Short communication

EPIDEMIOLOGICAL INVESTIGATION, MONITORING AND SURVELLANCE; STRATEGIES IN PUBLIC HEALTH SUSTENANCE

ABSTRACT

Epidemiological investigation, monitoring and surveillance of threat to public health are essential capabilities necessary for maintenance of an effective public health system. International Health Regulatory bodies require countries to maintain an organized and well coordinated national system for public health surveillance, response and monitoring, and make provisions for the main capabilities that a country should achieve. Laws concerning public health typically produce a comprehensive list of "notifiabe diseases" and certain conditions health care providers or scientists, hospitals and laboratories are required to inform the concerned public health authority. Generally, notifiable diseases are infectious diseases that quickly spread through an entire community and region through food, water, physical contact with household pets, via mosquitoes bite, airborne droplets or through sexual intercourse and other forms of physical interaction. Regular clinical and laboratory-based surveillance systems may not include rare and new events. An outbreak of a serious or contagious disease may require an immediate investigation so that an appropriate emergency public health measure which include an immediate isolation as well as contact tracing can be implemented. Stigma may be attached to certain diseases. Notifiable disease laws should ensure confidentiality of personal information, and should define clearly any exceptions. Concerns about discriminations and violation of privacy may be addressed properly by requiring certain diseases to be reported to relevant authorities on an anonymous or non-identified basis.

Key words: Monitoring, Surveillance, Investigation, Health, Public

INTRODUCTION

From the words of Rudyard Kipling (*1865-1936*), -"Six honest men taught me all I know, they include *what*, *where*, *when*, *who*, *why* and *how*. Epidemiology, according to Rudyard kipling, should; Define *what* will be studied, Find out *where* the problem is, *who* gets it, *when* it is occurring, Try to explain *why* the problem has such a distribution, Do specific studies to find out *how* the problem is occurring. The word epidemiology is coined from '*Epi*-'which means upon, among; '*demos*-'for people; and '*-ology*' meaning science or study of. One major threat to human existence is the onset and spread of diseases [1]. The prevention of onset and spread of diseases should be prioritized in other to assure sustenance of environmental health [2]. It is of immense or utmost importance that the distribution and determinants of human health and

disease conditions that define a population is studied and analyzed. Epidemiology should be the main or primary focus of public health. If humans lack the required tools to determine the-'who', 'when' and 'where', in relation to a given health condition, it will be a difficult task to develop mechanisms against such environmental challenges [3]. According to the World Health Organization (WHO), epidemiology, studies determinants and distribution of health-related states or events and the application of this study to the control of diseases and other health problems. It is the use of scientific methods for disease investigation [4]. It combines both biostatistics and medicine [1]. It is the study of how often diseases occur in different groups of people with aim of providing answers to questions like-'why is a disease more frequent amongst certain group of people? [5] From epidemiological investigations, an epidemiological information is derived and this information is used to plan and evaluate possible strategies that will serve as prevention mechanisms against illnesses and as a guide to the management of patients in whom diseases has already developed [1]. Epidemiological investigation includes all the procedures required to determine the relationship in terms of how often and why is a particular disease so common within a given population [5]. The goal of Epidemiological investigation is to control an epidemic and to prevent future epidemics attributable to the same or related causes. The specific objectives of an investigation are to define the parameters of the epidemic (i.e., time of illness onset and conclusion of the epidemic, number of cases, and morbidity and mortality), to identify control or prevention measures, and possibly to identify new data relative to the epidemiology of the health problem. Epidemiological investigation are always performed collaboratively with partners domestically or internationally [6].

OBJECTIVES OF EPIDEMIOLOGICAL INVESTIGATIONS

The main aim of epidemiological investigation is to derive information concerning the distribution and determinants of health [3], diseases and injury in human population and the application of this information to the control of health problems [5]. The objectives of investigation in epidemiology include;

- ✓ To investigate the etiology of disease and modes of transmission
- ✓ To determine the extent of disease problems in the community
- ✓ To study the natural history and prognosis of disease
- ✓ To evaluate both existing and new preventive and therapeutic measures and modes of health care delivery.
- ✓ To provide a foundation for developing public policy and regulatory decisions.

FEATURES OF EPIDEMIOLOGICAL INVESTIGATION

A key feature of epidemiological investigation is that the measurement of the disease outcomes must be in relation to a particular population at risk [6]. The population at risk in this case, is the

group of people, healthy or sick, who would be counted as cases if they had the disease investigated for. For instance, if a public health scientist were to determine or statistically evaluate how many patients visit a particular health center with complaints of gustatory defects, the population at risk would comprise those people on the list, and also, those who have a tendency of seeing him if they had similar problem. John snow (*1813-1858*), an English physician and modern day father of epidemiology, used scientific methods to identify the cause of an epidemic of cholera in London in 1854. He believed that it was the water pump on Board street in London that was responsible for the disease. The removal of the pump handle ended the outbreak of the disease. Another feature of epidemiological investigation is an epidemiological approach. Epidemiological approach, are strategic steps taken to investigate a problem or disease etiology [3]. They include;

- ✓ Perform an initial observation to confirm the outbreak
- ✓ Define the disease
- ✓ Describe the disease by time, place, and person
- ✓ Create a hypothesis as to the possible etiologic factors
- ✓ Conduct analytic studies
- ✓ Summarize the findings
- ✓ Recommend and communicate the interventions or preventative programs

They also include;

Conduct field work which includes

Perform initial observation of suspected condition, Establish the existence of an outbreak

Verify diagnosis of such disease, Collect data.

Define disease;

Establish case definition, Identify all cases, Identify the population at risk, Describe disease by time, place, and person, Plot epidemic curve, Plot spot map, Tabulate data of exposure and other characteristics.

Develop hypothesis;

Hypothesis (Alternative and null): exposure to ***x*** is associated with disease ***y***, Conduct analytic studies.

Use appropriate analytic studies;

Calculate measures of risk

- ✓ Refine hypothesis
- ✓ Conduct additional studies if needed
- ✓ Summarize findings
- ✓ Recommend and communicate interventions or preventative programs

STAGES OF EPIDEMIOLOGICAL INVESTIGATIONS

Epidemiological investigatory techniques have a primary objective of at least making descriptions and quantifications of disease problems and evaluating possible associations between determinants and diseases [6] [7]. With these objectives noted, epidemiological investigations are usually conducted in phases or series, which are broadly enumerated as follows:

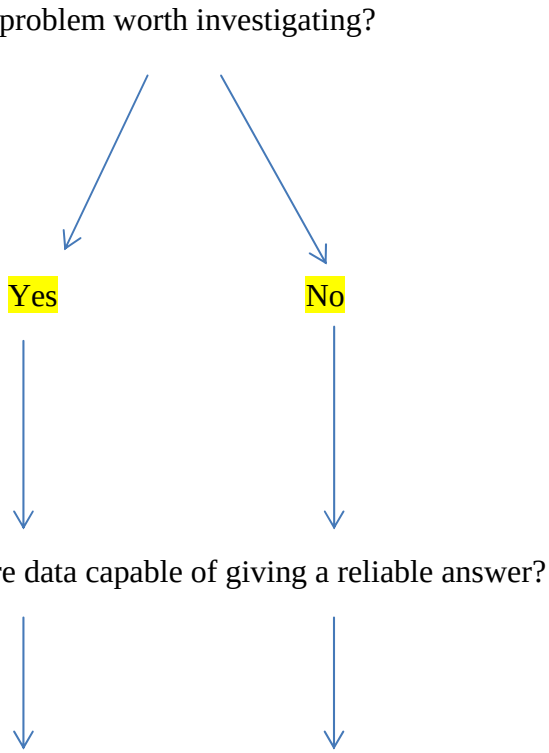
- ✓ A phase for diagnosis; for confirmation of the presence of the disease.
- ✓ A phase for descriptive analysis; with respect to the disease or infestation, it describes the distribution of the disease and the populations at risk, both in space and in time, within these populations. This allows different scientific guess or hypotheses to be formed about the probable cause of the disease and their effect on the frequency with which the disease occurs in the population at risk.
- ✓ A phase for investigative approach; which usually concerns the implementation of series of field studies meant to test the hypotheses.
- ✓ A phase for experimental procedures; in which scientific laboratory procedures are done under controlled conditions to test the hypotheses carefully and in detail, should the results gotten from the 3rd phase prove promising, then;
- ✓ A phase for critical and bio-statistical analytics; in which the results produced by the above investigations are analyzed. This is often combined with attempts to model the epidemiology of the disease using the information generated. Such a process often enables the epidemiologist to determine whether any vital bits of information about the disease process are missing.
- ✓ A phase for intervention; in which methods appropriate for controlling disease are examined either under strict experimental situations or in the field. Interventions in disease processes are altered by manipulation of the existing determinants or introduction of new ones.

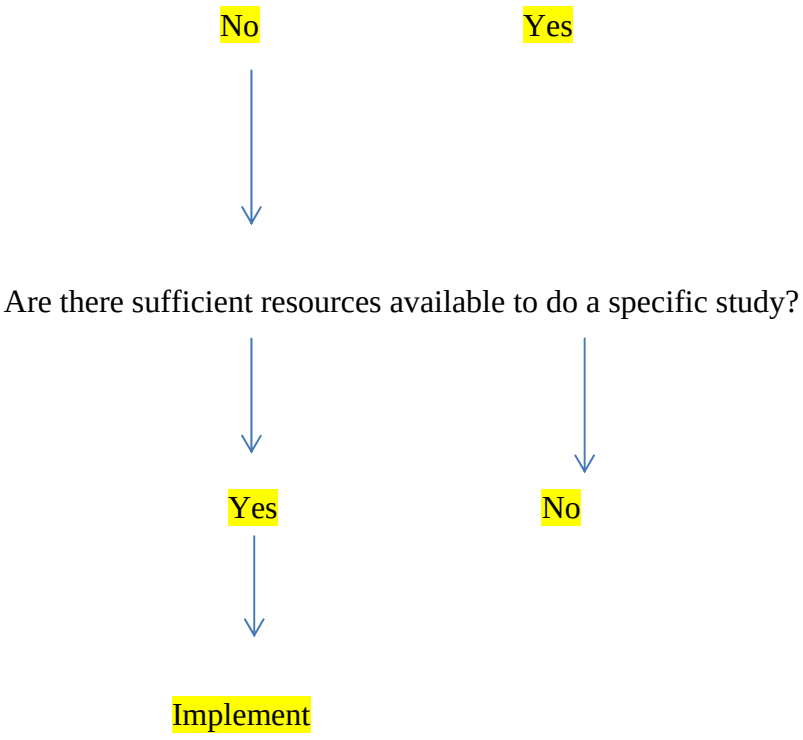
- ✓ A phase for Decision-making; where knowledge of epidemiology of the underlying disease is employed to explore the various available options for its control [8]. This may involve modeling of effects that these different options may likely have on the disease outbreak. These models can as well, be combined with some other models that can examine the challenges in terms of cost of the various possible control measures and compare them with some benefits, in terms of increase in productivity, which these measures are likely to produce. The optimum strategy for control can then be selected as a result of the expected decrease in disease incidence in the populations of livestock at risk.

- ✓ A phase for monitoring; which occurs during implementation of control measures to ensure that the measures are applied satisfactorily, and having the desired effect on reducing the incidence of disease, and that any development likely to compromise, negatively influence or jeopardize the effectiveness and success of the control programme are detected immediately.

BASIC CONSIDERATIONS IN THE DESIGN OF EPIDEMIOLOGICAL INVESTIGATIONS

A good way to approach the planning of a field study is to take the view that we are, in effect, buying information [9]. We must make sure, therefore, that the study produces the information required at the lowest possible cost. We should also ask ourselves if that information can be obtained from other, cheaper sources. The processes involved in such considerations could be schematized as follows:





The initial step is to clearly indicate the intended objectives of the study and the type of data that will be required in order to achieve the objectives [9] [10]. Throughout the entire process of planning, these objectives should be referenced in order to ensure that the procedures being planned are of relevance. The available resources may not allow the original objectives t be achieved, then, new objectives may have to be stated or additional resources found.

Constructing a hypothesis may help in defining an objective [11] [12]. A hypothesis in epidemiological study should:

Specify the population(s) it refers [11] ; which is the population which one wishes to make inferences and therefore sample from. This is referred to as the target population. Sometimes, for practical reasons, the population actually sampled may be smaller than the target population. In such cases the findings of the study will relate to the sampled population, and care must be exercised in extrapolating inferences from the sampled population to the target population [11] [12].

Frequently, inferences may be required about different groups within the target population. For example, one may want to estimate not only the overall prevalence of a specific disease, but also the prevalence's or incidences of the disease in various groups or subsets of the population. To

obtain estimates with the precision required, the samples taken from these groups must be large enough, and this will obviously affect the design of the study [13] [14].

A further problem may occur when defining the actual units to be sampled within a population. If, for example, the sample unit was a calf, at what age exactly does a calf cease being a calf? Alternatively, suppose the sample unit is a herd. What exactly is meant by the term "herd"? If a livestock owner has only one animal, does that constitute a herd? Obviously, the sample unit must be precisely defined and appropriate procedures designed to take care of borderline cases.

Specify the determinant(s) being considered can the determinants of disease such as "climate", "stress" and “management" be defined accurately? How are the determinants quantified and what measurements would be of use in their quantification? What are the advantages and also the disadvantages of these methods of measurement? How accurate are these measurements?

Specify the disease(s) being considered. The criteria by which an individual is regarded as suffering from a particular disease condition must be carefully defined. Will the disease be diagnosed based on clinical symptoms alone? What are the clinical symptoms? Are there likely to be problems with differential diagnoses? Will laboratory confirmation be needed? If so, are there adequate laboratory facilities available? Will they be able to process all the samples submitted? Will tests for diagnosis be used? How accurate are these tests? Remember that studies based solely on diagnosis tests may provide data about the rates of infection present in the population being sampled, but they may not indicate whether the infected animals are showing signs of disease or not. Additional data on mortalities and morbidities may have to be generated.

What calculations concerning rate are to be collected? Remember that incidence and attack rates normally cannot be obtained by a cross-sectional study. If estimates on economic losses due to particular diseases are required, various production parameters may have to be recorded. How are these to be measured? How good and how accurate will these measurements be?

Specify the response expected and induced by a determinant on the disease frequency of occurrence. What effect would a change in the frequency of occurrence of the determinant have on the frequency of occurrence of the disease? Remember that the determinant must occur prior to the disease. This may be difficult to demonstrate in a retrospective study.

Make biological sense. In epidemiology, one is concerned with exploring relationships between frequency of disease occurrence and frequency of determinant(s) occurrence. One is interested in determining whether the relationship is ‘causal’, i.e. whether the frequency of occurrence of the particular variable under study determines the disease frequency of occurrence. We analyze such relationships by the use of statistical tests which tell us the probability of occurring by chance of the relative distributions of the determinant and the disease in the studied populations. If there is a good probability that the distributions occur by chance, the result is not significant and the distributions of the variable and the disease are independently related. If there is a strong

probability that the distributions did not occur by chance, the result is significant and the distributions of the variable and the disease are related in some way.

Note that a statistically significant result does not necessarily imply a causal relationship.

EPIDEMIOLOGICAL MONITORING AND SURVEILLANCE

Continuous observation of the behavior of disease in populations is one of the most important activities in epidemiology [14]. This is referred to as monitoring or surveillance [16] [17]. In epidemiology, *surveillance* is simply the continuous observation of diseases in a number of different populations, while *monitoring* is simply the continuous observation of a specific disease in a particular population.

Epidemiological monitoring

This is the repeated standardized evaluation of the health status of a population for the purpose of protecting this population from environmental health hazards [18] [19]. It is compared with environmental monitoring and epidemiologic studies. This approach is relatively cost effective. Systematic monitoring of serious infectious diseases and other conditions is typically achieved through notifiable diseases legislation based on clinical observation and laboratory confirmation.

Clinical and laboratory-based surveillance also provides the basis for systematic collection of vital statistics (births, deaths, causes of death), and may extend to the reporting and analysis of risk factors for non-communicable diseases and injuries [20] [21]. Systematic collection of data informs the distribution of resources and also facilitates the evaluation of community-based and population-standard prevention strategies.

Epidemiological surveillance

Surveillance activities involve collecting data using a systematic technique from a number of sources [21]. These may include data sources already existing as well as new ones created for specific purposes of surveillance. The data are then analyzed in order to:

- ✓ Make provisions for detecting significant improvements in existing disease conditions, with reference to new diseases introduction , changes in existing diseases prevalence or incidence, and detection of causes likely to jeopardize existing disease control activities, such as introduction of new strains of disease agents, changes in systems of livestock management, changes in extent and also in pattern of movement of livestock, the importation of livestock and their products, and introduction of new treatment agents (drugs) and treatment regimens etc.
- ✓ Follow the course of the outbreak with the main objective of identifying the disease sources and the populations likely to be at risk.

- ✓ Provide a comprehensive and easily accessible data base on disease common in livestock populations for purposes of research and planning.

The primary objective of this activity is to provide updated information to authorities concerned with disease control which will help them in formulating policy decisions and in the planning and implementation of disease control programmes. Although a detailed discussion on the design and implementation of surveillance systems is beyond the scope of this review, it may be useful to review briefly some of the considerations involved.

The success of a system of monitoring or surveillance, depends mainly on the rate and efficiency in which data gathered is collated and analyzed, so updated information can rapidly be disseminated to interested parties [21]. Due to recent advances in data processing techniques, particularly in the computational field, the development of comprehensive and efficient surveillance and monitoring systems at a reasonable cost is now within the reach of most veterinary services.

The capacity of epidemiological units to employ these modern techniques means that such units may be able to offer services for data-processing to institutions and organizations in return for the use of their data. This has removed one of the main limitations on the development of such systems in the past [22], which was the reluctance of various data-generating sources to make their data available to those responsible for surveillance. Such Unisom may depend on clarified identification of the information needs of organizations reporting and fulfilling these rapidly and efficiently.

Modern data processing techniques allows more complex analysis to be carried out on large volumes of data quickly and easily. However, they must be used with a great deal of caution and only on data which justify them. If used on incomplete or inaccurate data whose limitations are not understood, they may produce results which are at best confusing or misleading. For this reason, the analysis of surveillance or monitoring data should be kept simple and the limitations of information produced should be clearly stated [23].

Confidentiality is also to be considered. Any monitoring or surveillance system contains a certain amount of confidential data. If such data in careless circumstances get into the wrong hands and are used indiscriminately without due regard to their supposed limitations, the outcome may be serious [24]. Appropriate safeguards need to be in place to ensure that information's are distributed to interested parties on a need to know and confidential basis.

In countries like Nigeria, the incidence management system (IMS) is used for outbreak coordination [25]. Several cases and deaths are identified through epidemiological surveillance system performed routinely using standard definitions for suspected and confirmed cases and deaths respectively [25] [26]. Blood specimens collected from suspect cases are sent for confirmation at a WHO accredited laboratories. Active case search are intensified, and identified

contacts of confirmed cases are followed up for the maximum incubation period of the disease. Other public health responses include infection prevention and control, communication and advocacy as well as case management [27].

Evolutionary changes have improved epidemiological investigation, monitoring and surveillance, in Nigeria [27] [28], they include;

- ✓ Improve tools in science, technology, and communication; Broader scope both in terms of geography and the nature of the public health problems under investigation;

- ✓ A better trained and equipped workforce that includes not only epidemiologists, public health advisors, microbiologists, and statisticians, but also behavioral and social scientists, economists, informaticians, toxicologists, and chemists;

- ✓ New or changed roles for public health partners (e.g., Environmental Protection Agency, Department of Justice, Department of Housing and Urban Development, Department of Homeland Security and local law enforcement) and enhanced collaborations with the World Health Organization; the U.S. Department of Agriculture; the Food and Drug Administration; the National Institutes of Health; the World Health Organization; and the private sector, including the business community, academia, community-based organizations, health plans, professional societies, volunteer agencies, and international organizations.

CONCLUSION

Epidemiological investigation, monitoring and surveillance are critical components of a good public health system. Public health professionals and scientists use these approaches to assist them in performing many key functions. These include monitoring, responding to outbreaks of infectious disease, vector control, identifying the source of illnesses that are foodborne , ensuring the safety of water we drink and national blood supplies, and tracking risk factors that are modifiable for non-communicable diseases in order to develop and evaluate preventive policies. The investigation, surveillance and monitoring of noncommunicable diseases and the risk factors associated tends to occur through community-based or voluntary clinical reporting systems, rather than through formal or legislative notification systems. In circumstances that are appropriate, the mandatory reporting of risk factors for noncommunicable diseases may assist in

identifying cases and ensuring that individuals affected are treated to prevent further progression of disease, also, the identity of concerned individuals should be treated with confidentiality to encourage early report by the public. It is further advised that anonymity be maintained and there should be no attempt to breach the privacy of anyone involved in the process of epidemiological investigation, monitoring and surveillance.

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