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AN OUTLINE OF A NATIONAL SYSTEM OF HEALTH STATISTICS

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F O R E W O R D

Health statistics is recognized as an independent branch of statistics and an efficient tool for public health and preventive medicine in policy making, in evaluation and in research work. Rapid development of health statistics in the last few decades has brought this discipline to a level, where it may be necessary to think of a system of health statistics aiming at better national and international comparability and at better understanding of these statistics that can be accomplished and that are the necessary pre-requisites for their proper functioning.

This paper - though deficient as it may be - is regarded as an approach to describe such a system. It is hoped that it can be of help to the public health administrator and to the health statistician to utilize health statistics in the proper places of public health administration. It may also give an orientation about the ways in which health statistics can be adequately developed and used under various conditions of public health **organisation**. Various fields of health statistics may be needed more and therefore developed better and perhaps easier, under various forms of organization of health services. Certain methods of these statistics may be more suitable in certain conditions than in others. What is absolutely needed, however, is that produced statistics should be reliable and comparable, and used properly and comprehensively.

Collection, processing and use of all kinds of statistics depend on the developmental (economic, cultural and social) level of the country. This is especially true for health statistics, which deal in many fields with observations which are to be made on high professional level. If this is lacking, fields of statistics have to be developed first, where high professional skill and knowledge is not so rigorously required. Developing these fields - inside a well planned programme for a country health statistics system - may be attained, step by step, for various health statistical fields until the conditions of satisfactory functioning of the whole system are reached. It is certainly not advisable and not possible to establish the whole system at once. Knowing, however the goal, namely, planning of a national health statistics system, will help to proceed cautiously, safely and rationally. It is necessary to give priority to fields which are needed most and which are feasible for implementation. The need for having clear

plans made for a complete health statistics system may be specially great in countries of the Eastern Mediterranean Region, where health statistics in many areas are in an embryonic stage of development and where the desire to develop these statistics has been so intensively and frequently emphasized at Regional Committee meetings and by health authorities of the countries themselves.

The United Nations Statistical Office has produced an extremely valuable publication "Principles for a Vital Statistics System". This publication has had a strong influence on the development of vital statistics, especially in developing countries and is helping to achieve satisfactory levels of comparability of these statistics internationally.

The WHO Expert Committee on Health Statistics has stressed in its meetings the need for having formulated principles for health statistics in an analogous way. It is obvious that to lay down these principles is a much harder task: the discussion on vital statistics has been going on for many decades while health statistics problems are internationally discussed mainly since the creation of WHO; in addition, the variety of subjects dealt with in health statistics and the complexity of observations are more subject to error. The need, however, to begin with this task is imperative; it is the wish of the writer, that this paper may serve also as a step towards accomplishment of this task.

## I INTRODUCTION

It is impossible to define theoretically the border line between vital and health statistics. There are wide fields of activity and research belonging undoubtedly to health statistics only, and also exclusive fields where only data on vital statistics are collected and analysed. But a wide field remains where both branches of statistics are involved, if good statistics are to be produced; statistics of causes of death may be mentioned as a subject where vital and health statistics have to work hand in hand.

Health statistics as a definite branch of statistics are of very recent origin. The term "Health Statistics" in this sense has been used for not longer than about forty years. The term "Medical Statistics", on which the first handbook was prepared by Fr. Osterlen<sup>1)</sup> and published in Tübingen in 1865, is much older. According to Prinzing<sup>2)</sup>, medical statistics deal with pathological phenomena in man; this field covers only a part of health statistics as they are understood at present.

The origin of health statistics can be traced back to the year 1532, when the first "Weekly Bills of Mortality" appeared in London. The first study in the field of health statistics was written by J. Graunt<sup>3)</sup> in 1662. In this paper, Graunt is the first to stress the high mortality in the first years of life and to discover a normally (at that time) higher mortality among the urban than among the rural population<sup>4)</sup>. It may be said that the earliest days of what are now called "Health Statistics" coincide with the early days of vital statistics.

Dr. W. Farr (1807 - 1883), however, can be regarded as the first "Health Statistician". It was he who first investigated the causes of large differences in mortality existing in various population groups. He pointed to the evidence that mortality in Liverpool was higher than in other urban areas. He assumed that it was due to certain specific factors applicable only to Liverpool and admitting that this was the case, he strove to find these factors, to examine the possibility of eliminating them, and thus to avoid the unnecessary destruction of human life. Are we not doing the same thing today when making health statistics evaluations, with, however, better tools for our analysis?

Statisticians and mathematicians of many countries (Leplace, Poisson, Gauss and others) had founded statistical methodology as early as the end of the eighteenth and first half of the nineteenth centuries. Others (Y. Snow, F. Galton, K. Pearson, Y. Brownles, F. Prinzing) contributed extensively to statistical methodology and have with their work provided health statisticians with better



tools. Dr. Farr's merit, however, was that health statistics were begun in England as early as 1840, when no other country had anything similar. What is today called "Health Statistical Analysis" may be regarded as originating in the year 1840. It exerted a deep influence on public health development in England and Wales. The investigators in Farr's biography stress rightly, "if Farr had been born a generation earlier and if the General Register Office had been created in 1807 instead of 1837, the sanitary history of our industrial towns would have been different"<sup>6)</sup>: Dr. Farr established health statistics as an indispensable tool in preventive medicine and health services.

The need for health statistics has been realized more and more and it has produced a number of men who have developed these statistics to their present level.

Health statistics as a branch of statistics are developing steadily and the field in which they are operating is widening with the growing needs of modern health services activities. Not very long ago, health statisticians were primarily occupied with mortality statistics and data on acute communicable diseases. Now it is believed that health statistics has a definite rôle to play in elaborating public health organization and its programmes. Health statistics assist in the evaluation of the efficiency of these programmes and of projects which have been carried out and guide them also during their execution. This is just as true for a country which is developing its basic public health services as for highly developed countries. The methods used and the extent of the information collected and analysed may vary considerably but without statistical guidance the way to a successful outcome is not safe.

This need for health statistics is felt more strongly and their rôle is more appreciated in those countries where a greater amount of attention is paid to the development of a highly efficient health service aiming at improving the standard of health in the population.

## II DEFINITION AND SCOPE

Health statistics deal with the collection, processing and analysis of numerical data illustrating the state of health of a population and the conditions which influence or may influence health. If health is defined as in the WHO Constitution<sup>8)</sup>, the range of health statistics activities is very broad. Therefore, health statisticians are interested also in many other branches of statistics. They use, in the first place, the data produced by vital and population statistics for their analysis. Statistics of housing, food consumption and education among others, are also of great importance.

The scope of health statistics is to provide the quantitative knowledge required as a basis for the promotion of the health of a population. This knowledge is utilized for making decision and rendering advice upon the basic principles for:

1. concrete public health measures
2. elaboration of long-range programmes of health activities
3. health legislation
4. promoting treatment of morbid conditions
5. advancement of preventive activities

Health services have to be informed of all cases of ill-health among the population which require the application of concrete public health measures in order to protect the unafflicted population from similar ill-health. Each individual case has to be registered, because these measures have to be applied in each individual case. Such measures can be: obligatory hospitalization and disinfection in dangerous (as regards spreading) infectious diseases, sanitation of microclimate in the cases of occupational accidents and occupational diseases, obligatory treatment of certain infectious chronic diseases (open tuberculosis, syphilis and similar diseases), prohibition of a definite occupation if the morbid condition found endangers the health of others, etc.

A programme of health services can be elaborated only when a background of quantitative data on the features of morbidity and mortality of a particular population is available. This knowledge indicates which activities of health institutions have to be established to deal with the existing problems. It will also help to determine the kind and number of health personnel needed in the various health institutions. If possibilities are limited - this usually being the case - health statistics will also indicate the priority of needs. Such data will also guide the running of a programme and give at its end reliable evaluation on the efficiency of its methods and procedures.

These two aims of health statistics must be achieved in the first place by each separate health institution (health centre, dispensary, hospital) and by the health service administration in the community or district.

Often statistics which have been utilized by local health services for the two purposes mentioned above are consolidated for larger population groups. Statistics thus consolidated for a region or a country may often show specific trends and features which will make it possible to reach a conclusion as to what legislative measures are necessary or indicated regarding: adequate types of health institutions needed, their organization and personnel, notification of diseases, compulsory hospitalization, public funds accorded for the control of various diseases or various kinds of patients, etc.

The information obtained from health statistics may also serve for the improvement of curative procedures. Even from data which are not collected for such a purpose, it may be possible to obtain information which can be utilized to this end. This is the case if, for instance, data on the average duration of stay in hospital for the same disease show a wide range or if the case fatality rate for the same disease varies significantly from one hospital to another. Such data reveal that attention should be paid to these facts and that the effects of different treatment procedures should be studied further and statistically observed in various institutions. In addition to these "by-products" of health statistics, specific statistical investigations have been used more and more often during recent years for the evaluation of the results of various treatments applied.

The use of statistical methodology in the field of preventive medicine is now-a-days a well-established practice. Investigations in the field of epidemiology and applying statistical methods, are commonly used; statistical analysis of the efficacy of various types of vaccines or of vaccination procedures, of the effects of hospitalization on the spread of some infectious diseases, may be mentioned as general examples. A solution to many disputable epidemiological problems has been found on this basis and many investigations of this kind are being permanently carried out in various countries. Some epidemiological aspects, which have been taught for many decades as absolutely "definite", have been refuted after having been reviewed on a sound statistical basis.

### III SUBJECT OF INVESTIGATION

Investigation of health statistics go into three directions considering the subjects of observation. The observed statistical mass belongs to:

1. Population
2. Environmental factors
3. Health services

Health statistics has its own exclusive field of activity and interest. In this field they collect data on the above subjects - as far as they are pertinent to the specific interest of health statistics, process and analyse them.

The first two of these subjects are of common interest to various **statistical** branches, which collect data on them for their own purposes. Health statistics utilise also these data from the specific viewpoint of health statistics analysis.

### 1. Population

Out of the statistical mass of "population" the following person-unit are investigated by health statistics:

deaths		
somatic or mentally defective		
sick		
injured		
pregnant women		
infants	) as specially endangered	
Children		) to their health
certain occupational groups		

Investigation of these statistical units cover their territorial, biological, pathological and socio-economic attributes. Their aim is to demonstrate the health status of specific biological or social groups or of an entire population and to progress in the knowledge of the patterns of morbid conditions and positive health.

Investigation into these fields (except mortality statistics, which also fall within vital statistics) is the exclusive sphere of work of health statistics.

### 2. Environmental conditions

A special field of health statistics is responsible for the study of environmental conditions; this specific field may be called "sanitary" statistics. The objects of statistical study are:

- working conditions
- nutrition
- housing
- school hygiene
- water supply
- sewage disposal
- way of living
- climate and soil

Statistical studies of these conditions and their components are relevant in so far as they influence the health of the population. It is studied under which circumstances these conditions are related to frequencies of ill-health within a population group and to what degree this is the case. Other statistical branches deal with the same subjects from their viewpoint.

### 3. Health services activities

The subjects investigated are:

- the network of health institutions
- health personnel
- activities of curative services
- activities of preventive services
- work in environmental sanitation
- work in improvement of levels of living

These subjects are under statistical observation in order to study and to evaluate their influence on the health of the population. These statistics fall exclusively into the sphere of health statistics.

## IV SOURCES OF DATA

There are four general sources of data which are needed in health statistics. They are the following:

1. data produced by health services
2. population census
3. registration of vital events, and
4. data collected from various other statistical branches

### 1. Data obtained from health services

This source constitutes the large majority of health statistical data. This source of data can be grouped into four categories from the viewpoint of their place within the health services.

1) Individual records, which are an obligatory requirement in the first place for a concrete health service measure for protection of the health of the population. Statistical analysis of these data is done after the measures have been taken. To this group of data belong; individual notifications of certain acute and chronic communicable diseases, of specially important diseases (cancer), of occupational injuries, of professional diseases, the registration of health records after medical examination of school children or of industrial workers, and other similar measures. Specialized health

services (epidemiological, occupational health, school hygiene, etc.) need these individual data for their daily routine activities. After the necessary measures have been taken in each single case, the data are processed by the health statistical services.

2) The next category are data which are collected for immediate statistical processing. After statistical processing and adequate analysis, conclusions are reached which help to improve the particular service for which these data are evaluated.

These data may be collected for a single statistical unit. Such are the individual reports for discharged in-patients, for mothers discharge after delivery in an institution, for insured workers who are incapable to work because of illness or injury, for patients diagnosed as tubercular after examination in a chest clinic, etc. The collection of these data is done by the method of individual registration.

These data can also be obtained as summaries produced by each individual health institution at the end of each year. Tabulation of data from the original records is, in this case, made in the institution itself.

The only difference between these two types of data is in the place where the basic statistical processing is performed. If it is done in the institutions themselves, the methodology for the processing has to be guarded by uniform procedures. If this condition is observed, the data from the single institution can be consolidated for larger administrative territories or for the whole country. Data of this kind are of value only in cases where institutions are in a position to do this work reliably.

3) The third category of currently collected data produced by health services has two purposes. They serve for concrete actions to be taken by these services as well as for statistical processing. These data are collected as obligatory reports sent in at fixed intervals (monthly, quarterly, six-monthly) by each health institutions. The forms for these reports are standardized and the data are filled in according to strict instructions. The main purpose of these reports is to inform the health service on the next high level or on the national level about the work done by each particular institution during the period of reporting. The information obtained should

help to evaluate the amount of work done and its efficiency with the aim of further improvement. These reports may also contain data which give an orientation on the health status of the population for which the particular institution is responsible.

4) The next category of data produced by health services is field health survey. The surveys are organized as a permanent or an ad hoc programme in order to obtain information not available from current reporting procedures or not obtained reliably or extensively enough to serve special needs. Methods of collection will be discussed later (Chapter V, 4.3).

It is not feasible to abandon obligatory notification (Chapter IV, 1.1) as a method of collecting data because this information is needed for immediate action to be taken by the health services on each of these cases. The same is true regarding periodical reports (Chapter IV, 1.3). The collection of data mentioned under (Chapter IV, 1.2) can be made - under certain circumstances - by applying the method of random sampling, thereby abstaining from collecting data on each single case; or in other cases the data can be collected for all individuals but processed only for a sample of the total mass.

## 2. Population census

Population census data provide basic information needed for computation of various rates, ratios and indices required for measuring the incidence and prevalence of various diseases or other conditions. Data on the distribution of population by geographical and administrative units as well as by biological, social and other attributes are indispensable for interpretation of health statistics. It is therefore necessary that needs of health statistics regarding population statistics are considered when the programmes of population censuses are discussed and established.

## 3. Registration of vital events

Data obtained from the registration of vital events represent the third important source of information needed in health statistics.

1) Mortality statistics are of the greatest importance for investigations into the health status of the population. Crude and specific death rates by territorial divisions as well as specific mortality rates, according to biological, social and occupational attributes are relevant for demonstrating the health of the population. The statistics of causes of death play a particularly important rôle as an indicator of the populations' health and are most often called for in health statistical analysis. They, in fact, represent a field of statistics common to vital and health statistics.

2) Individual information is required on causes of death by health services for specific diseases (tuberculosis, acute infectious diseases) since often, after a death has occurred from such a disease, individual measures have to be taken by the health service. After such action has been taken, these data can be utilized for statistical processing, thereby providing information which is not regularly obtained through usual vital statistics tabulations.

3) Birth statistics give valuable data for health statistical analysis on the vitality of newborn, the proportion of professional care at deliveries and on other items which are of importance for evaluating the health status of the population and the efficiency of the health services.

4) Vital statistics can thus provide data on the health status of the population which are of special importance for the health services. These data have to be analysed also for purely health statistical purposes. This close relationship between vital and health statistics is stressed in Article 15 of the United Nations "Principles for a Vital Statistics System" <sup>11)</sup>. This article reads as follows:

"Correlated with the general economic and social uses of vital statistics are the administrative and research needs of public health agencies in connection with the development, planning, operation and evaluation of public health programmes. Analysis of vital statistics with respect to the general and specific death rates is essential to the programmes of disease control. In addition to analytical uses, the public health authorities at the local level depend on the individual reports of the occurrences of specified events for initiating administrative action which will set in motion follow-up procedures essential to the maintenance of public health in the area."

A close co-ordination between services responsible for the registration of vital events and services responsible for vital statistics and for health statistics is to be maintained permanently. Article 105 of the above United Nations publication discusses this co-ordination as follows:



"(a) Clear delineation of duties should be supplemented by arrangements for co-ordination of needs and services between official agencies concerned with the registration of events for legal purposes, those responsible for compiling facts for statistical purposes, and those who use these data for administrative or analytical purposes in connection with economic and social matters or for planning, operating, and evaluating public health programmes whether on a national or an international scale."

"(b) Co-ordination, especially with respect to coverage, definition, classification schemes and tabulation programmes, should also be maintained with the authorities responsible for the population census or other types of population statistics, with those in charge of migration statistics, with the agencies responsible for public health statistics, and other related social and economic statistics."

"(c) The co-ordinating mechanism established to achieve these objectives should have a direct relationship with the agency responsible for the general co-ordination of the national system of statistics."

(Footnote: "In some countries it has been found that co-ordination as recommended in this Principle has been facilitated through the establishment of 'National Committees on Vital and Health Statistics' or committees or councils of a similar character.)"

#### 4. Data collected from other statistical agencies

Data produced by other statistical agencies are used for various ways of evaluation and analysis in the field of health statistics. In studies of the influence of environmental factors upon health, information is needed regarding housing, water supply, conditions at work or at school. In various other health statistical studies, data on educational level, social insurance, nutrition etc. may be indispensable.

#### 5. Fields of health statistics

The variety of subjects observed in the field of health statistics is large. The methodology applied for statistical observation must therefore differ to a great extent. Quite independent fields of health statistics are developing. Up to the present, the following may be regarded as already formed:

1. Morbidity statistics
2. Statistics of injuries
3. Statistics of incapacity for work caused by illness
4. Clinical statistics
5. Statistics of physically and mentally handicapped persons
6. Statistics on environmental factors influencing health
7. Statistics on health service facilities and activities

The extent to which these fields have developed varies from country to country, as does the importance given to them. The quantity and quality of data produced by these fields depend on the pattern and the efficiency of the health services and often also on the social system of the country. It may be stressed, however, that a health statistics system of a population to be complete, has to include all these fields. They are discussed below separately.

## V MORBIDITY STATISTICS

### 1. Subject of observation

Morbidity statistics concern all conditions in a population which are distinct from "health" according to the definition of this term in the WHO Constitution. This is the opinion of the WHO Expert Committee on Health Statistics<sup>10)</sup>. These statistics deal, therefore, with all conditions which differ from a state of health. Injuries, inability to work because of illness or injury, statistics of physically and mentally handicapped persons would according to this opinion be the subject of morbidity statistics. On account of differences in methodology applied in these health statistical fields it is, however, more appropriate to discuss under this heading morbidity statistics without the above mentioned three specific aspects of morbid conditions.

### 2. Statistical units and time of observation

The statistical units in morbidity statistics may be:

sick persons  
sickness cases  
spells of sickness

The period of observation may be a definite time period (Day, week, month, year, etc.) or one fixed point of time (as in population censuses) which is here in fact usually a day.

The graph reproduced as an Annex shows the possibilities of observing morbidity conditions, taking into consideration the possible statistical units and the factor of time. The graph has been prepared making use of the Sixth Report of the Expert Committee on Health Statistics<sup>34)</sup> which brought many

clarifications into this field. It may demonstrate how different "morbidity" under observation can be and it may help to differentiate the facts which are important for comparing the results obtained in various morbidity studies.

It has to be made clear in the first place whether the observations are related to a moment (in fact, a specific day) or to a period. If the observation extends over a period, the time limits of the period have to be clearly stated. In both cases it must be made clear what is observed: persons, illnesses, spells of sickness. If the observation is limited to one day, no differences will be found in the number of sick persons and of sickness cases or sickness spells, if only one disease is under study. So, for instance, the number of tuberculosis patients and number of cases of tuberculosis will be the same in investigations lasting one day among the same population. If the data are collected for all the diseases existing in a population on a certain day, then the number of disease cases will be larger than the number of sick persons since some persons might be found suffering from two or more diseases simultaneously.

In investigations on morbidity covering a longer period of time, there are still more complicated circumstances. Data on sicknesses may concern new cases only, i.e. cases which have started during that period. They may as well concern those sicknesses which have terminated during the period or finally the data may concern all sicknesses which have existed during the period.

Data concerning sick persons have to be separated to show whether the sick persons have been ill once or more often during the period of observation and, in addition to that, whether the illness was caused by one or more diseases. If a sick person had more than one disease, it has to be made clear again whether these diseases were present simultaneously or one after another.

All these possibilities make difficult not only the collection of the data in an adequate way but also the tabulation of the data and the presentation of the results. The basic distinction, however, is whether the data relate to persons, diseases or spells of disease. The decision on what should be observed in a concrete morbidity study depends naturally on the purpose for which the statistics are collected.

### 3. Scope and measurements

The data produced by morbidity studies are utilized for various purposes. In general the data are collected to obtain information on:

- 1) Prevalence and incidence of general morbidity in the observed population as a whole
- 2) Prevalence and incidence of general morbidity in various biological or social groups
- 3) Prevalence or incidence of certain single diseases or disease groups in the total population or in specific groups
- 4) Aetiological factors in disease incidence or prevalence
- 5) Data for evaluation of the efficiency of preventive services
- 6) Data for evaluation of the cost of sickness

In the analysis the morbidity statistics data are complete by data obtained from clinical statistics and some other branches of health statistics.

Morbidity measurements are to a great extent analogous to measurements of mortality adapted, of course, to the special conditions discussed under Chapter V, 2. The rates and ratios have to be precisely defined with regard to the statistical units observed and the time factor.

A general formula for the compilation of morbidity rates in the total population is as follows:

$$MB = \frac{I}{P} \times K \quad \text{or} \quad MB_1 = \frac{SP}{P} \times K ;$$

MB is the morbidity rate if it regards illness and  $MB_1$  if it regards ill-persons; I is the number of illnesses found, SP the number of sick persons, P the number of the population (in the middle of the period) under observation; K is usually 1000, 10 000 or 100 000.

In measuring the frequency of morbid conditions using the above formula for computing the morbidity rates, a strict distinction has to be made between "incidence" and "prevalence".

Besides measurements of the frequency of morbid conditions (expressed as sick persons, sicknesses and spells) measures of duration are frequently used in morbidity statistics. There are various measures of duration. Generally duration can be expressed in two ways: (a) as an average duration (number of sick days per one morbid condition or per one sick person) and (b) as a frequency distribution of duration by days, weeks, etc. In measuring duration the difficulty arises of how to define the day of onset and of termination of the morbid condition; this question will be discussed later.

1) Incidence rates measure the frequency of new morbid conditions which have appeared during the period of observation and of persons who have become sick during that period. It is necessary to consider that one and the same person may develop new different morbid conditions or develop the same morbid conditions several times (spells) during the observation period. If only one definite disease is investigated, the procedure is relatively easy as far as the diagnosis of that disease is not difficult. When "all" morbid conditions are under investigation in order to obtain data on "general" morbidity, then a clear definition has to be adopted to be on the safe side so as to know who should be regarded as an ill person and what should be regarded as illness (morbid condition). If the definition is made in such a way that all cases whose status deviates from health should be investigated, nothing is achieved towards clearing the situation, because then the term "health" has to be defined and this is certainly not easier.

There is no generally accepted definition of conditions which should be included in "general morbidity". It is even believed that it is impossible to define this term in a way that it may serve all different purposes. It has to vary according to the objectives of the particular study or survey.\* In its general meaning, morbidity does include not only active and progressive diseases, but also chronic or permanent ailments, which are static and which are the effects of a disease or an injury or a congenital malformation. All these different findings could be called "morbid conditions". The National Health Survey of the USA distinguishes various morbid conditions.\*\*

Incidence can be expressed for the purpose of comparison in relation to the average number of population at risk or to the estimated number of persons in the middle of the period under observation. In the two general formulae given above for the computation of morbidity rates of incidence, "I" means illness, "SP" means persons becoming sick and "P" means the number of population, as has just been stated. The rates so calculated are called the incidence rates.

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\* Origin and program of the U.S. National Health Survey, Series A1 of "Health Statistics"

\*\* Concepts and definitions in the Health Household-Interview Survey, Series A3 of "Health Statistics"

2) Morbidity prevalence

(a) during the period of investigation (e.g. week, month, year), all diseases in existence and/or persons who were sick during this period are considered. By "prevalence" the frequency of cases is understood with a definite disease (or disease-group), or the number of persons with a definite disease (or group), or of persons "ill" (generally, according the operational definition) during the investigated period; the number so found is related to the number of the population as mentioned for incidence. The rates so obtained are called prevalence rates.

(b) at a given point of time (day); in this case, the number of disease-cases diagnosed or the number of persons who were found sick on the day of observation show the prevalence; the day of observation can be taken as the first or the last day of the investigation or any other day. Prevalence can also be calculated as an average daily or weekly rate from observations made during the corresponding period. The computation of rates is analogous to what has been said under (a).

In both cases, when presenting prevalence rates, it is necessary to state whether they are period - or point - prevalence rates and, in addition, what has been observed - diseases (and/or spells) or sick persons.

In describing the frequency of morbidity, the expressions: "general morbidity incidence", "general prevalence rates", "specific (i.e. from a definite morbid condition) morbidity incidence" or "specific prevalence rates", should be used, for in this way it is clear what has been measured. "General morbidity rates" or "specific morbidity rates" lack the important information as to whether incidence or prevalence has been considered.

3) Besides general morbidity in the total population, morbidity in single biological groups is observed. Morbidity shows very significant variations according to sex and age.

The age and sex specific morbidity rates for single biological groups have to be found. To be able to do this, data about the basic population-groups are needed, which very often creates great difficulty. The formulae for the specific morbidity rates are as follows:

$$MB_{sp} = \frac{I_{sp}}{P_{sp}} \times K \quad \text{or} \quad MB_{sp_1} = \frac{SP_{sp}}{P_{sp}} \times K$$

MBsp is the morbidity rate in a specific age and sex population group if it regards illness and  $MBsp_1$  if it regards ill persons, Isp is the number of illnesses found, and SPsp the number of sick persons in this group. Psp is the number of the population group (in the middle of the period) under observation.

What has been said for biological groups also holds good for social groups of the population. Some of the most important questions regarding those groups are the following: what are the differences in the morbidity of workers, peasants or public employees? Do the economically active female population have a higher morbidity than other females? Do the population groups of a higher educational level or in better economic conditions have a different morbidity from groups less well off in those respects?<sup>2)</sup> Evaluations of the general morbidity level and of morbidity from various diseases are needed for various social groups of the population to give answers to these questions.

4) If morbidity is analysed further, the most interesting information to be given is which diseases or disease groups are involved and what is their importance in the total morbidity. For this purpose, the International Statistical Classification of Diseases, Injuries and Causes of Death should be used. In addition to this Classification which contains categories covering all diseases and pathological conditions which may occur in the total population, there is a need for special lists of diseases and pathological conditions selected from that Classification. These special lists have to be adapted to satisfy the specific needs of the particular statistical observation (e.g. the list of pathological conditions for periodical examination of school children, the list for pathological conditions of pregnant women, and so on). All such lists have to be prepared based on the International Classification; only in this way is a strict definition of each category clearly defined and a comparison even on international level guaranteed to a certain degree. Categories selected have to be provided with the category numbers from the International Statistical Classification of Diseases.

Investigations into the prevalence or incidence of various single diseases or disease groups are very frequent. Some of the acute infectious diseases, tuberculosis, malignant neoplasms, rheumatic diseases, and mental

diseases are, amongst others, studied particularly often. To survey these diseases, a special methodology for the collection of data has to be applied. This depends on the specific nature of that particular disease, on the possibility of establishing a reliable diagnosis on whether the sick person asks for medical care or not, on the social importance of the disease and on various other circumstances.

It is much easier to obtain the necessary data in cases where specific central health institutions or services for these diseases are in operation, especially if the network of local institutions (clinics, dispensaries) is large enough and their work has sufficiently penetrated into the population to enable them to discover and follow up all cases of the disease under investigation.

What has been said about the need to distinguish between the general morbidity for various biological and social groups of the population is also valid for morbidity from individual diseases or disease groups.

5) Knowledge of the total morbidity in specific social groups may throw some light on the aetiology of the established morbidity of that population group. Still more will come to light in that direction if the levels of age and sex specific morbidity are known for the groups. Investigating aetiological factors, the data of the morbidity level have to be related to the data on hygienic and ecological conditions, using the data produced by statistics on environmental factors.

6) Morbidity statistics use the findings of statistics on environmental factors in studies on aetiological factors. Morbidity statistics themselves may give appropriate measurements for the evaluation of the efficiency of preventive measures which have been undertaken to control the diseases. This efficiency is mirrored in the level of the total morbidity of socio-biological population groups or in the level of morbidity from a particular disease. Longitudinal observations of morbidity, parallel to the intensity of the preventive activity performed, should be carried on in order to obtain a proper evaluation.

7) Information on the general morbidity of a population and even more on the morbidity of biological and social groups of the population, as well as on morbidity from single diseases in these groups, helps to evaluate



the economic loss from prevailing morbidity. For this purpose, data on morbidity have to be supplemented with data on public health service activities and statistical information received from various branches of economic statistics.

Studies in this field are difficult and methodologically not yet developed to a satisfactory degree of statistical precision. From the studies in this field, the work of C.E.A. Winslow<sup>28)</sup> should be referred to especially. Information about the economic loss to society from disease is a valuable argument for obtaining funds which that human society has to provide for services for the prevention of disease. The authority providing funds is no longer satisfied just to be informed what the funds have been used for, but needs information also on, the effect of work done. Besides mortality information<sup>30)</sup> the most important indicator of the effects of preventive work is that provided by levels of morbidity.

#### 4. Methods and extent of statistical investigation of morbidity\*

The methods chosen for investigation into morbidity and the size of population on which information has to be collected are usually a compromise between existing wishes and the possibilities offered by prevailing conditions. The sources from which this information comes have been reviewed generally under 4.1) To get reliable information or information to the required extent, special investigations have very often to be organized to supplement statistics received as a routine.

Special investigations are indicated when it is necessary to solve a particular acute problem and the existing data do not give the information required for sound and efficient planning for its solution. Investigations are, therefore, organized to obtain additional information about a subject on which some (but not sufficient for a particular purpose) data are collected as a matter of routine or to obtain information on a subject on which no data whatever exist. Special "surveys" are then organized i.e. a special statistical investigation is carried out for a specific purpose.

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\* These discussions apply to other fields of health statistics also; they are given under this chapter because they are more often used in morbidity statistics.

There are various ways in which such a survey can be organized for the purposes of morbidity statistics. Three main groups of these surveys according to the source of data, can be distinguished.

1) Utilization of records available in health institutions. These records are collected in institutions as a result of their routine work with the population under their health care and protection (e.g. hospital case history records, child health cards, periodical examination records of school children, vaccination records, etc.). They are the basic documentation of the activities of each institution. These records give as a rule the identification data of the persons, their social characteristics, information about specific illnesses as a result of which medical care was sought, data about treatment, etc. The extent of the data and their quality cover a wide range. The minimum amount of data to be included in the records of these institutions (of the same type) throughout the whole country or large administrative units, is very often stipulated in regulations governing the work of the health services. If such regulations exist, the documentation is kept in a homogeneous way and adequate data can be obtained from institutions doing the same type of work (e.g. Maternal and Child Health) throughout the whole country.

If these data are collected uniformly and are of a satisfactory quality, copies of these records can be made and the data thus collected can be processed by the appropriate health statistical service. More often, a situation arises where records are not uniform either because of the non-existence of regulations for such records or because an inadequate procedure is applied in these institutions. In such a case, the utilization of the data is impossible and other ways of collecting information have to be applied.

2) Requests for supplementary or special data from health institutions. Special survey forms are sent to institutions, asking them to fill in the data for each newly admitted or old patient treated during a definite period of time; these data are collected in addition to records kept as a matter of routine by the institution. For example, the institutions can be requested to fill in a form for all persons with a well defined morbid condition who contacted the institution on a certain day or during a certain period of time. It is believed that data collected in this way may

be of better quality, because the rules of collection are uniform and the instructions can be more detailed. Of greatest importance is the fact that the person is in the institution when the data are recorded and they can be collected from him with all the necessary details, which is not the case when the data are taken from existing routine records.

3) Field surveys are the third main type of data collection for morbidity statistics. Surveys can be distinguished according to:

- a) geographical extent and the population group investigated: country, region, community; total population, specific bio-sociological population groups;
- b) statistical methodology applied for collection of data: census, sampling; deliberate or random sampling;
- c) subject of interest: single or multi-subject survey; total morbidity or morbidity from certain causes;
- d) method of obtaining information: self-recording, interview medical examinations;
- e) place where the information is obtained; house-to-house, convocation;
- f) statistical unit: individual, family, household;
- g) duration of observation: point of time period; repeated in certain periods of time;
- h) existence of a survey programme: one survey, more than one survey co-ordinated to a planned entity.

For each survey, decisions have to be made on all these characteristics; they are partly interrelated and partly independent.

The decision regarding the geographical extent of the survey has a decisive bearing on the statistical method used in data collection.

The census method is used in morbidity surveys in the first place if concrete health measures have to be taken on each single individual found with the specific morbid condition being investigated, (e.g. screening a population for trachoma treatment). If this is not the case, then the survey can be done with a saving of time and effort by investigating only a part of the population - a "sample" of it.

The decision as to which section of the population should be taken as the "sample" is difficult for practical work. Most often the purpose of a morbidity survey is to find out the level of morbidity due to a specific disease (e.g. tuberculosis of the lung) or a group of diseases (e.g. cardiovascular diseases). A health agency can usually not be satisfied with one average figure for the total population but would like to have this morbidity shown for biological groups (sex and age), for various social or professional groups, and according to some sort of geographical distribution. Very often these figures are needed for the sub-division of population groups according to various other attributes, especially those which it is supposed may have a bearing on the cause of the morbid condition under study. The more information we wish to obtain from a survey, the greater must be the proportion of the population we have to include in the sample, otherwise in the breakdown into items and further into groups, sub-groups and categories, values are obtained which cannot be regarded as satisfactory information on the subject. When seeking such extensive information, it is also expected that the values obtained should in some way be representative of the population investigated and its geographical, biological and social subdivisions, etc.

All these problems are theoretically treated by modern sampling theory. However, when it comes to the application of this theory to the purposes of complicated morbidity surveys, such as those just mentioned, it becomes very difficult, and sometimes even impracticable, to utilize sampling theory to its full extent and value. If representative random sampling methodology is to be applied with real usefulness in such cases, the proportion of the sample to the total population will have to be increased to such an extent that the savings in cost and effort derived from sampling are negligible. The remaining alternative is to narrow the aims of the survey and to limit the extent of information sought.

The best way of applying representative sampling methods to morbidity surveys is to use them in surveys in which an answer to a single question or to a few questions only is needed and the survey is then repeated to obtain further information.

A short discussion may be added here on deliberate sampling versus random sampling in morbidity surveys. The advantages of representative random sampling, as well as its limitations as opposed to the census method are well known and do not need to be discussed here.

On the other hand, deficiencies are obvious in a method where a sample is deliberately selected according to certain characteristics of population aggregates. Still, in morbidity surveys, deliberately chosen samples of population aggregates may be preferred to random sampling procedures in certain circumstances. This may be the case when the interest of the health administrator does not lie in obtaining average values (and their probability ranges) or morbidity from a certain disease (or many diseases) in an area, but when he considers that the real contrast values of morbidity in various types of population aggregates are more important for a special immediate purpose.

To get information about highest and lowest values in population investigations is for many purposes of public health activities much more interesting than the average value of the area as a whole, which would be obtained by the simple random sampling method. A stratified sample, however, when stratification is done according to the same characteristics as those of the population aggregates, would furnish this information, but the work would sometimes be far more complicated and voluminous. This combination of deliberate sampling of population aggregates in the first stage of sampling with the rigorous random sampling of statistical units in the second stage simplifies the work in morbidity surveys and produces information which in many cases is absolutely adequate for the purposes of these surveys.

##### 5. Existing difficulties and problems

Most of the problems in morbidity statistics arise from the fact that the terms used do not have the same meaning; by the nature of things many of the terms are subjective in character. The Expert Committee on Health Statistics in its reports has discussed many of the problems in this field<sup>10),34)</sup> and the suggestions made have already solved many problems when applied to morbidity statistics. More uniform definitions are needed for terms which are commonly used in medicine but applied and understood

very differently. The Expert Committee stressed the need for definitions of illnesses: new, old, repeated, latent, manifest, acute, chronic, sub-chronic, primary, secondary, recurrent, accessory; what is a complication; which disease has to be stated as the main illness; how should the duration of an illness be defined (beginning and termination of an illness) and others.

It is especially difficult to find objective criteria for estimating the severity of illness: what should be regarded as a light, difficult or serious illness? Generally accepted measurements of "incapacity" or "morbidity" have not yet been found. The severity of illness can be expressed in terms of pathological findings or in terms of how the persons' reactions are manifested or in terms important for the public health service (e.g. hospitalization needed).

In stating the diagnosis, there are many important circumstances to be considered. Was it made at the first medical examination, or on admission to hospital or on leaving hospital; or, if there is more than one disease involved, which diagnosis should be used for morbidity statistics; was the diagnosis made with the help of laboratory findings, etc.

All these rather difficult questions have to be solved when approaching systematical work in the field of morbidity statistics. Because of these difficulties, the items collected in most morbidity statistics are reduced to those which are easily defined. This narrows down the analysis of statistical series on morbidity statistics. The terms in use are defined differently in various investigations. Comparison of findings is difficult and even impossible with subjective criteria and the general value of such investigations is decreased.

Besides these, there are many other problems connected with the methodology of recording and collecting data in an adequate way. Some of them are the following:

a) One and the same person may get medical care for the same sickness in various institutions or from various practitioners, e.g. examination is first made in a general clinic (or by a general practitioner) and, depending on the findings, examinations may be made in one or more specialized clinics. The person may be registered in all these institutions and enters the statistics as many times; this can even be done under different diagnoses.

b) The course of an illness is very often not seen through to the end. The person comes for examination only once, and in spite of being so requested, may not come again. He goes perhaps to another institution or does not find it necessary to call again for medical care. It is, therefore, very often impossible to get data on the further development of the diagnosed and recorded morbid condition and its duration. If the number of such individuals is large, as is very often the case, the lack of such information makes proper statistical conclusions hazardous.

c) For the observation of general morbidity in general population groups, it is necessary to secure registration of all sick persons in the population who ask for medical care (if this is the definition of general morbidity). This attempt is limited by the fact that it is often impossible, for various reasons, to obtain this information from general practising medical personnel.

d) Reliability of diagnosis depends on the professional skill of the personnel and on the technical equipment at the disposal for this purpose.

#### 6. Sources of routine morbidity statistics

The most common sources of routine morbidity statistics are individual notifications or periodical **summary reports on:**

- a) acute infectious diseases;
- b) important chronic infectious diseases (e.g. tuberculosis)
- c) various other morbid conditions (e.g. cancer) which play a great rôle in the morbidity of the population;
- d) hospital in-patients;
- e) out-patients treated in hospitals, clinics, dispensaries and similar institutions;
- f) medical examinations of school children;
- g) findings in institutions for health protection of mothers and children;
- h) health examination of various occupational groups.

The extent of the information obtained from these sources varies widely, from information giving only the total frequency to information giving single cases by age, sex and other attributes relevant to the actual use of the data (see Chapter IV, 1.)

1) Acute infectious diseases. Notifications of these diseases are the oldest source of morbidity statistics. Regulations concern:

- a) lists of notifiable diseases;
- b) definitions of individual diseases (of this list) required to be reported;
- c) persons obliged to notify;
- d) time when notification has to be made;
- e) ways of reporting
- f) authority which has to be notified;
- g) extent of the information required.

The list of diseases for which notification is compulsory depends on the epidemiological conditions of the country and great variety exists in various countries<sup>\*)</sup> in this respect.

The extent to which this condition for various notifiable diseases is fulfilled is far from what is desirable. Often the disease to be notified is not even determined by a definite category of the International Classification of Diseases. The diagnostic procedures to be used for notification of an otherwise defined disease are not established or, if established, are not applied uniformly in all parts of the country, etc. Obviously, time must not be lost by waiting until diagnosis is confirmed by the required procedure before notification of certain epidemiologically important diseases are made; for this reason even suspect cases must be notified. What is necessary is that corrections be made in the original notifications before these data are utilized for final statistics and for epidemiological studies.

From the viewpoint of international statistics, recommendations are needed regarding the standardization of procedures to be used for reporting a certain disease. Until this is done, comparison of the incidence of various diseases between countries is of very limited value.

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\*) WHO Annual Epidemiological and Vital Statistics



The times and ways of reporting depend again on the character of the disease. From this viewpoint, the diseases can be classified into a least two large groups: (a) quarantinable diseases, recognized as such by the International Sanitary Regulations; and (b) all other diseases. As is known, the first group contains the following diseases: cholera, plague, smallpox, louse-borne typhus, louse-borne relapsing fever, and yellow fever. Strict and special provisions concerning the procedure of reporting and of control of these diseases are internationally accepted. The International Sanitary Regulations, published by WHO in 1957, give more information on this subject.

The current notifications required by these Regulations and obtained from countries throughout the world are published by WHO in the Weekly Epidemiological Record. Annual summaries and seasonal (by months) distribution of cases and deaths from these diseases and others which are notified are published in the Annual Epidemiological and Vital Statistics and in the monthly Epidemiological and Vital Statistics Report.

An official report<sup>\*</sup> of the American Public Health Association attempts to classify communicable diseases into five groups. In the first are included diseases already listed as reportable under the International Sanitary Regulations.

The second class (31 diseases) requires regular case reporting when the disease occurs; it has two sub-classes, one requiring notification by rapid means, and the other by the most practical means.

The third class contains 38 diseases (in three sub-classes) selectively reportable in recognized endemic areas, differentiating in the method of reporting used between the most rapid means (e.g. tularaemia), the most practical means (e.g. infectious hepatitis), and by collective report (e.g. malaria).

The fourth class contains 21 diseases for which a compulsory report of epidemics and not an individual case report is required (e.g. food poisoning-salmonella infection)

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\* Control of Communicable Diseases in Man, Eighth Edition, 1955

The fifth class contains 23 diseases for which an official report is not ordinarily justifiable (e.g. mumps).

The extent of the information required is the identifying data of the patient (name, address, place of occurrence, sex and age), in addition to the diagnosis and date of the report. Other information required on the individual report form would depend on the organizational scheme, and network, and on the extent of public health or epidemiological services and their activities. If it is feasible in the circumstances, additional information is requested, especially if the material being collected will be utilized for epidemiological studies.

In countries where the system of individual notification is applied, the amount of information requested, in addition to the basic items, varies widely. The most frequent additional item is "occupation". Very often this item cannot be used in an analysis because the criterion according to which this item is given does not permit its numerical relation to the basic population. Figures regarding occupations of the basic population for which the data are obtained from a population census are very often obtained by using other criteria. Other items such as: date of first symptoms, usual residence, laboratory confirmation, hospitalization, previous vaccinations, and others, are answered in such a variety of ways even in one and the same country that very little use can be made of this information. If such data are going to be used for statistical analysis, these items must be uniformly defined. For international use, international agreements on these definitions are necessary.

It is well known that only a part of the cases actually occurring is notified. If the proportion were known, it would help greatly to reach adequate conclusions. It would also be necessary to know whether this reported proportion represents the incidence of the disease in the basis population regarding its characteristics influencing the occurrence of the events. On this additional information depends the extent and value of any statistical analysis of the data. It is generally recognized that the unknown proportion of completeness in reporting cases is the most serious handicap in epidemiological studies, completeness varying from disease to disease inside the same country and from country to country, and that difficulties are encountered even in different administrative units of the same country or state.

This fact has to be borne in mind whenever evaluations of level and trend of these diseases are undertaken.

For most of these studies, the level of morbidity rates for a particular disease are compared in time, in space, or in various social and biological groups, the limitations mentioned earlier being taken into consideration. One has to be cautious in drawing conclusions from morbidity time-series. Not only changing concepts of diagnosis but, to a greater extent, changes in the proportion of reported cases to the number of total cases occurring, play a significant rôle. It can be assumed that reporting is generally improving (increase of medical care, higher standard of life, development of epidemiological services), except in some definite circumstances, and that therefore a decrease in the incidence level is more characteristic than an increase; an increase, however, should not always be explained as being the consequence of better reporting.

In calculating morbidity rates for comparison with populations or population groups, the fact should be borne in mind that some diseases are peculiar to children. A higher rate of measles per 100 000 total population in a population (e.g. country) with a high proportion of children than in another population with a small proportion of children does not necessarily mean that the situation in regard to measles in the first population is worse. Only specific age morbidity rates will demonstrate the real situation. This rule must also be applied when studying the incidence of communicable diseases in various occupational groups. This fact has also to be considered in explaining the time trend in diseases which show a definitely prevailing age distribution. They may, therefore, show a decrease or an increase only because the proportion of this definite age group has changed in the total population.

Comparing morbidity trends or levels with the trends or levels of another event or attribute, using various adequate statistical methods, may occasionally give an indication of existing relations between the incidence of the disease and other relevant factors. There have been so many failures in this field that such an explanation requires the greatest caution. No matter how close two events or attributes are statistically correlated, one can almost never say with safety that correlation found is the right one in the complex inter-relationships of two or more events and

their attributes. Not only pure mathematical-statistical reasoning is needed to arrive at such a conclusion, there is also the need for experienced and logical epidemiological reasoning for which a thorough knowledge of the field in question is indispensable.

The data, such as they are, have to be valued differently for morbidity analysis, depending upon whether they are to be analysed from an international, national, regional or more local viewpoint. Their value increases from international to local levels, i.e. analysis can be more extensive and more reliable in smaller population aggregates, if for no other reason than that the epidemiological and notification conditions are better known and are more homogeneous.

2) Chronic infectious diseases and various other morbid conditions.

The common characteristic of these is their usually unnoticed onset and their long duration. These characteristics have a bearing upon the methodology of collection of data. This depends also on special pathological development and on the treatment pattern of the disease.

The information may be obtained by individual notification or by a summary report of all diagnosed cases, in a similar way as for acute infectious diseases. The chronicity of these cases very often causes multiple notification of the same cases by various persons and institutions. Some kind of central register for larger geographical units is therefore a means of getting reliable information on the incidence and prevalence of these diseases. In the registers many other items of information are available and therefore these data can be used for obtaining periodical information on various diseases for which data are collected in this way. Tuberculosis and cancer registers (and others, e.g. leprosy, bilharziasis) are the best known and their methodology has been elaborated (e.g. WHO Sub-Committee on cancer statistics<sup>34</sup>).

3) Hospital in-patients. Great importance is paid to statistics from this source, for which the term "hospital morbidity statistics" is often used. They are produced in two different ways, either from summary reports of hospitals or from individual statistical reports on each single patient treated in the hospitals, and are then processed by the central health statistical service. The individual record procedure has many advantages.

Some authors<sup>12)</sup> question the usefulness of statistics based on hospital in-patients as a source of morbidity statistics. The WHO Expert Committee on Health Statistics in its Fifth Report\* discusses the limitations of hospital morbidity statistics and states "The usefulness of hospital records as a fruitful source of morbidity statistics depends upon the purposes for which such statistics are desired". Regarding the scope of morbidity statistics given under chapter V.3, there is no doubt that hospital morbidity statistics may usefully serve many purposes.

The publication which sets out the views expressed at the Conference on Hospital Statistics and their Application in Health Administration\*\* describes the position of hospital statistics in fifteen European countries and gives useful illustrations of special problems of hospital morbidity statistics.

Hospital morbidity statistics refer to a selected population and information on some kind of "general" morbidity cannot be obtained from these statistics. A comparison between hospitalization frequency for various population groups, such as social and geographical is also difficult. The use of hospital care depends on the network of hospitals and on the accessibility of this care either because of geographical factors (distance and transport facilities) or because of social conditions (possibility of bearing the expenses). An important factor in the utilization of hospital treatment is also, among others, health consciousness, which depends on the health education of the population. It is impossible to find out the proportions of the influence of these factors and it is, therefore, obvious that these statistics cannot be used as a measurement of the "general" morbidity of the population, except under certain conditions.

These statistics, however, can give extremely useful data on various attributes of hospital patients. General morbidity is but one important information item for morbidity statistics. Even for this purpose, hospital morbidity statistics are of value as is stated by the above-mentioned report

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\* WHO Expert Committee on Health Statistics, Fifth Report, TRS No.133

\*\* Conference sponsored by the WHO Regional Office for Europe, Geneva 24-28 November 1958; publication printed and distributed by EURO, Copenhagen, 1959.

of the Expert Committee: "... for some areas of the world, hospital records are perhaps the only source of information, and provided due caution is used, a good deal of knowledge of the prevalence of sickness in a community can be obtained from them".

Leaving this question aside, hospital morbidity statistics give important information on:

- a) the geographical influx of patients to various hospitals and various specialized departments;
- b) various diseases by sex and age and the duration of stay in hospital;
- c) the conformity of hospital diagnosis to previous diagnosis made outside;
- d) concurrent diseases;
- e) additional information required on certain important diseases (e.g. tuberculosis);
- f) the period between onset of the disease and admission to hospital;
- g) the type of treatment (e.g. operation, blood transfusion, use of special imported drugs);
- h) deaths in hospital.

From this (and other) information and their combination in tabulation, many important facts can be evaluated, relevant to the problem of morbidity in the population. In addition, many important facts in connection with treatment can be revealed, as is shown especially in publications of the Commission on Professional and Hospital Activities;\* this is referred to in chapter VIII. The use of statistics on hospital patients is very extensive for administrative purposes; this is referred to in chapter XI.2

The value and the possibilities of the use of hospital statistics depend in the first place on whether the number of the total population (and its socio-biological characteristics) served by a hospital (or hospitals) is known. This is the case if hospital statistics include all hospitals and all patients of the hospitals (regardless of whether a sampling procedure in processing of data is applied).

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\* Information Brochure on Scope and Activities,  
PAS 1960, Ann Arbor, Michigan, USA.

The report form on an individual hospital patient can be different for the following three groups of hospital admissions: injured persons, delivery and all others. The use of different forms for these three groups may be preferred because the information required is different.

4) Out-patients. Statistics may be collected on persons with morbid conditions asking for medical care in various clinics, general or specialized dispensaries or in private practice. Except in certain circumstances, periodic reports are prepared by these institutions and submitted to the health statistics services for consolidation of data by type of institution and by administrative areas. The extent of information in these reports varies widely; it can be used for morbidity statistics purposes, if some distinctions are made according to the groups or categories of morbid conditions found. As these reports are prepared in institutions, no long lists of diseases can be used. These lists usually contain various disease categories for various types of institutions; they depend on the kind of patients treated in the various types (e.g. general clinics, children's clinics or dispensaries).

By the nature of work performed in these institutions, diagnoses made at the first visit may usually be used for classification of the case in the list of diseases. A distinction is also made in showing the frequency of cases between the first and repeated visits because of one and the same morbid condition and the frequency of persons asking for medical care for the first time in a given calendar year or for the first time at all (e.g. children's dispensaries).

Because of the differences in routine procedures at institutions of various types, different report forms are usually used if more detailed information is sought for their findings and activities.

The usefulness of these statistics, consolidated by various types of institutions, depends on the coverage of the population for which medical care is given. If, for example, child clinics or dispensaries in a complete return take care of all children of a certain population group, the statistics produced can show the morbidity pattern of these children. Or, as is the case in some countries, if medical help can be obtained only in public clinics (abolition of private practice), statistics from these

clinics may give a good picture of the general morbidity of the population, (i.e. morbid conditions for which medical care has been sought), obviously with the application of sound statistical methodology in collecting and processing the data.

Records obtained from private practitioners can also under certain circumstances give an orientation on morbidity conditions, as is shown in the case of morbidity statistics collected from that source in England and Wales.

5) Periodic health examinations. Health examinations are performed as a matter of routine on various population groups whose health is considered as being in special danger, or for other reasons. Such routine health examinations are made on school children, certain occupational groups, pregnant mothers, etc. The results of these examinations are recorded and filed at the institution responsible for the examinations and the records are used for preparation of periodic reports, showing the work done and findings of these examinations.

These reports can be a valuable source on information on the morbidity of the population groups examined, if proper statistical methodology is applied to collection and processing the data. The most common deficiencies in this respect are the following:

- a) subjectivity of the examiner with regard to stating the morbid conditions existing;
- b) incomplete coverage of the population groups undergoing the examination;
- c) problems arising from unsatisfactory diagnostic facilities especially if the population groups examined are very large;
- d) problems arising from the classification of morbid conditions found.

These and also other deficiencies can be overcome by regulations giving definitions and procedures to be applied at the examination itself and at the processing of the data. Wherever possible central statistical processing should be used for coding and tabulating of data.



The advantage of these statistics lies in the fact that the rates of various conditions can be calculated according to the various attributes of the total population examined and if the total population examined covers the total population group it was planned to have examined, these data may give a reliable picture of that population group in connection with its various socio-biological characteristics. This is a result which would otherwise be possible to obtain only in specific health surveys. This, in fact, is an advantage even to these surveys. Because of the routine periodic examinations, results can be observed for subsequent years and changes in the pattern of the health status of these population groups can be observed; this information is most desirable for continuation of health care and protection given to these groups.

## VI STATISTICS OF INJURIES

### 1. Subject of observation

The need for statistics of injuries following various accidents was realized very long ago. Occupational injuries have a particularly important place in these statistics.

Injuries following accidents can be fatal. These statistics do not represent a difficult problem with regard to their completeness. Judicial procedures following such accidents are in use and are well established in all civilised countries. The data are produced by mortality statistics. Deaths following accidents are in most countries one of the leading causes of death and for the age-group 1-19 years, the one leading cause in most civilised countries.\*

Registration of non-fatal injuries always includes a certain number of injuries which are regarded as specially important. In some countries the reporting of injuries caused by traffic accidents is compulsory as are very often injuries at work (occupational injuries).

Notification of occupational injuries was introduced in industrialized countries following social security legislation for workers. This defines the responsibility of employers for accidents and the sickness allotments to be paid by social insurance funds. These statistics, therefore, started earlier in countries with an early industrialization; data on mine accidents go back to 1850 in France<sup>14)</sup>.

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\* WHO Annual Epidemiological and Vital Statistics

## 2. Classifications

Public health services look at the problem of injuries in the first place from the stand-point of their prevention and efficient treatment with subsequent rehabilitation. Statistical classifications have to be adjusted to that need; (classifications of the kind of accident, of the nature of the injury and of the cause of the accident). An attempt to give an international classification of external causes of injuries was made in 1948 when the "E" classification was introduced into the International Statistical Classification of Diseases, Injuries and Causes of Death. The circumstances under which accidents occur are so different in various countries that it may take many more years before an international classification will be made which will satisfactorily meet all conditions.

The detailed classification "N" for the nature of injuries in the same International Classification covers what is needed and can well be applied. A more elaborate Intermediate List would, however, be of great practical use; at present the Intermediate List gives only four categories.

For the classification of causes of occupational injuries, special classifications are needed to throw more light on the aetiology of these injuries.

## 3. On the definition of "injury"

Like morbid conditions in general, injuries cover a wide range of conditions. They can be of an irrelevant character or of no importance whatever. They, therefore, do not need to be included in any statistics. At the other end of the scale are fatal injuries which appear in statistics of causes of death. In between are injuries for which material help may be necessary with or without restriction of one's usual activities or for which hospital treatment is required. In collecting statistics of injuries a "working" definition is therefore used; the definition depends obviously on the aim of these statistics. Usually information is collected on injuries with recourse to medical assistance or with consequent restriction of normal daily activities.

Special importance is given to "occupational" injuries. In general terms, injuries are regarded as such when they are the consequence of accidents happening to employed persons at their occupational activities.

An exact definition of occupational injury is necessary for social security reasons, because of indemnities to be paid to persons with such injuries. However, a great variety of definitions exists in various countries and, therefore, no internationally comparable data can be obtained regarding the frequency of these injuries in various countries. Efforts of the International Labour Organization to get international agreement on a definition have been going on for many decades<sup>38)</sup>.

Whatever the definition may be in a particular country, injuries according to that definition have to be reported and statistics are processed from these reports. At least within a country comparable statistics are produced for various branches of industry, various occupations, etc.

In the following chapters, only occupational injuries statistics are under discussion; most of this, however, is applicable to all injuries.

#### 4. Scope of occupational injuries statistics

The reporting and processing of these statistics has to be organized in such a way that the following can be investigated:

- a) frequency
- b) aetiological factors
- c) severity of injury
- d) nature of injury
- e) efficiency of preventive work
- f) efficiency of treatment and rehabilitation
- g) costs and expenditures

1) General and specific frequency. The first requirement which has to be fulfilled for the investigation of frequency is the completeness of registration of all injuries according to the existing definition.

The general frequency of occupational injuries in a definite period of time (i.e. the incidence of injuries) is studied in relation to the total number of employed persons and in more detail: in single establishments in various branches of industry, in various occupational groups; this is shown for the whole country and for smaller administrative units. To calculate the incidence rate, the number of persons exposed to risk (i.e. number of persons employed) has to be available classified by the same characteristics.

The evaluation of frequency of injuries in relation to number of employees gives only qualified information on the subject. The reason for this are obvious. Employment figures show in many industries a high seasonal fluctuation; difficulty arises, therefore, as to how to proceed in order to get the basic average number of employees needed for the calculation of rates. Another difficulty lies in the fact that working hours - taking into consideration overtime - are not the same in the various industrial establishments; the influence of length of working time is wellknown in statistics of injuries.

It is, therefore, much more satisfactory to show the injuries rate in relation to working days and even only accurate if these rates are expressed in relation to working hours. Only this rate shows the actual risk in the population group for which the frequency is being computed. It is, therefore, necessary that not only the number of employees should be known, but also the number of total working days and total working hours. This information is not always available (or not even available as a rough estimate) concerning the total employed population in a country or in larger areas. The only possibility which remains is to investigate the detailed and most significant rates of incidence limited to those establishments or branches of industry for which information on actual working hours is available.

Age and sex specific incidence rates for individual branches of industry can throw some light on the differences found among branches of industry or among various occupational groups if the age and sex distributions are different. An evaluation of the existing risk of injury is going to be much safer if based on such specific rates. It is, however, very rare that the necessary data on working hours for these groups of workers are available without being specially registered, which is the case in special investigations.

2) Investigations of aetiological factors. The registration of accidents and especially statistics of occupational injuries obtained therefrom are in the first place directed to a study of the causes of accidents; the concrete questions are why and how an accident has occurred. This should lead to adequate preventive measures. Quite a few items in each occupational accident are registered with that view. The following can be regarded as important items of this type:

injured persons : age, sex, occupation and duration - period  
of working at that occupation

time : working hour at which the accident occurred  
day or night time,  
day of the week;

other conditions : overtime  
individual or group work,  
whether usual routine or unaccustomed work  
was being done at the time of the accident,  
physical and mental condition

Each one of these items can contribute to the explanation of the occurrence of an individual accident. They consequently help either directly or indirectly in investigations into the causes of accidents. To measure the rôle of all these factors is, however, a very difficult task and a thorough statistical knowledge, with a good knowledge of technology of conditions at work and of other concrete circumstances, is required for that purpose.

Besides these generally valid factors, a statement about the actual "cause of accident" is requested. Each accident has to be coded according to an existing statistical classification of accidents at work. This subject has already been discussed under chapter VI.2. It is believed that the International Classification does not satisfy all existing needs. A distinction may be necessary between the cause of accident and the cause of injury. For example, a fall on stairs (E 9II) may be a cause of injury, but this does not give any information on the cause of the accident, and this would be the information needed for prevention (for instance, stairs under repair, worn stairs, darkness, etc.). In some investigations, the "source of the injury" and the "cause of the injury" are distinguished; in the example given, a fall on stairs would in this case only be "the source" of the injury.

3) Measurement of the severity of an injury. The classification of injuries into severe and light injuries is subjective and, therefore, the distinction is unreliable and can hardly be used in statistical studies for comparison. It is also often difficult to make such a distinction

between injuries at the first examination of the injured person, i.e. when notification is made - because often it cannot be foreseen how the pathological process may develop.

The duration of treatment or of incapacity for work (usual daily activity or the end-effect of treatment may be used for this classification. The end-effect of treatment is among the particularly important measurements, but is, however, practicable only at the end of treatment. It has to be decided whether the injured person has been wholly or partially rehabilitated with regard to performing the same kind of work as before the injury or whether he is able to do work but of a different kind; complete disability or death indicate the most severe injuries.

To present statistics on the severity of injuries, data have to be collected giving information on the duration of treatment or on incapacity for work (or on incapacity to carry out normal activities). In addition, data have to be collected on possible changes regarding ability to carry out former duties. It is necessary to know whether the injured person has returned to his previous work, whether he has had to change his work or whether he is incapacitated as regards work.

The following grouping of this information may be suitable for objective measurements of the severity of injuries: (naturally with the added information on nature of injury):

a) Duration of incapacity for work (or prevention from usual activity)

- e.g.:
- 1 - 3 days
  - 4 - 7 days
  - 8 - 14 days
  - 15 - 30 days
  - 1 - 2 months
  - 3 - 5 months
  - 6 months or more

b) Establishment of full working capacity

- for the same work
- for other work

c) Incapacity for work

complete or partial according to the rules, which are purposed for defining the proportion (percentage) of the incapacity.

A statistical presentation of injuries on these lines may give a good indication of the severity of the injuries especially if an analysis of injuries is added according to the nature of the injuries (see chapter VI.4.4). The groupings given above can be used in calculating ratios showing the proportion of injuries in the groups or for rates of injuries in the above groups based on the total number of persons exposed to the risk of injury or to the total number of working days or working hours of the population investigated. Calculation of average duration of incapacity for work according to occupational groups, branches of industry, sex, age and nature of injury will usefully complete the picture obtained.

The source of data for all the information needed may be individual notification of each case of working incapacity caused by injury at work, the reporting by hospitals of cases of injuries treated or the reports of authorities and institutions deciding the percentage of incapacity caused by occupational injury to be used for recompensation.

4) Nature of injury. Knowledge of the nature of injuries is of the greatest importance for health services in planning organization of medical and institutional care for injured persons and for rehabilitation services; this information is also an important addition to the picture of severity of injuries. Often it may give a good indication of the ways of preventing a certain kind of injuries even without having data on the external causes of injuries.

The detailed list of the International Classification of Diseases, Injuries and Causes of Death (Seventh Revision) contains 189 categories for classification of injuries according to the nature of the lesion. The Intermediate List AN of this classification uses 13 categories and the Abbreviated List BN 4 categories. There are similar -although smaller- difficulties regarding the reliability of the diagnosis of an injury as there are regarding diseases; in many cases, the true diagnosis can be made only after longer observation and not at the moment when the first medical aid is given and when - as is often required - the notification of the injury has to be sent.

The nature of the injury is studied in relation to industry, branch of industry, profession, sex, age and - most important - to external causes (and sources) of the accident.

The statistical measurements which are applied are ratios of individual categories to the total number of injuries and rates related to the number of exposed persons.

5) Evaluation of preventive services. The responsibility for the prevention of accidents lies on the following: the employed person, the establishment (owner), industrial health inspection, labour inspection and occasionally, some other agency. For the study of the efficiency of preventive work, it is necessary to know the extent of the responsibility of these various factors. Only if this is known, is it possible to bring to light what has been neglected in carrying out preventive measures and what are the weaknesses of those measures.

From an analysis as suggested in paragraphs 4.1 and 4.2 of chapter VI, a good orientation can be obtained in that direction. High incidence rates in a branch of industry or in a factory or place of work indicate the need for a more detailed study on the spot of the aetiological factors in such cases. An investigation should then follow into the general aetiological factors and especially into specific causes of accidents and their sources. From such a study, the facts have to be discovered about deficiencies of preventive measures and this may indicate who is responsible for these deficiencies, etc.

To find the information which will reveal the existing situation, routine notifications of injuries may not be satisfactory as a source, and special surveys in that respect may need to be organized.

6) Evaluation of curative services and rehabilitation. Curative services for injured persons include all activities from first-aid at the place of the accident to the first medical aid and to highly professional services in specialized hospital facilities. These services have to be evaluated statistically under the following items:

- a) speed and quality of first-aid at place of accident
- b) speed of first medical aid
- c) quality of first professional (specialist) intervention
- d) period which elapsed between time of accident and specialist intervention
- e) quality of specialist treatment



In cases of serious injury, only specialist treatment in a hospital can be adequate. The period elapsing between the time of accident and such hospital treatment is often of decisive importance. The length of this period can, therefore, be regarded as the first most important measurement of the efficiency of the curative services. In that connection, items b) and c) mentioned above, also play an important part.

For an evaluation of the quality of curative services, a first step may be to classify broadly the quality of first-aid given at place of accident and relate this to the period of time (again in a few groups) elapsing until first medical aid was given. It may be useful in certain circumstances to give also information on kind of transport.

The quality of first medical aid is evaluated by a qualified specialist in the hospital to which all the serious cases are transported for specialist treatment. This evaluation should state: 1) has first-aid been wholly adequate, i.e. of such a kind that nothing more could be done; 2) has first-aid been satisfactory, but could have been more adequate; 3) was first aid not satisfactory.

The adequacy of specialist treatment in the hospital has to be evaluated by a highly qualified traumatologist in a similar way. The basis for his opinion is the information given on the hospital notification of the injuries treated. Care has to be taken that one and the same traumatologist does this service for the whole area to which the study refers.

An analysis of the data according to the items of this paragraph combined with items mentioned in chapter VI.4.3 (severity of the injury) can give a fairly good picture of the quality of the curative services for cases of injury. The items needed for this analysis have to be included in the standard form used in hospitals for notification of cases of injuries treated.

7) Economic loss because of injuries. Statistical evaluation of occupational traumatism may include information on the economic loss resulting from these injuries. For this purpose it is necessary to present statistics on:

- a) expenditure on treatment
- b) benefits (or salary) paid during period of incapacity for work
- c) benefits (or pensions) paid to persons permanently incapacitated because of injuries

- d) loss of national income because of lost working days
  - e) loss of national income because of pre-age inability to work, following injuries.
  - f) loss caused to national income because of lost manpower days through deaths following injuries (the length of time for which the deceased persons would still have participated in production if death had not occurred).
  - g) the amount of social investment (education, professional training) which was spent by society on injured persons with premature inability to work, or death through injury.
- a) Expenditure on treatment of injured persons includes actual expenses for ambulatory or hospital treatment. Hospital expenditure is usually known; it is sometimes more difficult to get data on expenditure for ambulatory patients. Various types of organization of these services and of ways of paying this expenditure have to be taken into account in collecting this information.
- b) Data on benefits (or salaries) paid during the period of incapacity for work can be estimated from the information on lost days of work because of an injury in connection with the average wages (or salaries) or from social insurance funds.
- c) Information on disablement pensions is usually supplied by social insurance fund statistics.
- d) Loss of national income can be estimated in various ways, depending on existing data on the gross national product. It has to be calculated on the basis of information on working days lost because of injury. If the national product is known by individual industries, and also the days lost in these industries, the estimation is fairly reliable.
- e) The loss due to pre-age incapacity can be calculated along similar lines, considering the data of disablement cases by age structure of these case.
- f) The amount of manpower lost because of deaths following an injury is more difficult to estimate. The most precise way, although elaborate, would be to calculate the number of working days lost, taking into consideration the period of time from date of death to the age limit when the

injured person would have reached his retirement age. If the age distribution of fatally injured persons is known, their average age can be computed and the total number of years lost for productive activities found. Knowing the figure of years lost and the average value of per capita national income, the economic loss can then be estimated.

g) The procedures are very different for estimating loss of national income due to injuries because of manpower lost following the premature elimination of the fatally injured from their productive activities. These procedures are very complex. The bases for these calculations are data regarding fatal injuries classified by age, sex and occupation, as discussed under f). Other information needed is the estimated man value by age and sex and - whenever possible - by occupation. These data are very seldom available, except in special surveys.

The aim of injuries statistics is, therefore, to build up the methodology which will give the necessary basic information to make it possible to calculate the economic loss caused by injuries. The discussion outlined above is but an indication of the methods which these statistics must follow in order to get a thorough insight into the problem, which is so important in most countries.

## VII STATISTICS OF INCAPACITY FOR WORK BECAUSE OF ILLNESS

### 1. Definition

These statistics are a specific kind of morbidity statistics. Economically active persons who are incapacitated for work because of illness - temporary or permanent - during the period of employment, compose the population group under statistical investigation. The morbidity in this case is limited to morbid conditions which cause absence from work.

The total economically active population to which data on work incapacity due to illness refer, has to be strictly defined and their characteristics (sex, age, occupation, etc.) established. This population may belong to a definite social insurance fund, or to an insurance system, or to an establishment (factory) etc.

The definition of incapacity for work because of illness must also be given and uniformly applied in all cases of incapacity for work.

The difference most often observed in this respect is the duration of incapacity for work which has to be considered in reporting a sick person as being incapacitated for work because of illness.

Statistics of incapacity for work because of illness may, therefore, include cases starting with one, two, three or more days of absence. These statistics are primarily collected for refund by sickness funds of wages lost and as these funds start recompensation after a certain period of illness (1, 2, 3-10 days), cases covering a shorter period than that required for entitlement to a refund are not shown in the statistics collected. When comparing such statistics, this fact has to be borne in mind. As a consequence, therefore, of what has been said, this kind of morbidity statistics do not give any information on illnesses which do not cause absence from work or in some countries which caused a short absence for which no refund of wages was effected.

## 2. Permanent incapacity for work (i.e. disablement) because of illness

These statistics are well elaborated in industrialized countries. On the basis of data collected for many years, tables of incapacity are prepared by age, sex and occupation, similar to life tables. This is an expression of the risk of becoming invalid because of illness in various industries and other places of work. This information forms the basis for determining the amount of contribution to be paid to the social insurance funds.

Permanent incapacity for work is statistically investigated independently of temporary incapacity because of illness. Its definition is laid down by legislation or by sickness funds regulations. Special instructions usually give the procedure according to which this incapacity is substantiated.

The greatest difficulty in these procedures is how to measure the decrease in capacity for work, because permanent work incapacity can be of different degrees. The problem which has to be solved is to what proportion the capacity for work decreases in each individual case. The estimation of this proportion can often be done only subjectively, and is complicated by the fact that the proportion of lost working capacity has to be estimated according to the actual occupation and to the occupations for which the injured person can eventually be rehabilitated. It is obvious that precise regulations settling all these basic problems must exist and must be applied as the first condition for statistics in this field.

Items giving the basic information for such statistics are:

- 1) A strictly diagnosed disease or condition which caused incapacity for work and in addition all other morbid conditions found present.
- 2) Occupation and duration of employment in present occupation and all previous occupations with length of time given for each of them.
- 3) Duration of present employment until beginning of the morbid condition which later caused incapacity.
- 4) Duration of temporary incapacity for work preceding a formal decision of permanent incapacity.
- 5) Estimate of the lowered capacity for work as regards work in the same or in another occupation.

3. Temporary incapacity for work because of illness

These statistics have a very long tradition and they were introduced to analyse the expenditure of social insurance and various sickness funds, with a view to rationalising their expenses. These statistics - if adequately organized - can also produce very useful information on morbidity of the insured population and give valuable clues for efficient preventive activities by the responsible health services. It is, therefore, believed that the organization of statistical services on this subject should be a joint enterprise of the authorities responsible for social insurance and for health services.

To obtain data of value for morbidity statistics, it is desirable to include in these statistics all cases of incapacity for work, i.e. starting from one day of incapacity. This is often not the case. It is also necessary to obtain information not only on number of working days lost, but of all days from the onset of incapacity (i.e. including Sundays and holidays). Importance has to be given to the proper diagnosis of the morbid condition. In tabulating these data, the diseases causing the incapacity have to be shown in as much detail as possible (Detailed List of the International Classification of Diseases).

In addition to age and sex distribution, distribution by occupation is needed for the study of morbidity. This information obviously can only be fully utilized if the data for the basic (i.e. total insured) population

are known, according to the same characteristics. Comparison of morbidity rates (individual diseases or disease groups) in various occupational groups by age and sex may disclose facts important for specific preventive action.

The duration of a single spell of incapacity due to various diseases is also an important item to be studied, according to the various characteristics of the insured population.

The source of these statistics are reports for each single case of incapacity for work because of illness: these are usually prepared by physicians or health institutions granting "sick leave". The statistics collected are, therefore, statistics on spells of incapacity for work and not of persons incapacitated.

Doubt is often raised about the quality of these statistics because "sick leave" may be requested and granted on the basis of stimulated illness. Such cases cannot be excluded, but proper analysis of data and accumulation of such cases in definite periods of the year (and mainly in certain disease categories) often reveal that such a practice is involved.

## VIII CLINICAL STATISTICS

### 1. Definition and methodology

It is suggested that the term "clinical statistics" may refer to statistics on subjects belonging to the field of clinical medicine. Accepting this meaning, clinical statistics would deal with observations concerning:

- a) therapeutical effects of drugs
- b) effects of surgical interventions
- c) effects of physiotherapy
- d) influence of climatic factors
- e) therapeutical effects of mineral water of various constituents
- f) influence of nursing of the patient

In addition to that, clinical statistics disclose facts in connection with research into aetiology, pathology and symptomatology of individual diseases.

The sources of information for this field of health statistics are experiments on animals, observation of reactions of patients undergoing various therapeutical treatments and observation of other relevant facts according to the purpose of the experiment. For many of these investigations, application of general statistical methodology is used.

The application of statistical methodology in the field of medicine is of very recent date. The presentation of figures for two different treatment methods showing differences found between differently treated patient-groups as absolute figures, rates or proportions is an old procedure in this field. In such observations proper regard to important statistical requirements for comparability has been neglected or underestimated: bias and change have been overlooked in such presentations. Quite a number of therapeutical blunders have been made, because sound statistical methodology was not observed.

Not many years ago, application of adequate statistical methodology was introduced into the field of medicine and the use of this methodology in planning observations, in processing data and in evaluating results obtained is growing.

In planning an observation, the first condition to be met is the existence of a control group, which has to follow a similar pattern in all its relevant characteristics, except the one which is under investigation. For example, if a group of persons with a definite morbid condition is to be studied and the effect of a definite drug assessed, the study and the control groups must have the same distribution by biological characteristics (sex, age, health status, and in some investigations also weight). They must further have similar distributions of socio-educational characteristics, if these can influence the investigation to be made. Absolute homogeneity of both groups in all relevant characteristics is required and all effort has to be made to fulfill this condition.

If the results for the two groups have to be compared, an important part is played by the duration of the sickness before the application of the treatment procedure under investigation; also of importance is the previous treatment of the patient. Climatic conditions have to be taken into consideration if the results are obtained at a different time or under

different geographical circumstances. The influence of the menstrual cycle has to be taken into account if it is expected that this factor may have a bearing on the results. There are also some other factors which should not be overlooked, as, for instance: kind of food consumed, puberty and menopause, possible presence of mental, psychoneurotic or personality disorders, alcohol and nicotine abstinence or abuse, sexual life, etc. These factors may influence the effect of therapeutic procedures applied. To make the group studies completely homogeneous to the control group is an almost impossible task and that is the reason why investigations in this field are extremely difficult.

It is necessary that during the period of observation the possibility of subjective recording be excluded. As a measure of safety in this regard, it is considered better if the recording is done by persons who are not acquainted with the aim of the investigation.

When analysing the results, the statistical methodology of variation has to be considered. Tests of a statistical significance on the results have to be given in all cases. Correlation methods have to be applied as appropriate.

From this short outline on how to carry out statistical investigations in this field, the conclusion may be reached that a statistician has to advise and co-operate in the undertaking from the beginning to the end. It may, however, not be superfluous to emphasize that the explanation and evaluation of the results can never be done from a statistical viewpoint alone, although formally that may be fully correct. It should not be forgotten that medicine is not an exact science like mathematics. Only much subtlety in thought and a good medical knowledge of the subject in question may ensure the proper evaluation of the results.

## 2. Measurements of the efficacy of treatment

The measurements most frequently used for this purpose are:

- a) case fatality;
- b) duration of illness from beginning of treatment;
- c) improvement observed in measurable indicators of health status;  
(e.g. number of erithrocytes, haemoglobin, etc.)



- d) re-establishment of physiological functions in diseased organs or parts of the body;
- e) occurrence of relapses and duration of health after treatment;
- f) occurrence of unexpected morbid conditions (complications, damage in certain organs, etc.)
- g) regaining of capacity for work, complete or partial

1) Case fatality (expressed as a ratio of patients who died to the total number of persons treated) was used long ago to demonstrate the advantage of one treatment procedure over another. The conclusion is made that the treatment procedure with the smaller case fatality is preferable. Quite often, however, in reaching the basic statistical conditions which would permit such a conclusion, are neglected. It is often regarded as satisfactory if comparisons are made between biologically homogeneous groups (specific age and sex groups). A whole series of other important factors is neglected, although it is known how important they might be in influencing the treatment result.

Among other factors, it is necessary to single out the fatality rate according to the period of time which has elapsed after the treatment procedure has been applied. This was brought out very clearly when following up the effects of treatment for malignant neoplasms. This fatality rate has to be followed up for years after the therapeutical intervention. A similar situation occurs with regard to the measurement of effects of tuberculosis treatment. In this case, as in many others, the patho-physiological factors are quite different, as in carcinoma; the factors usually treated in the field of social medicine should not be overlooked as they play a much more important rôle after therapeutical intervention in tuberculosis than is the case in cancer. In evaluating the results of a treatment procedure, the length of time elapsing between the end of the treatment and the point of time when the case was followed up and found apparently cured, still alive or dead, has always to be stated.

The case fatality rate is no doubt one of the most important measurements of the efficacy of therapy, because the prevention of death is in many instances the aim of such therapy. In using this measurement, important considerations have to be kept in mind, for

example: has death only been delayed or has it definitely been prevented for this particular morbid condition? With what limitations in the state of health has this been achieved? Without analysing these circumstances, in addition to many others mentioned before, the fatality rate by itself is not a reliable measurement for this particular purpose.

To ascertain possibly significant statistical difference in case fatality rates between two or more series of figures obtained by different therapeutical procedure is not a proof of significance, if the conditions for application of this method have not been fulfilled.

2) Duration of illness is another measurement of the efficacy of a definite procedure. The statement, however, that treatment with procedure "A" took seven days and with procedure "E" twelve days and that procedure "A" is consequently better than "B", is quite unsatisfactory. Quite a number of sources of error are possible. Among aspects as discussed under chapter VIII.1, the period of time between onset of the disease and beginning of the treatment must be considered.

The discussion which took place on efficacy of anti-diphtheria serum may be recalled. Observation of the efficacy of the serum taking into account the period between onset of the disease and time when the serum was given, definitely solved the problem. This time interval usually influences the period needed for treatment and the result of the treatment; it has to be considered in all measurements of efficacy of treatment procedures.

In the measurement of duration of treatment, the difficulty which was mentioned above when discussing morbidity statistics, arises: when does a sickness begin and when does it end. It may perhaps be easier to define the beginning of the disease in an objective way, but the definition of the end is often based on subjective observations. Only when a uniform and objective definition for determining objectively the termination of sickness for all cases observed cannot be found, may a definition based on subjective observations be used. The statement, however, as to whether the disease has ended or not, has to be made by a person who is completely desinterested in the results and who may not even know the therapeutic procedure which has been applied.

Differences in nursing may also exercise a strong influence on this measurement. It is quite natural that patients get better nursing when a procedure preferred by the investigator is applied. This may be the case even if the investigator does not wish it so. Great caution should, therefore, be used to prevent this from happening. Much sophistry, depending on the concrete circumstances of various investigations, has been used to avoid possible sources of subjectivity and bias when using this measurement for evaluating efficiency of therapy.

3) The reconstitution of physiological functions and restoration of health are further measurements of the efficiency of a therapeutical procedure under investigation. Unfortunately no objective indicators of positive health are known and many "normal" values are questionable. To ascertain that health has been regained at a certain date is, therefore, too often a subjective assumption of the observer.

The reconstitution of physiological function (or functions) of the morbid organ (or organs) is the ideal aim of each curative procedure. This reconstitution can be objectively stated in cases where these functions can be measured. Such cases may be: vital capacity of the lung, tested range of sight, tested sense of hearing, electrocardiogram, and others. This is much more difficult if the physiological functions to be observed are those for which no quantitative observations can be made, and there are too many at present. A good knowledge of the physiological functions of the diseased organ might help to find an objective measurement but this depends on the organ. Belonging to this group are those diseases in which the infective agent is no longer found in the diseased organ or organism: here again a strict procedure has to be applied.

4) The occurrence of a relapse and the duration of the restored health can also be a measure of efficiency of treatment. Less frequent relapses or longer periods of time before a relapse and longer periods of health due to the treatment procedure under study can also serve as measurements of the efficiency of the intervention. It goes without saying that the period of health is regarded as the time when the person is not suffering from the disease for which he has been treated. Inter-current morbid conditions should not be considered when the therapeutic procedure under investigation is not expected to influence them, although this may be rather difficult to decide in the case of certain diseases.

5) The absence of undesirable pathological effects connected with the application of a treatment procedure are also a measurement used in clinical statistics to prove in an objective way the adequacy of the efficiency of that particular procedure. The frequency of complications and damage to tissues or organs not otherwise involved, which are caused by the application of these procedures, can be regarded as expressing the quantitative information for that measurement.

6) Incapacity for work because of illness was discussed above as a branch of morbidity statistics. This information extended to cover ~~limitation~~ in the capacity to carry out normal activities can serve as a measure of the efficiency of treatment. One has to be aware, however, that it may be influenced by the subjective feeling of the diseased persons. The proportion of persons with the same morbid condition who regained their capacity to perform their work (or usual activity) may be investigated, as also the average length of time this took after the application of the therapeutical procedure under investigation.

### 3. Clinical trials

For studies within the fields of aetiology, pathology and symptomatology of various diseases, in order to promote knowledge of therapy for these diseases, general statistical methods are used which are found more and more useful in those fields. A special field of statistical methodology is developing under the name of clinical trials.

## IX STATISTICS OF PHYSICAL AND MENTAL DEFECTS

The desire to obtain numerical information on physical and mental defects in the population is very old. The proportion of persons with defects and the type of defects, especially congenital, is of importance in the field of genetics and would be of great practical use in public health work. It is, therefore, comprehensible that questions on the subject are often asked in population censuses. In thirty out of fifty censuses undertaken in the forties and fifties, information was sought on the occurrence of persons with defects or similar conditions.

It is, however, realized that data in this respect obtained from a population census cannot satisfy the needs of health services. Pending the finding of a comprehensive solution to this problem, which is of

growing importance, much more detailed and reliable information is needed than that which can be gathered by population census methods. It is necessary to collect information on physical and mental defects which will describe:

- a) distribution, according to geographical, biological and socio-economic attributes;
- b) factors which caused the condition (congenital, accidental, particular diseases)
- c) possibility of rehabilitation

The data collected during census taking have never given, and cannot give, answers to these questions, even though the census form may include questions in addition to the usual one asking for the nature of the defect. Such additional questions were asked about the duration of the defect (six countries) about the cause of the defect (five countries) and about the capacity to work (fifteen countries). The results obtained were not very satisfactory, as is stated in a United Nations study\*, as follows: "Although data on the physically and mentally handicapped are of great value to a country, the feasibility of procuring accurate data on this topic in population censuses may be seriously doubted".

Enumeration of handicaps in a population census may have a demographic character; the problem, however, is a health problem and it can, therefore, hardly be expected that it can be adequately presented in the results of a population census. It is believed that collection of data of this nature can only be done adequately when professional health personnel make the observations. It is necessary to decide whether the person in question is handicapped by a specific defect as defined in the enumeration procedure. It is also of the greatest importance to investigate the aetiology of the defect found and an opinion has to be formulated as to the possibility of rehabilitation. This task requires co-operation of professional, specialized enumerators and in some cases even of a whole group of such professionals. That is the reason why investigations of this subject come within the field of health statistics, by which a proper methodology has to be found for collection and for analysis of these data. As for many other subjects in

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\* Handbook of Population Census Methods, UN Studies on Methods, Series F No.5, 1954 - Statistical Office of the United Nations

the field of health statistics, the data collected may serve in the first place for an operative action referring to a single individual (individual rehabilitation proposals, hospitalization) and in the second place for further statistical processing.

#### X SANITARY STATISTICS

The aim of these statistics is to provide quantitative information needed on the one hand for directing practical activities for prevention of disease and promoting the health of the population, and on the other hand for discovery of new facts which are of importance for advance of the science of preventive medicine.

These statistics investigate factors which may be responsible for a certain level of health of the population with the aim of discovering the aetiological relations between an existing health status of the population and:

1. physical environment
2. nutrition
3. working conditions
4. living habits and customs
5. means and measures applied for health protection and advancement, and their efficiency

Statistical services organize the collection of necessary data, most of which are produced in preventive health services. Data which are collected by other statistical agencies are used to a considerable extent, for example, housing, schools, air pollution, etc., are utilized in combination with statistics of morbidity and of other fields of health statistics.

The source of basic data are records of various health services and of results of sanitary inspection; they may also be collected from various field observations made in health surveys carried out for this purpose.

##### 1. Physical environment

In the investigation of environment, sanitary statistics are limited to collection of data concerning factors which may influence the health of the population living in that environment. Observations, therefore, refer to: habitation (individual and community), water, excreta and waste

disposal, climate and several other factors. The field observations and the processing of data collected are done mostly by other statistical agencies, which collect the data either as routine procedure or through special surveys for their own purposes. Sanitary statistics must, however, extend their influence so that the related data are collected and processed with a view to their utilization in health analysis. Sanitary statistics have, therefore, a rôle to play in the methodology of housing censuses, water supply services, etc.

## 2. Nutrition

These statistics provide data on the amount of food consumed and the amount of the various components of food, in order to obtain information on adequacy of nutrition in a given population group. In addition, these statistics must produce information in a quantitative, objective way to show how the nutrition under observation is related to the health status of the population. The collection of all these data is liable to a series of considerable errors which may be greatly increased by the difficulty incurred in the proper processing and analysis of the results.

1) There are in general three methods used in these investigations. A rough method makes use of data based on produced, imported and exported food. The weakness of this system which can be used only on a national basis, lies in the fact that data on food production are subject to great error, for many reasons. In addition, the data exist only for certain kinds of foodstuffs, and do not permit analysis according to the territorial and social grouping of the population.

The second method is that of self-recording, carried out in individual households. A member of the household records daily what food has been consumed in the household, and its quantity. This recording is done on special forms according to the instructions received and may go on for one or more months. The effectiveness of this method depends entirely on the conscientiousness and ability of the member of the household who measures the food to be consumed and who does the recording. Many mistakes can arise by this method, in spite of concrete instructions for measuring and recording. Intentionally wrong statements are often made and they cannot be prevented, even by a strong field control organized by the investigator.

Another weakness of this method lies in the fact that it cannot be applied in households with low educational levels nor is it practicable in large population groups which cover, in the proportions needed for evaluation, the various population strata.

The third method makes use of the following procedure: a person trained for this work measures by an exact procedure the food consumed in certain defined households for a period of seven to fourteen days. This collection of information is repeated a few times a year in order to cover the various seasons when it may be supposed that food varies in quantity and composition. The quantity of foodstuffs stored in the household is measured at the beginning and at the end of the period under observation; every day the amount of newly produced and purchased food is also recorded. This method, with various modifications, is very often applied and it is believed to be practicable also when the population does not have a high educational level. In comparison with the other two methods, it is also relatively reliable.

Based on the amount of the various kinds of food consumed during the period under observation, the quantity of the various food components (animal and vegetable proteins, hydrocarbonates, fats, mineral salts and vitamins) is computed. Tables which have already been published and which show the quantity of those components in various foodstuffs, are used. These values can also be established by ad hoc chemical analysis of the food consumed. This method was used before the Second World War and was originally proposed by experts of the United States Department of Agriculture. It has been more widely used since the war.

Obviously, this method too has its difficulties with regard to establishing, in an objective way, the quantity of food consumed, if the household does not objectively co-operate. It can be biased, if the household wishes to hide certain facts regarding its nutrition (over or under-statements). Very meticulous and conscientious work is required of the home visitor. Obviously this method, like the two described above, gives information about the average consumption per person and differences between the various members of the household - which can be considerable - cannot be found.

The possibility of a generalization of the results obtained depends on the selection of households and of localities for the investigation (random sampling of localities in a certain area as opposed to a typical selection of localities followed by a random selection of households).



A source of error common to all these methods may lie in the computation of constituents of the various kinds of food when using existing tables of the nutritive values of food. Those values might have been obtained when analysing various articles of food produced and sold under quite different conditions. The difference existing between the proportion of the various constituents in a certain article of food as shown in the tables and as found in actual chemical analysis, may be quite large. It is, therefore, much safer to use values found by quantitative analysis of the actual food to be consumed. This, obviously, immensely increases the work of the whole investigation.

There are also other methods of investigation but they can hardly be applied in statistical investigations carried out on larger population groups (individual physiological method, and others).

For comparison of results obtained by the second and third methods mentioned above, it is necessary to apply corrections for differences in the biological structure of the population. Correction coefficients have to be used for children, pregnant women, etc. Various ways have been recommended for this purpose.

2) Relation between nutrition and the health status of the population. Information on food consumed per person (in calories or in food components) in the population under investigation has its full value from the point of view of preventive health care, when the status of health is evaluated simultaneously. In trying to establish this relation, a series of difficulties arises, which have to be borne in mind when planning such investigations.

One of the difficulties is the fact that a quantitative or qualitative deficiency in nutrition observed during the investigation may result in bad health a certain time later and the symptoms due to such nutrition may not yet be in existence. This difficulty can be met if observation of nutrition and of health is carried on for a longer period.

Another difficulty is the question of how to estimate the degree of deviation from a sufficient and adequate (in regard to its constituents) diet, i.e. what should be assumed as "normal" in the population under observation. The health of a population group with high nutritional levels

can be statistically analysed separately from a population group showing low nutritional levels. Further distinctions between social and biological groups are necessary in order to obtain reliable results.

The health status can be ascertained with the help of indicators for general and specific morbidity (see chapter "Morbidity") and/or by those symptoms and diseases which are known to be the result of inadequate nutrition. Nutritional status can also be measured by data on height and weight; however, caution is needed here because these measures also depend on other factors which, therefore, must be excluded beforehand; this may be done by proper cross-tabulation of results.

Study of nutrition and its relation to the status of health is one of the most important fields of health statistics and methodology in this field is relatively well developed.

3) Food inspection. Besides the nutritional value of various kinds of food, hygienic quality and sanitary conditions of food are studied in establishments handling food. These studies are related to information on the basis of data received from the following sources:

- a) notifications of cases of food poisoning;
- b) reports from laboratories making chemical and bacteriological analyses of food as a sanitary inspection service;
- c) reports of sanitary food inspection giving information about the quantities of food which have been ordered to be destroyed or prohibited to be sold

Data collected routinely or ad hoc about sanitary conditions in food producing factories serve for immediate operational activities in sanitary inspection and when statistically processed give valuable information for the improvement of conditions under which food is produced.

### 3. Working Conditions

These investigations should demonstrate the effect which a particular kind of work has on the person carrying it out from the point of view of health status and to what extent the preventive measures undertaken for health protection have been efficacious. These statistics are based on

mortality and morbidity data (mortality and morbidity, by occupation, occupational injuries and occupational diseases, incapacity for work). They are dealt with in previous chapters.

These data obtained through current recording and reporting have, for this purpose, to be adapted in order to obtain the necessary additional information on occupations. This information has to be very precise for these investigations. They should not be confounded with the branch of an industry, where the person is working, because workers within the same factory have a variety of occupations which are subject to noxious health influences to a very different extent.

The records are routinely collected in factory clinics or other institutions for medical care of the population groups involved. Routine reporting of health insurance institutions on diseases and injuries of the insured population can give quite reliable data for the analysis of conditions in this field.

Besides current data received from the sources mentioned above, special surveys are very often organized to study the health of the working population in connection with the various kinds of work. The methodology of these surveys, which are usually carried out in order to find a solution to a concrete problem, has to follow the general lines of a field health survey.

Industrial health inspection services produce current data on the results of the inspections carried out. These data can be used for the evaluation of the working conditions existing in a geographical area, in a certain branch of industry or in a certain business undertaking. These data usually serve for immediate action.

#### 4. School hygiene

Statistics in the field of school hygiene are a very elaborate subdivision of sanitary statistics. The subject of statistical observation can be:

- a) the pupil according to his biological, social and health attributes;
- b) the teacher in particular according to his physical and mental health;

- c) school buildings and equipment according to its sanitary and hygienic characteristics;
- d) teaching programme and teaching equipment from the mental health and hygienic points of view

Data on pupils are obtained from the periodic medical examinations of school children, by recording findings on standard cards and then by processing the data for a uniform standard tabulation for selected areas and various types of schools. School clinics register the morbid conditions of school children who ask for medical care when they are ill. These data may give adequate information on sickness incidence. Absence from school because of illness, if checked by home visits, may also give information on the subject.

The processing of results found by systematic health examination provides information to be used for biometrical and socio-medical analyses in connection with the frequency of various morbid conditions diagnosed at the examination. The tabulation should be done for individual schools, and for the same kind of schools by social and biological groups of school children (see chapter V.6.4)

Data on the health of teaching personnel serve primarily for the purpose of immediate action to prevent a harmful influence on the health of school children. An adequate tabulation of the findings and their evaluation may be used also for planning measures to be introduced for the health protection of teachers.

Statistics of school buildings and of their sanitary equipment are collected during specific surveys organized by educational statisticians for this purpose. Sanitary statistics have to be used in preparing programmes for these surveys which have to utilize information obtained from the point of view of health and which relate that information to the results of systematic health examinations and morbidity data.

##### 5. General living conditions and customs

In investigations into living conditions and customs from the health point of view, various social and biological factors are studied, for example, density of population per square kilometre for an area or per square metre for housing, educational level, alcohol drinking habits, utilization of free time for recreation, sexual life, etc.

Data for such statistics are very often collected in surveys of the total population of a given area or of definite population groups of this area, depending on the purpose of the survey. They are usually organized for the planning of social care and welfare. To use these data for an analysis of the health status of the population, a health statistics survey has to co-operate in the elaboration of the programme.

#### 6. Efficacy of preventive measures and means

The methods used in the investigation of the effect of measures and means applied for the protection of health, are analogous to those mentioned in the chapter on Clinical Statistics (efficacy of treatment). The efficiency of health protection provided by application of a certain measure against a disease can be proved by results showing that the population to which this measure has been applied:

- a) does not get ill;
- b) gets ill less frequently;
- c) gets a lighter form of the disease;
- d) gets the disease later

The available measurements are therefore:

- a) morbidity rates;
- b) fatality rates;
- c) form of the disease (light or severe);
- d) duration of the disease;
- e) length of the period from the application of the protective measure to the onset of the disease

These measurements can be used for investigation of efficiency of measures and means taken as protection against a definite disease and they should show a significant difference in values ascertained from the protected as opposed to the unprotected population groups. Observation of a control group is, therefore, definitely indicated. These measurements are most often used for evaluation of various immunization procedures and of chemicals used for prevention of disease. They can also be used to study advantages of one procedure over another. In this case, two population groups are investigated and the results from the application of two different procedures for

protection are compared with regard to the significance of differences in the results observed. The measures of protection which are investigated for various diseases, besides immunization, are for example, hospitalization, isolation, control of germ carriers, disinfection and others. The main measurement in these cases is the difference in frequency of secondary cases when those measures are applied and when they are not applied.

It is much more difficult to study the efficiency of some "general" preventive measures as, for instance, health education, sanitation, improved nutrition, improvements in living standards in general, etc. The question arises here as to which disease or which diseases can be expected to show an effect when those measures are applied and as to which disease or diseases the above mentioned yardsticks should be applied as measurements of efficiency?

General morbidity or still better positive health could be a measurement of the efficiency of those measures, but there is at present no way of reaching the conclusion that differences in general morbidity rates (apart from the difficulty of defining general morbidity) found in population groups are the effect of the preventive procedures applied. There are so many other factors concerned which can hardly be isolated and which may be involved in different ways in the morbidity of the investigated and control groups. So-called "positive health" is still less easy to determine objectively with quantitative measurements than is general morbidity. With a well planned field "experiment" some of the difficulties can be partially avoided.

Mortality rates can also be used as a measurement of the efficiency of control measures. This, however, is only the case when rates of specific mortality are analysed for biological and/or social population groups amongst whom those measures have been intensively applied and when the results can be compared with population groups of homogeneous character, where nothing has been done. Even then a high degree of caution and scepticism is indicated.

Each single task in this field of health statistics needs a specific programme which can be worked out in a practical way so as to give reliable results only when all the different factors which play a part in this particular task are considered in great detail.

## XI HEALTH SERVICES AND THEIR ACTIVITIES

### 1. Field of work

The collection of data on the activities of health services is organized for the purpose of obtaining information on the extent and quality of work and on its efficiency. It is also necessary to have quantitative information on various types of health institutions and services and on the personnel carrying out this work.

The kinds of activities performed by the network of health services are: treatment (including rehabilitation), personal health care, sanitation of the environment and of living conditions. Each one of these activities can be carried on in a different way; treatment can be given in a hospital, in an out-patient clinic or at home; personal health care varies also according to the different health hazards to which the population groups are exposed (infants, school children, pregnant women, various occupational groups, etc.) The same is true of various kinds of sanitation. It follows that measurements of the extent of the work, of its quality and of its efficacy have to be different for various activities. This fact decides the whole methodology of the collection and presentation of statistics in this field.

A practicable way of discussing the statistics of health service activities is to discuss them according to the various types of institution and services. Only the main types of these can be discussed here. The source of these statistics are discussed generally under IV.1.2 and IV.1.3.

### 2. Hospitals

Hospital statistics serve two purposes: the first one is to study morbidity and the second to evaluate the facilities, expenditures and services rendered. Subjects on which data are collected are in the first case the hospital patient and in the second, the hospital facilities and the work carried out. Consequently, a distinction can be made between hospital morbidity statistics and hospital administration statistics, although obviously some characteristics of hospital patients have also to be included in hospital administration statistics. Statistics regarding morbidity have already been discussed in chapter V. This chapter, therefore, deals only with hospital services and their activities.

1) Facilities, personnel and extent of work. The chief aim of these statistics is to provide information on the extent of hospital facilities. For this purpose, besides information on the number of hospitals, data are needed on the number of hospital beds according to the medical specialties for which they are available. A distinction has to be made between all available beds and "standard" beds. Beds are counted as standard beds if they fulfil definite conditions laid down by specific regulations of the country (e.g. having a definite surface in a ward room). No international standards exist in this respect.

For the comparison of hospital facilities, the number of hospital beds is shown in relation to the population which may utilize them. This can be shown preferably by the number of population per hospital bed or by the number of beds per 1 000 population. These data are supplemented by the average number of beds occupied per day. This information, with the additional figures of number of persons to whom admission has been refused because of lack of available beds, gives a basis for a conclusion regarding the sufficiency of the hospital facilities for a given population.

Data on the number of various types of health (and also of administrative) personnel are necessary for the evaluation of existing conditions with regard to sufficiency of hospital staff. These figures are brought in relation to the number of existing beds or better still to the number of patients under hospital care, as a daily average. The number of patients with whom a physician, specialist, nurse or other type of auxiliary is occupied per day, is computed. This information is obtained by calculating the average daily number of patients in a ward (from the annual figure of hospital days) and by dividing this figure by the number of various types of professional staff in the same ward (or specialized department in the hospital). In a similar way, information is obtained regarding the administrative staff of a hospital as a whole and of various non-medical departments of the hospital (kitchens, laundry, etc.). When differences among various hospitals are found, the reasons for these differences may be further investigated.

Among others, the following can be used as measurements of the extent of the work carried out:



1. Proportion of population ~~admitted to hospital~~ during during a certain period (usually one year).
2. Average daily frequency of patients and seasonal distribution by month.
3. Distribution of patients according to an established list of diseases.
4. Proportion of patients for whom hospitalization is compulsory (certain infectious diseases).
5. Proportion of patients by sex and age and by social characteristics to the number of these population groups in the area of the hospital (usually only possible for large administrative units or for a country as a whole).
6. Average daily bed occupancy.
7. Frequency of therapeutic interventions according to an established classification of the interventions in proportion to the total number of patients and to the number of staff involved in a particular kind of intervention.

2) The following can be regarded among others as measurements of the quality of the work carried out:

1. total fatality rate, and more useful still, specific fatality rates (as explained earlier, see chapter VIII.2.1);
2. average stay in hospital for individual diseases or disease groups;
3. number of infections occurring in the hospital;
4. number of post-operative complications by kind of operation per total number of such operations;
5. puerperal infections and complications per number of puerperal cases;
6. number of newborn developing a disease in relation to the total newborn in the institution;
7. proportion of diagnoses, as made during treatment, and findings when a post mortem has been performed, which do not coincide;

8. proportion of patients who left hospital undiagnosed;
9. frequency of various diagnostic procedures per patient (EKG, Rø, laboratory, etc.).

The measurements mentioned here under 1-6 can be used also for ascertaining the efficiency of the work of the hospital. Other measurements for this purpose have been discussed in the chapter on clinical statistics (VIII.2) and are, therefore, not mentioned here.

3) When evaluating the work of a hospital, the question of the "profitableness" of the hospital service may be disputed. This certainly is a complicated problem. It is obvious, although not always realized, that the cost of a hospital day alone cannot be the indicator used for this purpose. It may be, perhaps, better to put the question in this way: how should one decide whether this cost is economic, i.e. whether the per day cost is too high or reasonable. It is not a good procedure for the evaluation of the cost per hospital day to compare it for various hospitals and to conclude that hospitals with a low cost are those that economise the best. A low cost must have as its result longer treatment and delayed restitution of health if it "economises" with expensive but otherwise more efficient drugs and therapeutical procedures. A low daily cost achieved by such "economy" can definitely not be evaluated as a low cost. A further step forward can be made by breaking down the cost of a hospital day into its components: food, heating, etc. (so-called "hotel costs"), drugs, laboratory, salaries for professional or administrative staff etc. In this way, information may be obtained on some components of the cost and it is possible to see whether much is spent on food, heating, etc.

Objective and true information on the economy of hospital work could be obtained from data on deaths that were prevented, days of work capacity gained, shortened length of treatment. It is impossible to obtain these data from routine hospital statistics and, therefore, it is impossible to follow up the economy of hospital expenditure, as can be done for the extent, quality and efficiency of its work. It is, however, possible, with special investigations for this purpose, to obtain some insight into the problem. It can be useful in this respect to study expenses incurred in treatment of a disease at home or in the out-patient department and to correlate the results with hospital treatment.

### 3. Out-patient clinics

What has been said regarding the ascertaining of hospital facilities is of value in a similar way also for out-patient clinics. The work of these institutions can be evaluated by the number of general and specialized clinics, the number of physicians, the number of medical posts in these institutions and of working hours, all in relation to the population for whom these services are available. The accessibility of these institutions (from the transport and economic points of view) has also to be considered.

1) The following, among others, can be used as measurements of extent of this work:

- a) relation of the number of first medical examinations of sick persons to the number of population (or population group) covered by the service;
- b) relation of the number of all visits of sick persons to the institution (first and subsequent) to the population (as above);
- c) average number of medical examinations per working hour;
- d) seasonal variations in daily number of examinations;
- e) distribution of persons examined, by disease (according to an established list);
- f) number of various kinds of therapeutic intervention (according to an established list) by disease in relation to all patients;
- g) number of home visits made per staff member of the clinic;
- h) proportion of persons examined from various population groups to total number of the population of these groups (e.g. those covered by social insurance, school children, infants, etc.)

2) Practical measurements for the quality of work in out-patient clinics can be:

- a) the relation of first examinations to total number of examinations as a whole for individual diseases or disease groups;
- b) the proportion of undefined and ill defined (symptoms) cases to all patients;

- c) the proportion of patients sent to hospital for further treatment to all patients, the proportion being shown for individual diseases or disease groups and for various social groups;
- d) the proportion of examinations by specialists to total number of examinations;
- e) the number of home visits made (follow-up) per patient;
- f) the relation of specific diagnostic procedures applied (Rtg laboratory, etc.) to number of first examinations

For measuring the efficiency of these clinics, reference may be made to chapter VIII.2, with the addition of what has been discussed in the chapter on incapacity for work and on injuries.

#### 4. Dispensaries

Data on mortality and morbidity for a population under the care of a dispensary indicate the particular health problem with which the various types of dispensaries are actively concerned.

1) Facilities of dispensary care. The number of dispensaries of a definite type (tuberculosis, trachoma, cancer, etc.) and of personnel working in them can indicate possible needs. This can be demonstrated by relating the number of dispensaries, of professional staff and of working hours of these institutions to:

- a) total number of the population if the dispensary takes care of total population (probably less frequent); otherwise, in relation to the population of a particular biological group (e.g. school dispensary, maternity dispensary) or to a socio-biological group for which the dispensary works;
- b) prevalence of the disease for the control of which the dispensary has been established (e.g. tuberculosis).

2) The extent of work can be measured by studying:

- a) proportion of the population actually under care of the dispensary to the total population controlled by the programme established (e.g. number of tuberculosis cases under control to the total number of tuberculosis cases in the area of the dispensary; or the number of newborn under care out of the total number of births in the area);

- b) relation of first examinations to the total number of the population or population group;
- c) relation of all examinations to the total number of the population or population groups;
- d) average number of examinations per working hour;
- e) seasonal variations in number of persons visiting the dispensary per day;
- f) proportion of persons with morbid conditions (from the field of the dispensary's activities) out of the total number of persons examined;
- g) frequency of therapeutical interventions;
- h) frequency of various specific diagnostic prodedures;
- i) frequency of home visits

3) The measurements of the quality of work vary according to the type of the dispensary. They are in general related to two fields:

- a) the regaining of full health or rehabilitation; in this field the measurements listed in the chapter on clinical statistics can be applied (this can be used for dispensaries engaged in the control of a particular disease or disease group);
- b) the methodology or work carried on by the dispensary; here can be listed:
  - number of first examinations in relation to repeated examinations;
  - number of home visits per case under supervision;
  - number of diagnostic and therapeutic procedures per case under supervision;
  - increase in the proportion of persons under supervision in relation to the total number of population needing supervision.

The efficiency of dispensary services is measured by the decline in morbidity, i.e. in the incidence of the disease (or diseases) which the dispensary is controlling. Dispensaries which give medical care or take preventive measures in a definite population group can evaluate the efficiency of their work in terms of trends in the morbidity or mortality

from that disease of that particular population group or in the changing pattern of the morbid condition, which means a decline of the morbid conditions against which the dispensary's activities are particularly directed. A conclusion about its efficiency can thus be reached when the extent of work and morbidity trends are observed concurrently, and when an increase in the extent of work is followed by a decline of specific morbidity to which that work has been directed. It is obvious that many other factors involved in morbidity have to be carefully considered; caution should, therefore, be exercised in investigating the correlation between the extent of work done and the trend of morbidity.

#### 5. Control of acute infectious diseases

In activities regarding control of acute infectious diseases, the specific work to be measured, among others, concerns: immunization, isolation, hospitalization, supervision of germ carriers, disinfection and desinsection.

Data on cases for which these measures have been taken are recorded and the records serve as source for statistical reports. The records have to be kept up to date, because they form the basis for planning immediate action, when necessary, and often the data are used for tabulation, showing the extent of work.

With regard to measurements, which vary according to the infectious disease in question, the following, of a general character, can be used:

1. the coincidence of reported diagnoses with those definitely established;
2. cases discovered in retrospect during a field survey of an epidemic;
3. the proportion of reported cases out of the actual total number of cases;
4. the frequency of secondary cases;
5. the proportion of hospitalized cases to all cases for which hospitalization is compulsory;

The sources for these data are found either in routine reporting or in special field investigations.

The efficiency of epidemiological activities can be measured in terms of declining morbidity and mortality from the specific infectious disease against which control measures have been taken.

#### 6. Sanitation

Activities in this field are numerous and of a very different character, as follows from what has been said in the chapter on sanitary statistics (X).

The measurements used in this field are, therefore, very diverse. They aim at finding facts on the extent to which objects or persons who should be under supervision, have actually been subjected to supervision and on the extent to which hygienic standards have been achieved or hygienic conditions improved (e.g. improvements in school hygiene, improvements in sanitary conditions at places of work, etc.)

Obviously the measurements of the quality of work are also different in the various fields of these activities. These measurements should, in general, show the decline in the frequency of conditions considered as deficient from the point of view of hygiene (e.g. the declining proportion of samples found as deficient in laboratory analysis, the declining proportion of cases filed because of unsanitary conditions found during inspection, etc.) In other instances, measurements are used to demonstrate the improvement of conditions of hygiene in the field in which sanitation has been extensive (e.g. increased proportion of the population having a hygienic water supply).

From the point of view of efficiency, sanitation has to have a favourable effect on the morbidity and mortality of those diseases which are supposed to be influenced by sanitation (e.g. typhoid, after the introduction of a hygienic water supply).

### XII ORGANIZATION OF HEALTH STATISTICAL SERVICES

#### 1. General principles

The field of work of health statistics is very wide and heterogeneous. When comparing it with other branches of statistics, it can be said that in no other branch, except for economic statistics as a whole, are the investigations and pattern of statistical analysis so manifold.

A special feature of these statistics, which has always to be considered, is, first and foremost, the immediate use of individual data for the operative work of the health services and then for statistical processing again serving promotion of health on wider scale. The collection of data is, therefore, very closely connected with the functioning of health institutions and services.

Another important characteristic of these statistics is the need of each individual health institution collecting these data to have a statistical analysis made for its own purpose, in order that its work may be properly directed. This is the best way of observing the effect of its proper work. In this respect, health statistics differ from many other branches of statistics. The health service itself is the main user of these statistics, right from the smallest institution and continuing up through community, city and regional health services to the central authority, where the main outlines of health policy are framed and where the basic forms of health service organization may be laid down and legal regulations issued.

Health statistics have to function as an entity and the services within the field have to follow one single clearly defined methodology; this may not be the case for various other health service activities. There are many reasons for this, the most important being the indivisibility of data needed for proper functioning of a health service. Data on hospital patients are utilized for example, by the services controlling tuberculosis, traumatological services (treatment of injuries), health care for mothers (deliveries) and children (disease of newborn and of children), to the epidemiological services (patients hospitalized for acute infections, etc.) Morbidity statistics are equally of use to the curative and preventive services. Statistics on incapacity for work because of illness are needed for out-patient services, for tuberculosis control, for mother and child care, etc. Health statistics can, therefore, not be separated, for example, into tuberculosis statistics, dealt with by tuberculosis institutions, into maternal and child health statistics, carried out by maternal and child health institutions, into sanitary statistics, handled by various hygiene institutions, and so on. Health statistics form a single indivisible system, which, when divided into parts, would not be able to produce results as they can do if considered and organized as an entity. Such a



division would also cause an overlapping in procedures for collecting and processing the data and would ask for more effort and for more funds. With separation of statistical services, it would be necessary to send original data collected in one institution to various places for processing and a great deal of alike data would be processed in various statistical units.

Professional knowledge, which can be obtained almost exclusively by a broad medical education, is necessary for the establishment of a programme of collection and processing, and for the statistical analysis of tabulated data. It, therefore, follows that the responsibility for health statistical services has to be placed in the hands of medically qualified persons. It is necessary, however, that these persons should have statistical knowledge in addition. It is less advisable for these statistics to be directed by staff having a statistical education only, with additional knowledge gained while working in health statistical services or obtained by some additional education in the fields of medicine and health. A post-graduate acquisition of statistical knowledge for a medically qualified person with a quantitative mind is much easier to obtain and more efficient than to make a statistician "biologically" and "medically" minded by giving him some additional public health course. The basic qualification for a leading health statistician is the right approach to the problems of health statistics and this has to be based on biological, physiological and pathophysiological knowledge.

From what has been said above, the following general principles for the organization of health statistical services can be laid down:

1. Professional health personnel producing information for the use of health statistics must have an understanding of the ways and means by which these statistics are obtained and of the reason for the importance of this work; they should have a basic knowledge of general statistical methodology and of health statistics.
2. Each health institution should have a special unit (in small institutions this unit may consist of one person or even one person part-time) which directs the collection, processing (in small institutions it may be very simple) and statistical analysis of the data produced in this particular institution

and of data from other sources which are needed for the analysis (e.g. population data). The work has to be done under the direct supervision of the chief of the institution, who has to define the extent of the statistical analysis.

3. Each centre (community, district, city, country, region or state) which administers health services or which is responsible for the health policy of that territory, should have its own health statistical unit responsible for collecting data from health institutions and other services. This unit has to process data and to analyse them for the needs of the particular centre. Health statistics units in these centres have to be at a professional level which will enable them to carry out - for the needs of that particular centre - their own health-statistical investigations which are, methodologically, not included in the routine observations of the country-wide system of health statistics.
4. The country as a whole must have one single methodological centre for health statistics. This centre must be legally authorized to organize the collection and the processing of data for the country as a whole, according to uniform methodology. The participation of representatives from the whole country has to be sought for the elaboration of this methodology. In their selection, consideration must be given to the professional medical side, to the public health organization experts and to health statisticians.

## 2. The rôle of health personnel

Without full co-operation of health personnel, no health statistics can be produced in a satisfactory manner.

A specially important rôle is played by medical personnel. A high quality of data is needed for the evaluation of the health status of the population and this depends upon the reliability and precision of diagnoses of morbid conditions recorded for morbidity and mortality statistics. The attitude of medical personnel towards the importance of good recording has its effect also on the work done in this field by nurses, sanitary technicians

and other personnel involved in the collection of data because medical persons are in most cases the chiefs of the services in which this recording is done. Medical personnel are also, or should be, the primary users of these data, employing comprehensive statistical analyses for extending their professional knowledge and for the evaluation of work for which they are responsible. It is, therefore, necessary that measures are taken and all possible efforts made to secure their conscious co-operation in the field of health statistics.

The following obstacles are met with in achieving this co-operation:

1. The minds of medical personnel have an inclination to individual observation and to a subjective formulation of findings resulting from that observation. To a great extent, this inclination is caused by the essential character of medical science and medical education; it must also be borne in mind that the medical profession is built up to a great extent by the selection of persons whose trend of mind is in that direction.
2. Lack of awareness of the usefulness which health statistics can have for them and for the proper organization of efficient medical care and public health services.
3. The medical profession in general does not have any knowledge of statistical methodology and, therefore, avoids any activity in this field through lack of ability.

A curriculum of medical study which would be directed also to awakening and promoting the ability for quantitative thinking and would educate medical students in observing the facts in quantitative terms, may change the generally negative attitude of the medical profession towards statistics. Many medical faculties have realized that statistics can be a useful weapon for the advancement of medical science in the hands of medical workers. Health statistics services at a high level of medical care and prevention require their medical staff to be also in possession of statistical knowledge. In the curriculum of health statistics for medical students, it is important to arouse an interest in and an understanding of quantitative observation, and to make them acquainted with basic statistical methods and their application in the field of medicine and health. More advanced statistical methodology

is not necessary in this curriculum; it may be the subject of free courses for medical students who wish to advance their knowledge in this field. The aim of post-graduate medical education has, however, to be considered quite differently and the extent of statistical teaching will depend on the scope of a particular post-graduate course.

Besides a proper curriculum for medical students, it is a condition for the success of each concrete statistical investigation that the active co-operation of the medical profession be sought; without close co-operation of any medical staff who may be involved in such an investigation, the whole undertaking will be a failure. To ensure this co-operation, it is necessary:

1. that personal contacts be established with the medical staff of the area or of the institutions where a statistical investigation will be undertaken;
2. that the aim of the action be explained to them;
3. that the usefulness of the information be obtained from the medical staff of the area or of the institution be shown;
4. that the part of the work to be done by doctors be limited to recording only, when their participation is unavoidable; a clear explanation of the procedure to be followed has to be given to them; they should not be asked to do technical manipulative work;
5. that they be informed of the results of the investigation

When making all these efforts to obtain the efficient co-operation of the medical profession in the field of health statistics, the fact has to be borne in mind that the medical profession at present does not have a great liking for anything connected with "mathematics". Many doctors have chosen medical studies in order to keep away from anything connected with figures.

The rôle of other types of health personnel is of a different nature, although the co-operation of nurses, midwives and sanitary technicians is necessary. These categories of staff have to carry out quite a number of activities in connection with recording for health statistical investigations and it is a general experience that they can contribute

very much to the quality of the data collected. It is, therefore, necessary that this personnel should have in their curriculum some statistical knowledge. The extent of their knowledge depends on the kind of work they are expected to perform; this may vary according to the legal definition of their duties.

It has been observed that these types of health personnel do very good work in collecting and processing (e.g. coding) data from their field of work; for example, a sanitary technician who has been working in the field of industrial hygiene may do good statistical work in that field. The so-called "logical" checking of the data collected and similar parts of processing can, in many fields of investigation, be done by such personnel. If they acquired an additional statistical education and training, they could also be utilized for the preparation of elementary statistical analyses for various types of health activities and could be responsible for health statistics in smaller institutions or in smaller areas of health administrations. They have, of course, to obtain instructions for their work from the medical profession and health statistics methodological centres. An obligatory course in health statistics should be given to them during their education in schools for nurses, sanitarians, etc. The programme for such courses will depend on the kind of that personnel and on the specific conditions of the country.

GENERAL

MEASUREMENTS IN MORBIDITY STATISTICS

EM/SEM.VHS/11  
ANNEX

Certain Definite  
Morbid Condition

MORBIDITY

MORBID CONDITION (DISEASE)

PERSONS WITH MORBID CONDITION(S) "ILL"

At Definite Point of Time  
(Prevalence)

During Time Period  
(Incidence or Prevalence)

One Condition

More conditions

Existing (Prevalence)

With Condition Initiating (Incidence)

With One Condition

One Condition

More Conditions

One Spell

Repeated

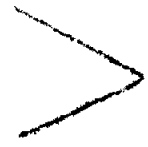
With More  
Conditions

One spell

Repeated

At the same Time

At Different Times



At Definite Point  
of Time Existing  
(Prevalence)

During time period  
(Incidence or Prevalence)

Initiated  
(Incidence)

Existing  
(Prevalence)

One Spell

More Spells

Once

Repeated

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