

Epidemiology for the Health Officer: A Field Manual for the Tropics

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1. THE EPIDEMIOLOGICAL PERSPECTIVE

1.1 A useful definition of epidemiology is that it is the study of the distribution and determinants of health and disease in populations. The purpose of epidemiological methods is to obtain and interpret the information needed to promote health and reduce disease. The basic epidemiological concepts required by the Health Officers are highly practical and need to be understood by the entire health team.

1.2 The most important idea in epidemiology is that of the denominator. It is vital to know about the apparently healthy non-patient as well as the obviously ill patient, and the population at risk of developing a disease problem as well as those who presently have it. The idea of the denominator is key to developing the needed information for health planning, supervision of activities, and the evaluation of health promotion and disease control activities. Every member of the health team should thoroughly understand that his responsibilities extend to those not-yet-sick as well as those already ill. The team must know how many children are to be immunized this month, how many patients are scheduled for leprosy treatment, how many houses are to have residual insecticides sprayed, etc.

1.3 Epidemiologically, the idea of "cause" is that of some factor which when changed results in a decrease in that particular disease. Although many interacting factors may combine to lead to a disease state, the Health Officer and his Team need to focus upon knowing which factors can most readily be changed to bring about a reduction of disease.

For example, the effects of malaria on the population were greatly reduced by the Greeks through draining swamps and building cities on hills. Protection from the bite of mosquitoes was found to be an effective preventive measure before the plasmodium parasite was found. Today, a non-immune traveller visiting West Africa will develop falciparum malaria if a chemoprophylactic drug is not taken; in a sense the non-taking of an antimalarial is an effective cause of malaria. Thus there are many levels of "cause", and effective methods for reduction of disease will change as our understanding of disease processes and the associated socio-cultural-economic milieu advances. The Health Officer/Team should concentrate on those methods which are most effective in their particular situation.

Rarely will the Health Officer or Team be involved in the type of epidemiological studies needed for unravelling the determinants of disease, but they must have the epidemiological knowledge and skills needed to acquire essential health information and to make the best use of it in the conduct of the health care activities under their responsibility.

1.4 Epidemiology is about information: the information needed for health planning, supervision, and evaluation of the health promotion and disease control activities. The key components of the data needed can be approached through a series of questions:

- 1.4.1 WHO? - Who is affected, referring to age, sex, social class, ethnic group, occupation, heredity and personal habits? (These are the person-factors.)
- 1.4.2 WHERE? - Where did it happen, in relation to place of residence, geographical distribution and place of exposure? (These are the place-factors.)
- 1.4.3 WHEN? - When did it happen, in terms of the month, season or year? (These are the time-factors.)
- 1.4.4 WHAT? - What is the disease or condition, its clinical manifestations and diagnosis?
- 1.4.5 HOW? - How did the disease occur, in relation to the interplay of the specific agent, vector, source of infection, susceptible groups and other contributing factors?
- 1.4.6 WHY? - Why did it occur, in terms of the reasons for the disease outbreak (e.g. breakdown of sanitary services)?
- 1.4.7 WHAT NOW? - The most important question - what action is now to be taken as a result of the information gained?
- 1.5 The methods of epidemiology include:
 - 1.5.1 those for the collection of health-related data, namely:
 - (a) appropriate diagnostic tools for numerator data (see Chapter 7);
 - (b) appropriate methods to estimate the population at risk for denominator data (see Chapter 3);
 - (c) appropriate procedures for recording the data (see Chapter 10);
 - 1.5.2 those for the tabulation and analysis of the data to produce the essential information, (see Chapters 11-13), and
 - 1.5.3 the use of this information for decision making and evaluation.

2. THE EPIDEMIOLOGICAL RESPONSIBILITIES OF THE HEALTH OFFICER AND TEAM

2.1 The Health Officer who has responsibilities for the general health of a community cannot confine his work to the consultation room. He has to know the health needs, aspirations and expectations of the people in the community. Only then can the resources of the community be harnessed in the best way to preserve and promote the health of the people.

These responsibilities are much broader than those of a clinician. They extend to the entire community and include the healthy as well as the sick, those not seeking help as well as those that do, and even those unborn or dead.

2.2 There is a fundamental difference in approach between clinical and epidemiological work:

The clinician examines the individual patient and has to recognize and to identify the pathognomonic significance of the clinical signs and symptoms to reach a specific diagnosis in order to prescribe the appropriate treatment.

In contrast, the epidemiologist looks at the population and has to select the diagnostic indicators most suitable for case definition of the diseases in that population. He must pre-select the methods and tests which can be applied for mass diagnosis.

Neither approach is self-sufficient; they complement each other in the overall approach to solving health problems of the community.

Just as a clinician may need to order a variety of laboratory or other special tests after he makes a preliminary assessment of a patient from the routine history and physical examination; so, too, the Health Officer/Team may need to make special surveys beyond the routine data in order to obtain more epidemiological information.

2.3 Basic information needs

Health-related information of various types is needed by the Health Officer and Team for planning, preparing a budget, management, implementation and evaluation of the health care system at all levels. Each level of the system must gather pre-determined information required for its own management and decision-making and summarize selected items for transmission to the next level above.

The process of identifying and describing health problems in a community is sometimes referred to as "community diagnosis", just as "clinical diagnosis" pertains to the detection of health problems in an individual.

The following kinds of information should be available to and known by the Health Team - though in varying degrees of detail in different places - and should serve as the starting point for the provision of the health services for the district:

- 2.3.1 General background information of the area, including something of its history, physical and climatic characteristics, community organization and development, major occupations and activities, economic and political structure and other relevant subjects.
- 2.3.2 Map of the area of responsibility, giving the distribution of households, major roads, important geographical features, such as rivers and major landmarks (see Chapter 3).
- 2.3.3 Vital statistics or at least best estimates of infant and crude mortality rates and birth rates (see Chapter 3).
- 2.3.4 Census of the population - or at least a reasonable estimate of the population size and distribution (see Chapter 3).
- 2.3.5 Demographic characteristics of the population.
- 2.3.6 Information related to health includes (see Chapter 4):
 - (a) Disease information
 - i) Mortality - most common causes of death
 - ii) Morbidity - most frequently diagnosed diseases
 - iii) Distribution of the important diseases by demographic characteristics
 - (b) Health resources
 - i) Health facilities
 - ii) Health personnel
 - iii) Health services
 - iv) Management support from health services
 - (c) Present health programmes
 - i) Pregnancy management (maternal health) data
 - ii) Nutritional assessment
 - iii) Immunization data
 - iv) Environmental health data
 - v) Communicable diseases control programmes.
- 2.3.7 Information is available from a variety of sources. In a few countries the Ministry of Health may have the information already available for each district; in some countries the information may exist but may be scattered in various other ministries or agencies; in many other countries, much of the information (particularly mapping, census, demographic and vital statistics) is not available in a form useable at the district level and therefore the Health Officer and Team will have to obtain the data themselves.

2.4 Data collection

Each country will have its own system of data collection from the peripheral to the central levels. The Health Officer and Team must be familiar with what is required of them and comply with the filling in of the many forms demanded by the system.

Unfortunately, the health data systems of many countries have been characterised by the production of elaborate forms filled in by clerical workers in outpatient clinics and hospitals and sent for processing at central headquarters, often carried out many months or even years later, with no feedback to those collecting the data. The result is vast quantities of largely useless data at a very great cost.

For the most part, the Health Officer will have little say in the number or format of the forms to be used, but he may be able to influence how they are used. It may help to keep in mind that information is needed and information is generated by virtually everyone involved in the system. Information and efficient, timely communication of that information is the very essence, the life blood, of the system. Properly designed forms can be the key to accomplishing such communication.

For the primary health care system, emphasis should be on the collection of the minimum amount of data necessary in the simplest possible fashion. An important principle should be that any data recorded by an individual should be useful to that individual and to his supervisor in the conduct of their duties. The major purpose for the collection of the information is for the management and evaluation of the activities being carried out at that level. The Health Officer and Team should make the best use of the forms they can with these principles in mind.

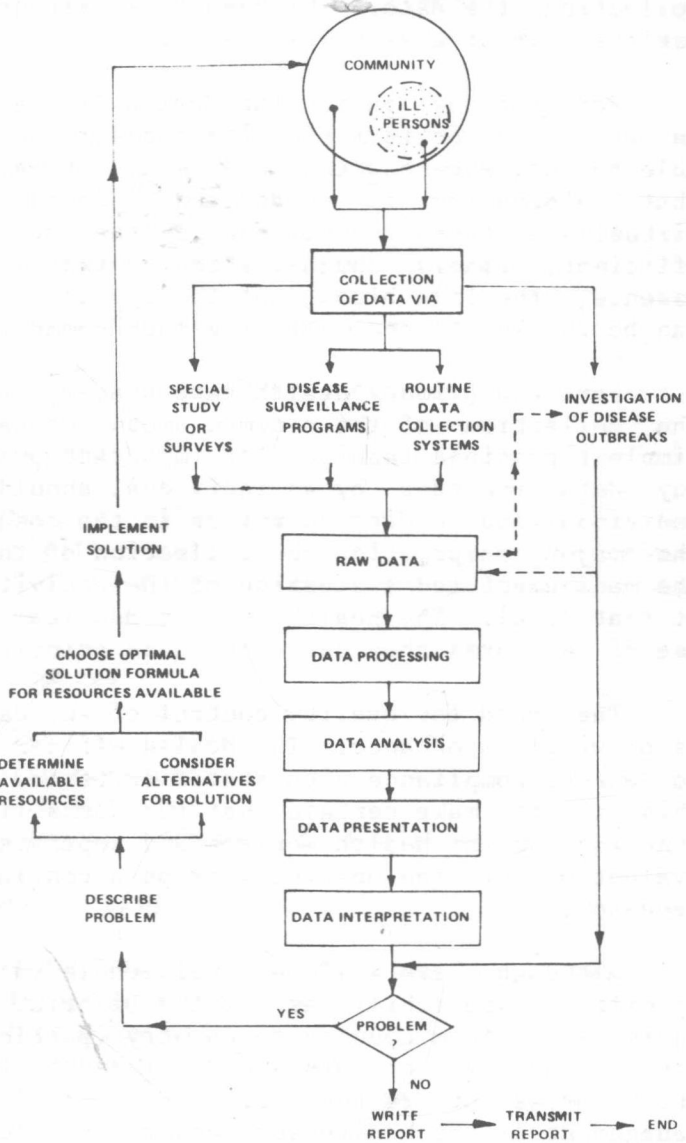
The need for quality control of any data that are collected is of vital importance. The Health Officer must institute checks to ensure compliance with stated criteria. The best way to do this is to make certain that the forms filled serve a useful function for the health workers and supervisor in the planning or evaluation of the ongoing work on a continual basis to ensure feedback.

Although there will be considerable variation in the list of specific responsibilities of the District Health Officer (or equivalent) from country to country (particularly in relation to the size and type of personnel assigned to the Health Team), the broad areas of responsibility will involve the planning and management of the health services to promote and maintain health and control disease in the entire population of the designated geographical area.

To meet these responsibilities the Health Officer will have to have the knowledge and skills needed in order to carry out the following epidemiological activities (Figure 2.1):

- 2.4.1 Assessment of the health status of the population, both currently and on a continuing or periodic basis as the health status changes over time.
- 2.4.2 Evaluation of the effectiveness of the various health improvement programmes on a continuing or periodic basis.
- 2.4.3 Surveillance for specific diseases on a continuing basis.
- 2.4.4 Investigation and containment of disease outbreaks.

Figure 2.1 FUNCTIONS OF A DISTRICT HEALTH OFFICER CONCERNING EPIDEMIOLOGY



3. CHARACTERISTICS OF THE POPULATION

The knowledge of the number of people living in the service area of the health team's responsibility with additional information about them such as age, sex and geographical distribution is necessary for several aspects of planning and evaluation of health services.

3.1 Published sources of demographic data

3.1.1 Report on the census of population

If a population census has been taken recently and the data for the area in question is available, the Census Report may be invaluable. Very often, however, the information is not readily available on a local area basis and other ways to obtain it will have to be explored.

3.1.2. Reports on other studies carried out in your area

A study carried out by somebody else in your area may have yielded population data that can serve the purpose. For example, there may have been an agricultural or economic survey in the area, or a survey in connection with social research. There may also have been studies previously carried out by other health authorities or personnel. The extensive geographical reconnaissance data with mapping and census collected by malaria control programmes can be an excellent source.

3.2 Sources other than reports and publications

Other possible sources of information are the authorities concerned with the provision of other services in the area, for example, hospitals, housing, education, law enforcement, public utilities. Valuable information may be obtained from several socio-economic development schemes carried out by sectors other than health e.g. Ministry of Agriculture and Water Development, Department of Labour and Social Welfare and the Department of Rural Development.

3.3 Assistance in obtaining data

Assistance may be sought from senior officers in the medical and health services, and from research personnel and demographers or statisticians in the government and in universities. It is possible that similar requests for assistance are received from others in other parts of the country, and a programme can be drawn up and co-ordinated at a central or regional level for obtaining population data or updating the information.

3.4 Obtaining demographic data

If the population data needed cannot be found in any of the sources previously mentioned, then the health team may have to obtain them directly.

3.4.1 Accuracy of data

When considering how to obtain the data wanted, it would be well to bear in mind that the degree of accuracy with which population data can be obtained is limited not only by the resources available for their collection but also by the level of socio-economic development and of educational and cultural sophistication of the population itself. Because of the numerous factors that can contribute to inaccuracies of population data, it is very important to have built-in mechanisms for validating various items of information. For example, to elicit information on the number of living children a mother has, one could help verify the information by obtaining the birth order of the children starting with the first born and expecting a pregnancy about every 2 years thereafter in many countries.

To improve the level of accuracy of the information on the various population characteristics, it will be helpful to consider the following examples of various approaches which have been used with some success.

(a) Age

Age is a basic variable that is required for almost all studies. It may be also one of the most difficult variables to ascertain accurately.

In situations where birth records are not kept age sometimes may be estimated according to a calendar of notable events that occurred in the village. In such a situation a person's age could be estimated by asking:

"How many seasons after the earthquake were you born?"

If the year when the earthquake occurred is known, the age of the person can be estimated with some degree of accuracy.

A more precise method of estimating age for those in the younger age groups is sometimes required. For those in the age range of 6-24 months, age can be estimated from the formula below, provided there was no severe calorie protein malnutrition in the child:

Age (in months) = 6 + number of erupted teeth.

Sometimes the concepts of age differs in different cultural societies. Most people give their age based upon that on the last birthday or that at the next birthday. This will give an estimate of the number of years the individual has lived. The more traditional Chinese, particularly those in the older age groups, calculate their ages according to a different system. Thus on the day a child is born he or she is considered to be already one year of age. In a previous study, a researcher has examined the percentage of persons classified in a different age group based on information obtained in two successive interviews: 43% of those enumerated in a study in Ghana in 1960 were classified in different five - year age groups in the two interviews, with

older age groups being more inaccurate than younger ones. One form of age error which is very widespread is a tendency to round off ages to numbers ending in certain preferred digits at the expense of other (and avoided) digits, a practice known as age heaping. In the Malumfashi area, despite the existence of civil registration from the 1950s, very few birth certificates were available. The researcher was forced to estimate age through the use of a calendar of local events. Such an age calendar may reduce age heaping without improving the overall distribution, but it was considered worthwhile adopting for the determination of age. Furthermore, in Malumfashi men wished to seem older as this brings more prestige, and for the same reason the men had a tendency to want their wives to seem younger. Inaccuracies in the ages of the women are particularly unfortunate as most of the retrospective analyses depended on this information. In order to avoid the distortion of the age structure which may arise from wrong information about age, it might be better to group such populations by five or ten-year age intervals e.g. 0-4, 5-9, 10-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65+ etc.

It is therefore important that strict criteria be used when recording age to specify, not only how age is to be calculated, but also to mention the source of information (e.g. birth certificates or notable events etc.).

(b) Sex

This is another important epidemiological variable to record because of the different physiological and behavioural patterns in the two sexes. Marked differences in the sex composition of the survey population could result in differences in your survey results. For example, Muslims in Hausaland practise strict seclusion of their women. This phenomenon posed major problems for the demography study and medical studies in Malumfashi, where seclusion seemed to be applied particularly rigorously.

(c) Ethnic group

People in the same ethnic group tend to have similar social and cultural practices. Such practices could result in either the increase or decrease of disease prevalence in that particular ethnic group. Therefore, it may be important to study different ethnic groups and to understand their particular socio-cultural patterns as this could provide clues of how disease may be minimized in the community.

(d) Marital status

Problems exist regarding the precise definition of what is meant by a 'married' or 'separated' state. Such definitions vary considerably. Often such distinctions in marital status do not play as important a social role as they have in traditional western society. A thorough understanding of the population and of its customs and life styles is thus important, for this will help to decide

whether to include such variables in the study or not.

(e) Occupation

In obtaining information about the person's occupational status, decide whether the present or past occupations is to be recorded. For example, a person could have recently started his present job but worked for the last 10 years in totally different occupation. Sometimes, it may be more useful to record the occupation in which the person has spent the longest duration rather than his present occupation. A worker could have spent the last 15 years working in a granite quarry. Then if as a result of silicosis he is unable to continue in his demanding job, he obtains employment as a watchman. If your study on silicosis records only his present employment, you would find it difficult to understand how a watchman in a primary school had silicosis. The change of occupation from one season to another is also a common occurrence in rural areas. Some villagers may do farming during the rainy season and fishing after the harvest. The possibility of exposure to more than one risk has therefore to be kept in mind.

(f) Other variables

Other variables like parity, religion, social class, place of residence and mobility may be required. In both enumeration and registration the location and duration of stay of nomads can pose some difficulties. Village heads rarely know the whereabouts of all the nomads in their village areas. A problem encountered in some parts of Africa is that the men leave their camps early in the morning to follow cattle and, though the women were not secluded, they were not permitted to mention their husbands' names. The enumerators in a study side-stepped this problem by the use of a comprehensive list of personal names which they ran through. It is necessary to adapt your methods to the local context and the requirements of your study.

How accurate and complete must population data be, before they can be useful? It depends really on the purpose to which they are to be put. Sometimes even very rough estimates may be good enough for the purpose at hand; if so, resources can be wasted on efforts to obtain more accurate data. In any case, data are rarely useless simply because they are not absolutely accurate.

In general the more developed the medical and health services are, the greater will be the need for more accurate data for planning and evaluation; and at the same time, the easier it will also be to obtain data more accurately.

The target in terms of accuracy can never be 100%. However desirable this may seem to be, it is in practice neither possible nor necessary to attain this degree of accuracy. The target in practice should be two-fold; firstly, to obtain the data as accurately as needed, given the resources available; and secondly, to obtain some estimation of the nature and extent of

inaccuracies in your data, so that this can be taken into consideration when the data are used and interpreted. It is at least as important to try to estimate what inaccuracies are present as it is to try to obtain data as accurately as possible.

3.4.2 Collection of data

Demographic data can be obtained at different levels.

- (a) Through ongoing programmes.
- (b) A sample household survey.
- (c) A complete census.

(a) Population data collected through ongoing programmes

Data about the number of persons and their birth-dates and sex are obtained for all households which are in contact with the health authorities in connection with ongoing programmes. Information already on file is updated at subsequent contact. In this way a household file or register is maintained, in which data are correct and up-to-date. However, no information will be available on those not in contact.

(b) Sample survey

Sample surveys are rarely, if ever, conducted for the sole or even primary purpose of collecting data on characteristics of the population. They usually take the form of morbidity surveys done for the purpose of measuring the prevalence of specified diseases. Such surveys have been discussed elsewhere but it may be noted here that population data may also be collected in the course of such surveys.

(c) Population census

The main components of a census operation are mapping and enumeration, carried out in that order. The following examples illustrate how these might be carried out.

(i) The Malumfashi endemic diseases research project

In the Malumfashi Project on endemic disease in Nigeria, maps were required before enumeration could commence. Because of the inadequacy of existing maps, basic maps at a scale of 1:20 000 were derived from recent air photography. These were then checked in the field when households were assigned numbers, and compounds which had been omitted on the base map were added while those which had been abandoned were deleted. Such maps served the purpose for scattered settlements while large scale plans were drawn for compact settlements.

The enumeration questionnaire used in Malumfashi was similar to that used at Machakos, which was a slightly modified version of the form designed by Blacker for the 1969 Uganda census. This census incorporated a number of questions on survivorship, fertility and mortality from which vital rates could be estimated by indirect methods.

The first half of the enumeration questionnaire used at Malumfashi sought basic information on age, sex, residence, etc., as in any census. The second half consisted of more involved questions on survivorship, fertility and mortality. The main sections of the questionnaire were as follows:

- Each individual was identified by name, discrete sample number and geographical location. The construction of individual sample numbers intentionally involved elements of location so that the number alone provided a guide as to where individuals were resident.
- Data was collected on residence. For demographic purposes it was essential to distinguish between residents and visitors when defining the population. As enumeration was carried out over some months, a de jure definition of population was used, i.e. the population that comprises all persons usually resident in the defined area.
- The date of birth and sex of each individual were noted. It was intended that the date of birth should be accurate to the month for children under five and accurate to the year from age five onwards.
- Cultural group, and stated religion were recorded.
- Marital status was also noted for each individual.
- Questions were asked on the survivorship of parents, first spouses, oldest siblings, and deaths in the household during the previous 12 months were recorded, to provide estimates of mortality.
- Females aged 12 and over were asked questions about the number of births they had had, and also about their most recent live birth and whether the child survived or not. Fertility rates and infant/child mortality rates can then be computed from this information.

(ii) The Danfa Project

Although maps are essential they need not be detailed. The basic requirement is siting the houses or compounds as accurately as possible in relation to the surrounding countryside.

The approach adopted was to train six field interviewers who had a suitable background in map reading and draughtsmanship. A two-week course was organized under the direction of an experienced technical officer from the Survey Department. During the training, the principles of map reading, the use of the compass, scaling and the conversion of field sketches into village and hamlet maps were emphasized. Following the classroom instructions the trainees were given an opportunity of mapping a nearby village in order to practise the various procedures.

When sufficient proficiency was gained, the mappers started work in the project study villages after the usual introductions to the village leaders. The mapping team worked together in one village at a time. Working in pairs, they usually started with the chief or village headman's house. One of the mappers began by pacing the distance between the house and the next one while the other took the bearing of the house in relation to the next one. The next pair of mappers then continued from the second house in a fixed direction to sketch the relationship of the next two houses. A third pair of mappers followed the others and painted a square patch with a white paint on the front of the house on an easily visible spot but also one protected from the rain. Using a black paint, a house number was written on the white patch. The numbering was done systematically in a fixed direction at a time, usually starting with the chief's house as number one, until all the houses in the village had been mapped and numbered. In addition to the dwelling units, structures such as latrines, water sources, grain barns and public facilities such as churches, market places and schools, were indicated.

The mapping team usually preceded the enumeration team by about one week. The enumerators and their supervisors followed the mappers and listed the members of each household, a household being defined as a group of villagers living in the same house who ate from one cooking pot. There were eighteen enumerators and three supervisors. It took the entire team ten weeks to complete the mapping, numbering of houses and enumeration of the members of the households in a study area with a population of 10 000.

3.5 Data on population growth

Within any defined geographical area and period of time, the population increases or decreases as a result of the numbers of births and deaths that take place, as well as the numbers of movements of people into or out of the area. The excess of births over deaths is referred to as "natural increase" and the difference between the number of immigrants and emigrants is "net

migration".

It is possible therefore, at least in theory, to keep track of population growth in your area by having some means of recording or estimating the amount of net increase and net migration that has taken place over a specified time. In practice this is rarely possible, either because part or all of this information is not available, or if available, they do not relate specifically to your area in question.

Estimates of population growth at the local level of service areas are therefore usually derived from data on the size of the population at 2 or more points in time.

The simplest way of estimating population growth is to obtain the difference between these population sizes at 2 points in time and then to divide this difference by the number of years' interval between them. This yields the average growth in number of persons per year.

Example: If the population in your area was estimated to be 7 830 on 31 March 1975 and 8 450 on 30 September 1979, then the average increase per year is estimated to be $(8\ 450 - 7\ 830) \div 4.5 = 138$. Having got that, you can then estimate the population on 30 September 1980 to be $8\ 450 + 138 = 8\ 588$.

This method assumes that the increase in number of persons per year is constant. When used for projection over a longer period of time, this method tends progressively to underestimate the future population, since populations tend to grow at a constant rate of growth rather than at a constant absolute increase per year.

3.6 Data on births and deaths

In looking for data on the numbers of births and deaths that occur in your area, similar considerations apply as for data on population. That is to say, look first for available data from published or unpublished sources and from records for ongoing programmes before embarking on any new programme for collecting vital statistics.

3.7 Illustrative examples

In Annexe C are 9 illustrative examples that demonstrate a variety of issues that have arisen from actual field situations concerning the collection and analyses of epidemiological data.

4. COMMUNITY DIAGNOSIS

- 4.1 The assessment of the health status of the community is the basis both for planning and for evaluation of the health services. There are many components of health which can be measured in varying degrees of detail; but because there is a considerable cost in resources and time in obtaining such information, it is very important that the Health Officer/Team select those components that are most useful in the planning and evaluation of their work.

Although much data routinely available from most health systems may seem of little value, useful information needed for making decisions can often be obtained, not so much from detailed or elaborate analysis but rather by looking at the data in their proper context (Figure 4.1). For example, if in a report of an outbreak of a dozen jaundice cases in a community the medical officer notes that there were 2 or 3 deaths, then that is a good indicator that the problem may be yellow fever and not hepatitis. A general increase in reported diarrhoea in older children or adults from a community may herald a cholera outbreak. The best use should be made of any data collected. The Health Officer/Team are in the best position to put locally collected information into its context.

Much information can be obtained concerning the frequency and distribution of morbidity, mortality and their causes from routine sources:

4.2 Mortality Information

- 4.2.1 Mortality data are based on death registration (number and distribution) and death certification (cause). In most developing countries a large fraction of deaths are unregistered, and death certification, often of doubtful accuracy, is generally limited to patients who have been hospitalized. In Ghana, for example, only 12 percent of estimated deaths were certified by cause. Further most were urban, middle-aged adults, and tended to be relatively well-off, reflecting the heavy biases of selection that exist amongst those hospitalized. There was a great under-representation of rural people, infants, the elderly and the poor. Knowing these biases, however, such information can provide some idea about the major causes of death. The information is rarely available on a district level, however, and the Health Officer/Team will likely have to extrapolate to make estimates for their population.

- 4.2.2 Another source of information available in some countries is from special samples of the national census which can provide age and sex specific death rates sometimes by state or region. These rates are likely to be far more accurate than those from registration, but they provide no information concerning cause of death.

4.3 Morbidity Information

- 4.3.1 Data about morbidity help to complete the measurement of ill-