involved in the handling of morbidity data are those that are common to the handling of all types of statistics. However, they have certain special features that are considered in the following sections.

3.1 Clerical handling

Almost all data-handling procedures involve a certain amount of clerical handling, although its extent may be very limited when advanced mechanical or electronic data-processing devices are used. It is perfectly possible to produce good statistical analyses solely by clerical methods; indeed, the study of mortality statistics was developed to a high level of efficiency in many countries before any other methods were available.

When data are to be handled clerically, the most important requirements are (1) simplicity in the format of the reports and (2) a good bookkeeping procedure to ensure that incoming data are complete and are received on time.

3.2 Simple machines

A comprehensive statistical service can be based on the use of simple punched-card machines. Such machines have been the main means of data handling in most national health statistical offices for many years, and they will no doubt continue to be used for many more years. Even a simple counter-sorter can handle a large number of statistical data. Their principal drawbacks are their generally limited arithmetical capability, which necessitates the use of calculating machines (or clerical calculation) for obtaining rates and percentages, and their lack of speed compared with electronic computers.

3.3 Electronic computers

Electronic computers are replacing simpler sorters and tabulators in health statistical offices. Their principal disadvantages are their capital cost, the expense of employing highly trained programmers, and the relatively long time required for programming. The latter disadvantage usually becomes less important as a set of suitable programmes becomes available, and is often unimportant when the programming of new procedures is facilitated by advanced programming systems.

Computers can handle statistical data, carry out analyses (including calculation), print the results in tabular format, and perform complex logical operations that facilitate data interpretation. They will greatly increase the speed, flexibility, and power of statistical analysis in the health statistical offices of those countries that can afford them, and they will become more widely available in the relatively near future.

It might be possible for more countries to enjoy the advantages of computer processing if computer centres could be developed, possibly on an international basis. Where the need for them arises, the establishment of such centres should be encouraged. If computer systems and programmes become more flexible and interchangeable, it is possible that the high costs of such centres could be shared.

3.4 Selection of methods

The selection of data-handling methods is usually determined by the financial resources that are available. There is no doubt that elaborate

methods will improve the speed, flexibility, and power of analysis, but their cost is often substantially greater than that of simple methods. There is also no doubt that useful statistics can be obtained by simple and inexpensive methods, particularly if careful thought is given to their design and to the selection of the data to be collected and analysed. It is impossible to suggest methods for general use, since populations vary so widely in size, needs, and resources; however, it is recommended that all health statistical services use at least some simple machinery, preferably involving punched cards that would be generally compatible with more elaborate machinery when this became available.

3.5 Record linkage

Owing to the increasing need for investigating the long-term experience of patients, rather than the periodic occurrence of simple unconnected events, it is necessary to develop methods of data linkage. The term " record linkage " is used in two different, although related, ways and has acquired highly specific meanings that may be confusing. There seem to be two distinct practical approaches to the problems of linking morbidity statistics on a national scale. The first involves the creation of a series of files related to individuals and composed of nationally reported events in their medical and health histories. The files are automatically maintained, kept up-to-date, and subjected to whatever statistical analysis may be required. Such a system is usually practical only if based on electronic computers, the files being stored on magnetic tape or some equivalent medium to ensure rapidity in keeping them up-to-date and analysing them when necessary. The advantages of such a comprehensive system for epidemiological research and for studies of the utilization of medical care are readily apparent. Unfortunately, the costs involved are difficult to estimate and almost certainly very high.

A second approach is to ensure that all statistical reports whose linkage is likely to be required are permanently maintained and suitably identified so that particular items can be linked as and when desired. The equipment and personnel requirements of such an approach are much more modest than those of the first system. With both systems it is necessary to use highly specific devices for identifying individual records and to develop procedures for linking data on persons whose identity is reasonably certain but whose identifying data contain the inconsistencies that are inevitable from time to time in any recording system. Such methods are being developed in several countries, and dissemination of information on progress would be of great value. Further study is required of the relative discriminating power of the various items that can be used to identify persons.

Applications of linked data that would be of considerable interest now and in the near future include (1) the study of readmission to hospital after various therapeutic procedures, (2) the linkage of out-patient and in-patient data so as to permit study of patterns of referral within health services, (3) the linkage of obstetric data with records of morbidity in the children resulting from pregnancies, and (4) simple linkage of data on births and child deaths so that analyses of such mortality might more conveniently relate cause of death to circumstances of birth. Linkage methods could also be used with profit to improve statistics of follow-up and survival in cancer registration and similar statistics of the outcome of other diseases.

4. ELEMENTS AND METHODS OF ANALYSIS

In analysing statistical data, it is important that the definitions and procedures used be compatible with the purposes for which the data were collected, and it may be necessary to modify such definitions and procedures to achieve this objective. However, it is also useful to have a number of standardized definitions and procedures that facilitate international comparability and that have been found generally useful. A detailed list of terms and definitions is given in the sixth report of the WHO Expert Committee on Health Statistics,[1] and it is suggested that future committees bring this list up-to-date as the need arises.

4.1 Statistical units

Since morbidity statistics reflect the occurrence of sickness in the population, it is desirable that sickness be defined with some precision. Unfortunately, this is not possible, because sickness is variable in severity and duration and is inevitably complicated by variation in individual tolerance of disability. Such variation is fairly simply related to age and perhaps to occupation, but its relation to psychological and social characteristics is much more complex. In dealing with morbidity statistics, it is usually necessary to define sickness in such a way as to accommodate the particular features of the statistical reporting system involved. For example, for statistics reported from medical care agencies sickness is usually defined in terms of contacts with such agencies, and for surveys it is defined in terms of abnormal states detectable by the survey technique.

Morbidity may be measured in terms of the numbers of persons who are sick, the number of episodes of sickness, or the duration of sickness. It is possible, for example, for a person to fall sick more than once and

[1] *Wld Hlth Org. techn. Rep. Ser.*, 1959, **164**, p. 3.

to have more than one diagnosis during a period under review. The detailed study of such factors is often impossible with the national morbidity statistics that are at present available.

The simplest statistical unit in many morbidity studies is the case of illness. This is particularly true for acute diseases whose onset and resolution are clearly definable, such as many of the acute notifiable infectious diseases. It is also possible to use such a unit for certain chronic diseases not having an episodic course, but national statistics of such diseases are uncommon except for the chronic infections (e.g., tuberculosis), congenital malformations, and cancer, for which registers are often kept. It is particularly important, if statistics of chronic diseases are to be useful, that no case appear twice in the statistics, and the avoidance of such duplication often requires quite elaborate methods.

A spell of sickness is a useful statistical unit for many purposes, but it must be recognized that its application to data from many of the commonly used sources permits the multiple inclusion of cases of disease having an episodic course. For example, sickness absence statistics and hospital in-patient admission statistics are usually related to spells of sickness, and they may cover several spells of absence or hospitalization in the course of a single case of an episodic chronic disease, such as bronchitis.

In the study of hospital statistics, the unit used may be admissions, discharges, or patients currently resident. Studies of residents are particularly useful in hospitals for chronic illnesses, such as mental hospitals, and as a measure of bed occupancy at a given point in time. However, admission and discharge statistics are usually easier to collect. For hospitals dealing with acute illness, admission statistics are useful as a simple index of the work of the hospital. For hospitals dealing with chronic illness, they are invaluable as a guide to trends in hospitalization. For most purposes, however, discharge statistics are the most useful because they convey more definitive diagnostic data; furthermore, they permit the inclusion of data not only on sources of referral for admision but also on disposal at discharge. It is often useful for hospitals dealing with chronic illness to collect statistics on admissions and discharges; the study of such statistics may be facilitated if admission data are also recorded on discharge reports.

Statistics of sickness absence or of claims for sickness benefit are useful in that the units may be easily defined. However, statistics of other generally treated morbidity may pose particularly difficult problems in the choice of units. For example, statistics of morbidity treated outside the hospital, whether by general practitioners or by other agencies, have no natural unit except that of a consultation. For patients (such as the elderly) who make relatively frequent use of such consultation, an episode of illness can sometimes be defined only indeterminately in terms of a temporal clustering of consultations. However, the use of a consult-

ation as a unit often imposes a heavy recording burden. It may be practicable if statistics are collected by means of a sampling technique that involves only occasional reporting days for individual practitioners, or if the first consultation in an episode of illness is selected as the reporting unit.

4.2 Rates

Simple enumeration of the occurrence of morbidity is not generally useful unless the data are clearly related to time and to the population in which the morbidity occurs. Rates express these relationships by measuring morbidity in terms of the amount of sickness per unit of population during a defined period or at a particular point in time. It is usual to define incidence rates as the number of new cases (or, for some applications, spells) during a defined period divided by the average number of the population at risk during the period.

For many diseases whose onset is insidious and whose course may be long, incidence rates might be difficult to calculate and relatively uninformative. For such diseases, it is usual to calculate a rate from the number of cases in existence either at a given point in time or during a short period. These rates, called point or period prevalence rates, respectively, reflect the current disease load in a population.

In hospital statistics, admission rates correspond to incidence rates (as also, in a certain sense, do discharge rates) and residence rates correspond to prevalence rates. The type of prevalence rate that is usually reflected in a residence rate is the point prevalence rate.

Incidence and prevalence are arithmetically related in that point prevalence is equal to the product of incidence and average disease duration, when duration is measured in units corresponding to the period for which incidence is calculated. Thus, if incidence is 6 per million population and the average duration is 1 month, the average point prevalence rate for a year is 0.5 per million population. This relationship is often useful when one of the quantities is unknown and the other two are known. For example, if the number of new cancer registrations per year and the total number on the register at a given time are known, the average duration of survival can be calculated. The relationship will be disturbed if any of the three quantities is subject to secular change.

In rates, the numerator represents the occurrence of morbidity and the denominator the population at risk; thus, a rate expresses the probability or risk of disease occurrence. It is often difficult to obtain population data, particularly when dealing with hospital statistics where the catchment population may be difficult to define. It is important to ensure, when calculating rates, that the denominator is appropriate in the sense that all persons in the denominator population were at risk of

suffering the morbidity that characterizes the individuals who represent the numerator.

Analysis of the morbidity in different regions of a given country is often valuable if the necessary population data are available. Whenever possible, such analyses should include age and sex classification, since populations vary in their age and sex structure.

Other basic classifications of the population for use in the analysis of morbidity statistics will usually depend on the particular needs and resources of different countries. Distinctions between urban and rural communities are often informative, as are those between levels of medical care provision. In some countries, ethnic classification may be desirable where cultural, nutritional, or other differences may influence health levels.

Many countries have found it useful to classify occupations. Such classifications are useful in studies of occupational morbidity and may also be useful as indicators of socio-economic and educational level. No international classification of occupations has been proposed for health statistical applications, but use may be made of the classification prapared by the International Labour Office.[1]

An important recent development is the use of life-table methods in the study of survival and duration of hospital stay in chronic diseases. This approach makes more efficient use of data than do conventional methods that deal with the proportion of survivors after a specified interval, and readily permits demonstration of the nature of the survival curve.

4.3 Classification

In dealing with morbidity statistics, the classification of diagnostic data is an important problem. If such data are derived from diagnoses made by physicians on an adequate basis, there is no doubt that the best available classification is the *International Classification of Diseases*. When the data are derived from other sources (e.g., interview surveys), or when specialized applications are intended, it may be desirable to use special classifications. There is much to be gained by the use of classifications derived from or compatible with the *International Classification of Diseases*.

Classification of sick persons so as to identify factors associated with morbidity is a much more complex problem. An important consideration is that it is usually desirable that any classification used for sick persons should also be applicable to the population of which they are members, so as to permit comparison of incidence or prevalence rates for different groups.

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[1] International Labour Office (1952) *International classification of occupations for migration and employment placement*, Geneva.

Classification by age and sex is usually the most informative simple analysis that can be applied to morbidity statistics. Estimates of the age and sex distribution of the population are usually available, making possible the calculation of age-specific rates, which is always worth-while. For many purposes, age and sex standardized rates are useful.

4.4 Publication of data

It is the function of health statistical services to provide a continuing numerical report on the state of health of the population and to demonstrate the important features of population health that merit consideration by the health service agencies. To this end, publication of data is usually undertaken both regularly and occasionally. In the past, the principal publications of health statistical services have been annual or other regular reports, occasional reports having been less important. This situation is now changing, and it must be expected that such regular reporting will eventually assume a relatively minor role in the gathering of health statistics.

In areas where regular published reports remain valuable, it is important that they be published much more frequently than annually. Many countries publish weekly summaries of notified diseases, a practice that has much to commend it in countries where notification of diseases is still an important source of morbidity statistics.

It is important that regular volumes of statistics appear relatively soon after the period to which they refer, whatever this may be; data are of less immediate value if too long a period elapses before their publication.

Statistical services should aim at providing a verbal commentary in addition to numerical tabulations. Such commentaries should preferably accompany the tabular data, but if this would delay publication of the latter, it might be better to publish the commentary separately. Many countries prefer to publish detailed analyses separately from the data, which may then be published earlier; the analyses may best be published as occasional studies of particular topics.

5. TRAINING OF PERSONNEL

At all levels of a health statistical service, the quality of the work performed depends to a great extent on the attitudes and capabilities of the personnel. For this reason, it is most important that the following personnel receive adequate training : (*a*) professional health statisticians; (*b*) intermediate or operational personnel; and (*c*) statistical clerks.

5.1 Professional health statisticians

The training of professional health statisticians may begin with (*a*) a degree in medicine, followed by training in public health and statistics; or (*b*) a degree in statistics, mathematics, or a biometric or social science, followed by training in public health. In many countries the postgraduate training may be quite informal, consisting mainly of in-service training.

In view of the need for close collaboration between health statisticians and health administrators, it may be useful for these two classes of personnel to receive similar education and for their career possibilities to be substantially interchangeable. In some countries, these objectives are achieved through a common postgraduate public health course in which students may, if they wish, specialize in health statistics.

5.2 Intermediate or operational personnel

These include a wide range of different personnel who occupy positions of responsibility in relation to either the collection or the analysis of statistical data. They include heads of peripheral health statistical units, medical reports officers, and supervisors of junior statistical personnel. For many of these occupations there are specific training programmes and qualifications based on courses organized in institutions of higher education, which may include universities. In some countries, some or all of these personnel may be required to have a first university degree before they are admitted to specialized training in the particular field. However, it is more usual to require such personnel to have only pre-university education, and to gain their specialized qualifications concurrently with their early professional experience.

In many countries it is this group of personnel for whom there is the greatest need, and facilities for their training may be limited. Following the recommendation made in the fifth report [1] of the WHO Expert Committee on Health Statistics, regional training courses have been developed; however, there is a great need for their expansion, and it is recommended that WHO study this question further.

5.3 Statistical clerks

The training of statistical clerks presents few problems, since in-service experience is usually adequate. Furthermore, adequately trained intermediate workers are qualified to organize the training of clerical workers. In some countries, such training may also be developed and supervised by professional personnel.

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[1] *Wld Hlth Org. techn. Rep. Ser.*, 1957, **133**.

6. FUTURE DEVELOPMENTS

Some of the ways in which the handling of morbidity statistics is likely to develop in the future are discussed in the following sections, although the review is by no means exhaustive.

6.1 Methods

The application of a variety of new data collection and processing techniques may be expected in the near future. Many of these procedures are already well established in commerce and industry, but their application to health statistics poses special problems that arise from the personal nature of the physician-patient relationship. Technical solutions may be possible to many of these problems, including that of confidentiality, and development is already in progress in many countries. Procedures such as record automation, record linkage, and direct statistical reporting from computer-held records have been discussed elsewhere in this report.

The advantages of applying computers to data processing, as previously noted, include (1) the production of tables much more quickly than was possible with earlier methods; (2) the greater data reduction that is possible, (3) the possibility of using more efficient analytical procedures, such as multivariate methods; and (4) the fact that tables can be produced directly from the computer and then reproduced by photocopying or similar methods.

6.2 Subject matter

The subject matter of morbidity statistics is also likely to undergo change. At present, most countries limit their morbidity statistics to the traditional, clearly identifiable examples of morbidity. In the future, it will be desirable to develop methods for studying the changing levels of health that prevail in different groups of the population. For example, the weight of infants at birth, levels of intellectual development, and the age at which children develop necessary skills and social attitudes have all been studied in some countries, and are of increasing importance in many. In some countries, more elaborate studies of biochemical and serological variables have been undertaken, and may eventually lead to the use of data on changing serological levels as an early warning system for communicable disease control.

In many countries, the most important morbidity in children and young adults is related to social maladjustment, which may be manifested by delinquency or narcotic addiction. The extension of morbidity statis-

tics into these fields has begun in many countries and is likely to continue. Statistics are often available from the relevant social agencies, and it may be desirable that present responsibilities for their analysis and dissemination should not be changed. Nevertheless, health statistical agencies are likely to establish close liaisons with other agencies in order to exercise an influence on all stages of the collection, processing, and interpretation of statistics.

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