A Critical Review of Levels of Disease Development and Prevention in Epidemiology

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Abstract

Epidemiology is the scientific study of the distribution and determinants of health-related states or occurrences in a given population, as well as its use and application in the management of health issues. This article has discussed in detail the meaning and significance of each key word in the definition of epidemiology to fill the knowledge gap among stakeholders in health and the general population. Incubation, prodromal sickness, illness, decline, and convalescence are the typical phases or stages that illnesses go through while they develop. This article has discussed in details with examples the stages of diseases development. The paper also notes that the length of each stage or phase varies depending on whether the condition is acute or chronic, as well as other factors. To target the prevention of various phases of a disease, corresponding preventive health strategies have been developed and categorized into similar stages. Primordial prevention, primary prevention, secondary prevention, and tertiary prevention are the four stages of prevention. These preventive measures are discussed with appropriate examples. The authors have recommended that all types of health workers and other stakeholders in health should be educated on the necessity of prevention as an important part of caring for individuals in order to attain population-wide optimal health.

Keywords: Epidemiology, Critical review, Disease development, Prevention

Introduction

Many definitions have been offered for epidemiology but the one below best represents the subject's fundamental concepts and public health spirit. Epidemiology is the study of the distribution and determinants of health-related states or occurrences in specific populations, as well as the application of this knowledge to the prevention of disease (Last, 2001). In current usage, the term epidemiology refers to the causes, distribution, determinants, and deterrents of illnesses, injuries, and other health-related disorders in human populations, rather than only infectious diseases and outbreaks (Iorvaa, 2012, Jackson, 2018).

Generally, a 'critical review', or 'critique', is a complete type of text (or genre), discussing one particular article or book in detail. However, in critical review of epidemiological studies, one takes into consideration the methodologies, the representativeness of the research sample, and the characteristics of the community from which it is collected (Zaccai, 2004). Assessing the quality of an epidemiological study translates to analyzing whether the conclusions formed from it are justifiable. At every stage of an epidemiological research, bias, confounding, and chance might jeopardize its quality (Boccia, 2007; Zaccai, 2004). Their presence, however, does not always suggest that a study should be dismissed. Any dangers or gaps in the report's information must first be weighed against their possible influence on the report's findings.

Disease Development

A disease refers to any harmful deviation from the normal structural or functional state of an organism (Scarpelli,2020). It is generally associated with certain signs and symptoms and differs in nature from a physical injury . A diseased organism will usually exhibit signs or symptoms indicative of its abnormal state. It is therefore necessary that the normal condition of an organism to be understood in order to recognize the hallmarks of disease when they appear. However, a sharp demarcation between disease and health is not always apparent (Scarpelli, 2020).

The scientific study of the causes and effects of disease is called pathology. This involves the determination of the cause (etiology) of the disease, the understanding of the mechanisms of its development (pathogenesis), the structural changes associated with the disease process (morphological changes), and the functional consequences or complications of those changes (Luonamo, 2014; Scarpelli, 2020). The incubation , prodromal, sickness, decline, and convalescence periods (sometimes known as stages or phases) are the five stages of disease development(Hou, 2020) .The disease if transmissible is transmitted from one person to another .This transmission is a process in which several events happen one after the other in the form of a chain. Hence, this process is commonly referred to as a chain of transmission (Luonamo, 2014). Six major factors can be identified which facilitate this process: the infectious agent, the reservoir, the route of exit, the mode of transmission, the route of entry and the susceptible host (Luanamo, 2014; Scarpelli, 2020).

The Importance Epidemiological Studies in Disease Quantification and Analysis

Epidemiology is a scientific subject that is built on good scientific research methodologies. It is a data-driven field that relies on a methodical and objective approach to data gathering, analysis, and interpretation (Centre for Disease Control and Prevention [CDC], 2011). Basic epidemiologic methods rely on careful observation and the use of valid comparison groups to determine whether what was observed, such as the number of cases of disease in a specific area during a specific time period or the frequency of an exposure among diseased people, differs from what might be expected (Last, 2001). Epidemiology also combines biologic, economic, social, and behavioral sciences with tools from other scientific domains, such as biostatistics and informatics.

Epidemiology is generally referred to be the foundation of public health research, and for good reason. First and foremost, epidemiology is a quantitative science that requires a strong grasp of probability, statistics, and good research procedures. Secondly, epidemiology is a way of causal reasoning that involves formulating and testing hypotheses based on scientific disciplines such as biology, behavioral sciences, physics, and ergonomics in order to explain health-related behaviours, states, and occurrences (Cates, 1982: CDC, 2011). Epidemiology, on the other hand, is more than simply a study activity; it's also an important part of public health, since it lays the groundwork for directing practical and appropriate public health action based on this knowledge and causal reasoning (Cates, 1982).

Disease Distribution and Patterns in Epidemiology

The frequency and pattern of health events in a population are the focus of epidemiology. The term "frequency" refers not only to the number of health occurrences in a community, such as the number of instances of meningitis or diabetes, but also to the link between that number and the population's size. Epidemiologists can use the resultant rate to compare illness incidence in various populations (CDC, 2016). On the other hand, occurrence of health-related events by time, place, and person is referred to as a pattern. Annual, seasonal, weekly, daily, hourly, workday, weekend, or any other division of time might impact the occurrence of sickness or damage. Geographic variance, urban/rural distinctions, and the placement of work locations or schools are all examples of place patterns. Personal characteristics include age, sex, marital status, and socioeconomic level, as well as behaviors and environmental exposures that may be linked to the risk of sickness, injury, or disability. (CDC, 2016; Iorvaa, 2012).

Determinants of Disease and Health-Related States in Epidemiology

Any event, trait, or other definable item that causes a change in a health state or other specified attribute is referred to as a determinant. Epidemiology is also used to look for determinants or variables that impact the incidence of illness and other health-related occurrences (Iorvaa, 2012; Pierce, 2008). Epidemiologists believe that sickness does not strike a community at random, but rather occurs when the correct combination of risk factors or determinants exists in a single person. Epidemiologists employ analytic epidemiology or epidemiologic investigations to find these variables and to explain the "Why" and "How" of such events (Iorvaa, 2012). These experts in epidemiology also look for differences in demographics, genetic or immunologic make-up, habits, environmental exposures, and other possible risk factors across populations with varying illness rates. The findings should, in theory, offer enough data to guide fast and successful public health management and preventative efforts (CDC, 2016).

Epidemiology was once solely concerned with communicable illness outbreaks (Greenwood, 1935). This was then broadened to include endemic infectious illnesses as well as non-communicable infectious disorders. Additional epidemiologic methodologies had been developed and applied to chronic illnesses, injuries, birth defects, maternal-child health, occupational health, and environmental health by the middle of the twentieth century (Pierce, 2008). Then epidemiologists started looking at behaviors associated to health and well-being, such as how much exercise people get and whether or not they wear seat belts. Epidemiologists may now make significant progress in investigating genetic indicators of illness risk because of the recent growth in molecular technologies (Jackson, 2018). Indeed, the word "health-related states or occurrences" can refer to anything that has an impact on a population's well-being. Despite this, many epidemiologists still use the term "disease" to refer to a wide variety of health-related states and events that are investigated.

Specified Population and Targeted Intervention in Epidemiology

Although epidemiologists and direct health-care professionals (clinicians) are both concerned with illness incidence and control, their perspectives on "the patient" are vastly different. The doctor is concerned about an individual's health; the epidemiologist is concerned with the health of a community or population as a whole (Pierce, 2008). In other words, the person is the "patient" of the doctor, whereas the community is the "patient" of the

epidemiologist. As a result, while dealing with a sick individual, the clinician and the epidemiologist have separate roles to play (Iorvaa, 2012: Jackson, 2018). When a patient with diarrhoea appears, for example, both parties are interested in determining the accurate diagnosis. While a clinician's primary focus is on treating and caring for the individual, an epidemiologist's primary focus is on determining the source of the illness, the number of other people who may have been similarly exposed to the risk of further spread in the community, and interventions to prevent further cases or recurrences (Jackson, 2018).

Application of Epidemiology in Disease Prevention and Control

Epidemiology is more than simply "the study of" population health; it also entails putting what researchers have learned to community-based practice. The profession of epidemiology, just like the practice of medicine, is both a science and an art (Iorvaa, 2012; Slattery, 2002). The clinician integrates medical (scientific) knowledge with experience, clinical judgment, and understanding of the patient to establish the accurate diagnosis and prescribe suitable therapy for the patient (Pierce, 2008; Slattery, 2002). Similarly, an epidemiologist "diagnoses" a community's health and proposes appropriate, practical, and acceptable public health interventions to control and prevent disease using scientific methods of descriptive and analytic epidemiology, as well as experience, epidemiologic judgment, and understanding of local conditions.

Disease Prevention in Epidemiology

Prevention is defined as “actions aimed at eradicating, eliminating or minimizing the impact of disease and disability. The concept of prevention is best defined in the context of levels, traditionally called primary, secondary and tertiary prevention” (Last, 2001). Medicine's aims are to promote health (health promotion), preserve health (health preservation), restore health (health restoration), and reduce suffering and pain (suffering and distress) (Last, 2001; Webb, 2005). Clinical medicine's main goal is to help patients who are unwell. We would prefer that individuals did not become unwell in terms of population health. By identifying illness causes, epidemiology can play a critical role in disease prevention. It gives quantifiable measurements of relative and absolute risk that aid direct preventative action, and it is critical in determining whether preventive programs are effective in practice (Webb, 2015).

Critical Explanation of Stages of Disease Development in Epidemiology

The incubation, prodromal, sickness, decline, and convalescence periods (sometimes known as stages or phases) are the five stages of disease. In an acute illness, the incubation period begins once the pathogen first enters the host (patient). The pathogen begins to proliferate in the host during this time (Hou, 2020). However, there isn't enough pathogen particles (cells or viruses) present to create illness signs and symptoms. Depending on the pathogen, incubation durations can range from a day or two in acute disease to months or years in chronic disease. The potency of the pathogen, the strength of the host immune defenses, the place of infection, the kind of infection, and the quantity of the infectious dose received are all factors that influence the length of the incubation period (CDC, 2016; Hou, 2020). During this time, the patient is completely ignorant that a condition is developing. After the incubation phase, the prodromal period begins. During this phase, the pathogen continues to grow, and the host begins to exhibit basic signs and symptoms of sickness, such as fever, discomfort, soreness, swelling, or inflammation, which are often caused by immune system activation (Pierce, 2008). Typically, such signs and symptoms are too broad to be indicative of a specific illness. The phase of sickness that follows the prodromal stage is when the disease's signs and symptoms are most visible and severe (Eske, 2021; Hou, 2020).

The period of disease is followed by a period of decline, during which the quantity of pathogen particles decreases and the signs and symptoms of illness decrease. Patients may be more susceptible to subsequent infections during the decline stage because their immune systems have been compromised by the first infection. The final stage is referred to as the convalescence period. The patient returns to normal activities during this period, while some disorders may cause chronic harm that the body cannot fully cure (Lumen, 2021).

Infectious diseases can spread during all five stages of the disease. The disease, the pathogen, and the processes through which the disease starts and advances all influence which phases of disease are more likely to be linked with infection transmissibility. For example, the duration of infectivity in meningitis and infection of the brain lining is determined by the bacteria that causes the illness (CDC, 2016). Patients with bacterial meningitis are infectious during the incubation phase, which can last up to a week before the prodromal period begins, but patients with viral meningitis become contagious once the prodromal period's first signs and symptoms occur. Many viral infections that cause rashes (such as chickenpox, measles, rubella, and roseola) are infectious throughout the incubation phase, which can last up to a week before

the rash appears (De Pietro, 2019). Many respiratory illnesses, on the other hand, (such as colds, influenza, diphtheria, strep throat, and pertussis) cause the patient to become contagious as soon as the prodromal stage begins. Transmission can occur during periods of decline, convalescence, and even long after signs and symptoms of the disease have faded, depending on the pathogen, the condition, and the individual afflicted (De Pietro, 2019; Eske, 2021). For example, a person recuperating from diarrheal illness may continue to carry and shed the pathogen in feces for some time, putting others at risk of infection through direct or indirect contact (for example through contaminated objects or food).

Period Of Illness in Acute and Chronic Diseases

The length of disease varies widely depending on the infection, the efficiency of the host's immunological response, and any medical therapy received (Kusters, 2006). Pathologic changes in acute disease occur over a short period of time (e.g., hours, days, or a few weeks) and entail a quick development of disease symptoms. Because the incubation period is about 1–2 days, influenza (produced by the Influenzavirus) is termed an acute illness (Eske, 2021; Kusters, 2006). For about 5 days after being ill, infected people can spread influenza to others. Individuals enter the period of decline after about a week.

Pathologic alterations in chronic diseases might take place over prolonged periods of time (e.g., months, years, or a lifetime). The gram-negative bacteria Helicobacter pylori, for example, cause chronic gastritis (inflammation of the stomach lining). By generating the enzyme urease, H. pylori is able to colonize the stomach and thrive in its extremely acidic environment, permanently (Kusters, 2006). Unless the infection is eradicated with medications, H. pylori infections can reoccur continuously (Salama, 2013). In certain people who do not eradicate the virus after the acute sickness, the hepatitis B virus might produce a chronic infection. The presence of viral antigen in blood tests indicates a chronic infection with the hepatitis B virus, which is defined as the generation of infectious virus for 6 months or more after the acute infection (Kusters, 2006).

In contrast to chronic infections, the causative pathogen in latent illnesses remains dormant for long periods of time with no active reproduction (Salama, 2013). Herpes (herpes simplex viruses [HSV-1 and HSV-2]), chickenpox (varicella-zoster virus [VZV]), (Epstein-Barr virus [EBV]) and mononucleosis are examples of illnesses that fall into a latent condition following an acute infection (Salama, 2013). HSV-1, HSV-2, and VZV avoid the host immune

system by staying in a dormant state within nervous system cells for lengthy periods of time, but they can reawaken into active infections during times of stress or immunosuppression (Boldogh, 1996; Salama, 2013). An initial VZV infection, for example, may cause children chickenpox followed by a long period of latency. The virus can resurface decades later, resulting in shingles attacks in adults. EBV enters a state of dormancy in immune system B cells and perhaps epithelial cells, and it can revive years later to cause B-cell lymphoma (Boldogh, 1996; Eske, 2021).

Critical Explanation of Levels of Disease Prevention in Epidemiology

A disease's natural history is divided into five stages: underlying, susceptible, subclinical, clinical and recovery/disability/death. To focus the prevention of various phases of a disease, corresponding preventive health measures have been classified into similar stages. Primordial prevention, primary prevention, secondary prevention, and tertiary prevention are the four stages of prevention. These techniques, when combined, attempt to avoid not just the beginning of illness but also the downstream consequences of a displayed disease through risk reduction (Kisling, 2020).

In 1978, primordial prevention, the most recent contribution to preventive techniques, was presented (kisling, 2021). It entails reducing risk factors across a whole population while focusing on social and environmental factors. Laws and national policy are frequently used to support such actions. Because primordial prevention is the first form of prevention, it is frequently targeted towards children in order to reduce risk exposure as much as possible (Eske, 2021; Kisling, 2020). Primordial prevention aims to address the underlying stage of natural illness by addressing the social factors that encourage disease emergence. Improved access to safe sidewalks in an urban community promotes physical activity, which reduces risk factors for obesity, cardiovascular disease, and type 2 diabetes (Kisling, 2020).

Primary prevention refers to steps taken to protect a vulnerable community or person. The goal of primary prevention is to keep a disease from happening in the first place. As a result, it is aimed for those who are in good health. It frequently implements actions that restrict risk exposure or boost the immunity of at-risk persons in order to prevent a disease from advancing to subclinical illness in a vulnerable individual. Immunizations, for example, are a type of primary prevention (Kisling, 2020).

Secondary prevention on the other hand focuses on early illness diagnosis in healthy-appearing people who are suffering from subclinical versions of the disease. Pathologic alterations characterize subclinical illness, yet there are no overt symptoms that may be diagnosed during a doctor's visit. Screenings are a common technique of secondary prevention. A Papanicolaou (Pap) smear, for example, is a type of secondary prevention that aims to detect cervical cancer in its early stages before it progresses (Eske, 2021; Kisling, 2020).

Tertiary level of prevention focuses on both the clinical and the outcome stages of a disease (Eske, 2021). It is used in symptomatic individuals with the goal of reducing the severity of the condition as well as any accompanying complications. Secondary prevention strives to avoid the beginning of sickness, whereas tertiary prevention works to lessen the disease's consequences once it has been established in a person. Rehabilitation activities are widely used as a kind of tertiary prevention (Barowski, 2021).

Quartenary prevention has been defined as an action taken to identify a patient at risk of over medicalization in order to protect him from new medical invasion, and to suggest to him interventions, which are ethically acceptable (Jamoulle, 2015). Over medicalization is a term that refers to non-validated medical procedures that are possibly hazardous and hence unduly expensive (Hanslik, 2016). The general population is becoming more aware of this severe public health issue. The growth of diagnostic and therapeutic treatments, illness mongering, insufficient handling of diagnostic ambiguity, conflicts of interest, or a lack of commitment by doctors and patients to shared decision-making may be responsible in some cases . Also lack of medical decision-making training among health providers and users can allow for over medicalization (Hanslik, 2016). Only a comprehensive research effort combining the medical and non-medical sectors will enable remedial steps to be implemented. This concept was initially proposed, and the targets were mainly patients with illness but without the disease. The definition has undergone recent modification as" an action taken to protect individuals (persons/patients) from medical interventions that are likely to cause more harm than good (Martin, 2018)."

While preventive services are regulated and must undergo thorough safety testing, there is risk involved with prevention. Particularly, primary and secondary preventive factors targeted at intervening in healthy-appearing individuals. It is often challenging to gain buy-in with patients regarding the risk-benefit ratio of various preventive services (Martin, 2018).

Finally, the cost of preventive services is commonly a topic of discussion. Several cost-benefit analyses have been undertaken regarding the evaluation of preventive services with varying degrees of confidence. While often a long-term gain of healthy life-years is noted, preventive services are not inexpensive, which can limit the use of these services by both healthcare systems and patients and is a consideration when promoting preventive services (Hanslik, 2016; Martin, 2018).

Examples of Targeted Preventive Strategies in Epidemiology

Primordial prevention may involve influencing government policy by increasing cigarette taxes and reducing tobacco advertisement to prevent lung cancer (Fielding, 2004).A Conducive environment may be created by government to prevent accidents by building safe walking pathways in congested cities. Obesity and other forms of malnutrition can be prevented by government encouraging farmers through favourable agricultural policies to provide healthy foods for the population.

Primary prevention typically involves immunizations for vaccine preventable diseases (Maier,2015).The expanded programme on immunization(EPI) which was later named national programme on immunization (NPI) in 2003 has been in place for the prevention of tuberculosis, poliomyelitis, diphtheria, pertussis ,tetanus ,measles and hepatitis in Nigeria to reduce morbidity and mortality for under-five children.(Ophori,2014). Another example is the design and implementation of programs to help people quit smoking (Sagaydevan, 2019).

Secondary prevention is exemplified by a Papanicolaou (Pap) smear for cervical cancer early detection (Nguyen, 2002) and Mammography for early identification of breast cancer. Colonoscopies which are used to identify colon cancer early as well as regular checking of blood pressure for early detection of hypertension are also secondary preventive strategies.

In the treatment of burn patients, occupational and physical therapy comes into play as a tertiary prevention strategy. This is aimed at rehabilitating the victim to a point where he may return to his premorbid state or be able to do another less demanding job. Other forms of tertiary prevention include post-myocardial infarction rehabilitation and foot care for diabetics who are at risk of diabetic foot ulcers.

The conditions that are at risk of being over-treated (overmedicalization) include incidentalomas. These are incidental findings for example tramline osteomyelitis in sickle cell disease patients on radiological examination which do not have negative clinical effect

(Sherlock, 2020). Another example is after a myocardial infarction, the overzealous administration of antiarrhythmic medications to decrease arrhythmias may actually increase mortality. Likewise, hormone replacement in women to prevent osteoporosis has been linked to an increase in breast cancer, stroke, and thromboembolic events. Over medicalization should be avoided as much as possible so as not the make the treatment of a disease worse than its endurance.

Cost –Effectiveness of Disease Prevention in Epidemiology

If a preventative program provides more health benefits than other uses of health-care resources, it is cost-effective (Weinstein, 1990). Some preventative programs fit this criterion: they either save more health-care resources than they use, or their net costs per healthy year of life gained are lower than those of curative or palliative medicine. Other forms of prevention, on the other hand, are less cost-effective than medical therapies for the same condition (Weinstein, 1990). One lesson for public policy is to avoid broad generalizations about the cost-effectiveness of "prevention." Another lesson is that prevention programs should not be held to a higher standard than other health programs in terms of cost savings, but they should be held to a higher standard in terms of improved health at a reasonable cost.

Health Communication and Disease Prevention in Epidemiology

Individuals, populations, and communities can be influenced and empowered to make better choices through health communication, which encompasses both verbal and written tactics (Wurz, 2013). To encourage positive changes in attitudes and actions, health communication frequently incorporates elements from many theories and models (Ekunwe, 1994; Mulderij-Jensin, 2020)). Health communication is linked to social marketing, which is the creation of activities and interventions aimed at changing habits for the better. Some examples of media strategies for communicating health messages include radio, television, newspapers, flyers, brochures and internet tools for using social media that is Twitter, Facebook, and YouTube. To reach a wider audience, tobacco prevention and cessation campaigns frequently employ health communication (Mulderij-Jensin, 2020; Wurz, 2013).

Conclusion

Epidemiology concerns the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health

problems. The five stages of disease development are incubation, prodromal, illness, decline, and convalescence stages. Other researchers have also described the natural history of a disease into five stages namely; underlying, susceptible, subclinical, clinical, and recovery/disability/death. Corresponding preventive health measures have been grouped into similar stages to target the prevention of these stages of a disease. These preventive stages are primordial prevention, primary prevention, secondary prevention, and tertiary prevention. All categories of health workers require education on the importance of providing prevention as an important aspect of caring for people in order to achieve optimal health for the population.

Recommendations

Preventive services have proven an essential aspect of healthcare; however, they appear consistently underutilized in both developing and developed countries (Chung, 2018; Kottke, 1997; Smith, 2017). With cost and resource constraints on physicians, many preventive services get overlooked for patients. Physicians need to remain up to date on the prevention guidelines and ensure all patients are offered appropriate services with a full explanation of risks and benefits.

Proper communication among the various health care personnel should be emphasized to provide appropriate levels of prevention to the general public and patients. All categories of health workers require education on the importance of providing prevention as an important aspect of caring for an individual to achieve optimal health for the population.

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