Evolution of Infectious Disease: A Biocultural Analysis of AIDS

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ABSTRACT The evolution of infectious disease can be understood from an ecological model that incorporates information from anthropology, epidemiology, and biomedicine. This model considers variables such as the pathogen, the host population, and the environment. In this model, the role that culture as well as other environmental variables plays in the transmission of infectious disease in human populations is considered. In addition, the sociocultural response and its impact on the disease process can be analyzed. The present AIDS epidemic is placed in an ecological and evolutionary context of the disease in hominid evolution. The interaction between Human Immunodeficiency Virus (HIV) and human populations is considered in this perspective. The ability of the virus to survive in semen and blood both increases as well as limits the possibility of transmission. Cultural practices that increase the transmission of blood and semen or increase sexual activity will obviously increase the potential risk of viral transmission. In societies that practice exchange of blood, blood transfusion, and where vaccinations with unclean needles exist or where there is intravenous (IV) drug use, the transmission of HIV by blood is enhanced. HIV which can cause a breakdown of the immunological system is paradoxically a very fragile pathogen. Replication occurs within T-cells, an important part of the immunological system. Outside of the blood or semen the virus dies quickly. From the perspective of the pathogen’s adaptation, the virus has effectively solved the problem of survival. The fragile virus’s long incubation period and its ability to survive in the presence of antibodies help to assure its transmission. HIV’s ability to suppress the immunological system may assure its immediate survival, but this adaptation may cause the death of its host from other opportunistic pathogens that are usually not lethal.

At the 86th Annual Meeting of the American Anthropological Association, Dr. Jonathan Mann of the World Health Organization spoke of the role of anthropology in the AIDS (Acquired Immunodeficiency Syndrome) pandemic. Mann and others emphasized the urgency of the situation (Bayer, 1987; Carballo, 1987; Feldman, 1986, 1987; Grant, 1987; Herdt, 1987a,b). These researchers consider the biological and cultural dispositions of the groups at risk, and the groups soon to be at risk. The opinion of Mann and others is that the AIDS pandemic would spare no one; with the increase in incidence of the disease in the at-risk groups will come an increase in demands on resources to meet the health needs of those affected. This will have a major social and economic impact on all segments of society. Mann spoke of the necessity of collaboration across professional and national boundaries, based upon the understanding that AIDS is a shared social responsibility. In January 1990, 203,599 cases of HIV infection in the world were diagnosed (WHO 1Jan90, personal communication), and more than half (117,781) were in the United States. It is estimated that approximately 1.5 million people harbor the virus in the United States alone (Booth, 1988). In Africa approximately 41,303 cases of AIDS have been reported (WHO 17Mar90, personal communication).

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As a disease of such magnitude, it will require broad collaboration to combat and cope effectively with the impact of this pandemic. An understanding of the AIDS epidemic can be enhanced by the use of an ecological model that incorporates biological and cultural factors in describing the disease process. The interaction between human populations and the disease process provides information about the pathogen's adaptation and the biocultural responses of humans to the disease. The cultural system can dramatically influence the disease process, and disease can significantly alter the cultural adaptation.

In medical anthropology, two distinct and opposing models have been used to understand human-disease interactions. Cultural anthropologists have traditionally used an ethnomedical model to interpret the cultural response to disease (Armelagos et al., 1978; Fabrega, 1975; Hughes, 1968; Wellin, 1978). In the ethnomedical approach, one of the major objectives is to determine the way in which a society defines disease. Defining a disease is a critical undertaking, since it is evidence that a society perceives a threat and is ready to mobilize its material resources to challenge it. Whether a disease is viewed as originating supernaturally or as a part of nature, its study can provide insights into a society's cosmology and world view. The ethnomedical perspective can also be used to develop an understanding of how a society mobilizes its social resources to contain the disease threat. In this way, the basic features of the social system are revealed as a group organizes itself to control the disease (Fabrega, 1975). The ethnomedical model has been applied to the study of disease in non-Western societies and seldom is used to examine Western societies that rely on biomedicine. We believe that for a holistic understanding of the disease process in Western society, it is necessary to incorporate the ethnomedical perspective in the study of biomedicine. We will use the AIDS pandemic as an example of how we can integrate an ecological and ethnomedical perspective in the study of disease.

ECOLOGICAL MODELS OF DISEASE

The ecological model, the other medical anthropological perspective that predominates in the study of disease, is basically the analysis of the biocultural response to disease. This model, used extensively by biological anthropologists, is derived from epidemiology. The epidemiological model originally was concerned with the interaction of the variables—the host, pathogen, and the environment. There are a number of problems with the earlier epidemiological models since they often presented simplistic approaches to the study of disease. The earlier epidemiological models often failed to consider relevant social and cultural factors that might underlie the disease process.

The ecological model has been challenged on other grounds as well. While we are aware of the shortcomings of the model, we are interested in modifying it to deal with the criticisms and to then expand its use. Specifically, we are interested in modifying the variables (host, pathogen, and the environment) to provide a broader understanding of the cause of disease and its impact on the population.

While the analysis of host, pathogen, and environment was useful in early epidemiological research, they have been expanded into a broader ecological model in recent years. For example, modifications include the population (rather than the individual) as the unit of study. This use of population represents an important change in perspective that resulted from the influence of population biology on human disease ecology. The population as the unit of study allows us to move beyond the clinical perspective and to consider disease in broader biological and social context.

Secondly, the ecological model is no longer restricted to the study of pathogens as the only source of disease. Following Audy and Dunn (1974), there has been a shift to consider a broader category of insults as the source of disease. Insults include factors which adversely affect the ability of the host population to adapt successfully to the environment. Insults include pathogens, toxins, physical forces which cause trauma, chemical pollutants, and even psychological factors. Disease is defined in this context as the lowering of an individual's or population's ability to cope with its environment. Health is defined as an individual's or population's continuing ability to rally from the effects of these insults. Health and disease are considered to be a continuum and not an either-or condition (Audy and Dunn, 1974:329).

The most significant change in the ecological model is the transformation in how we perceive the environment. The original view
of the environment was restricted to considering the biotic, climatic, topographic, and geographic factors which may influence disease. Marston Bates (1953) and Jacque May (1960) argue that this concept of the environment is too limiting and must include the cultural system as a part of the human-disease interaction. Culture is comprised of the technology (the way in which energy and resources are extracted from the environment), the social organization (how the society organizes itself to maintain and reproduce itself), and ideology (ideas, attitudes, and beliefs). Furthermore, considerations of the ideology and social organization can include an ethnomedical perspective which analyzes the process by which contemporary societies define disease and how they organize themselves to deal with a disease threat.

The cultural system often acts as an effective barrier buffering the population from the insults that emanate from the environment. There is, however, the possibility that cultural systems can be the source of insults. The technology, social organization, and ideology often create insults that affect the health of the population. Changes in the technology, social organization, and ideology can potentially produce new insults.

THE EVOLUTION OF DISEASE

Human populations as with all living organisms have faced a struggle with disease that often threatens their adaptation. Understanding how human populations have evolved and adapted to changes in disease ecology may help us place the modern AIDS epidemic into perspective. During the last four million years human disease ecology has changed significantly as a function of changes in the environment, evolution of the species, and cultural adaptation. These processes created different environments for the pathogens and altered their interaction with human populations. There is now a substantial literature that describes the evolutionary impact of disease on human populations. These studies (Armelagos, 1967; Armelagos and Dewey, 1970; Armelagos and McArdle, 1975; Cockburn, 1971; Boyd, 1970; Fenner, 1970; Polgar, 1964) agree that there has been dramatic change in the pattern of disease and the human response, especially within the last 10,000 years. When gathering and hunting were the sole means of human subsistence (a period lasting from 4,000,000 years ago to the beginning of the Neolithic), population size was small, and density was quite low.

Human population size and density presumably remained quite low throughout the Paleolithic. It is assumed that fertility and mortality rates in these small gathering-hunting populations were balanced and that population growth was low and stable. Controversy continues as to the demographic factors which created this stability. Some demographers argue that gatherer-hunters were at their maximum natural fertility and this was balanced by high mortality. Other demographers have argued that gatherer-hunters maintained a stable population with controlled moderate fertility balanced by moderate mortality.

The Neolithic not only heralded a major shift in subsistence, it also resulted in a dramatic increase in population size and density. The reasons for this increase are complex. There are those who have argued that the Neolithic economy generated food surpluses which provided the key to population growth. The abundance of food would have led to a better nourished and healthier population with a reduced rate of mortality. Since populations were at their natural maximum fertility, there would have been a rapid increase in population.

While this scenario is appealing in its simplicity, the empirical evidence paints a different picture. The biological consequence of the shift from gathering and hunting to agriculture presents a much bleaker picture of health and disease. Instead of experiencing improved health, there is evidence of an increase in infectious and nutritional disease.

Disease in gatherer-hunters

A consideration of the disease ecology of contemporary gatherer-hunters provides insights into the types of disease that would have affected our gatherer-hunter ancestors. Polgar (1964) suggests that gatherer-hunters would have two types of disease to contend with in their adaptation to their environment. One class of disease would be those organisms that had adapted to pre-hominid ancestors and persisted with them as they evolved into hominids. Head and body lice (Pediculus humanus), pinworms, yaws, and possibly malaria would be included in this group. Cockburn (1967b) adds to this list most of the internal protozoa
found in modern humans and such bacteria as salmonella, typhi, and staphylococci.

Livingstone (1958) dismisses the threat of malaria in early hominids because of the small population size and their adaptation to the savannah, an environment that would not have included the mosquitoes that carry the malaria plasmodium. The second class of diseases are the zoonotic, which have nonhuman animals as their primary host and only incidentally infect humans. Humans can be infected by zoonoses through insect bites, by preparing and eating contaminated flesh, and from wounds inflicted by animals. Sleeping sickness, tetanus, scrub typhus, relapsing fever, trichinosis, tularemia, leptospirosis, and schistosomiasis are among the zoonotic diseases which could have afflicted earlier gatherer-hunters.

The range of the earliest hominids was probably restricted to the tropical savannah. This would have limited the pathogens that were potential disease agents. During the course of human evolution there was eventually an expansion of habitat into the temperate and eventually the tundra zones. As Lambrecht (1964, 1985) points out, the hominids would have avoided large areas of the African landscape because of tsetse flies and thus avoided the trypanosomes they carried. The evolution of the human species and its expansion into new ecological niches would have led to a change in the pattern of trypanosome infection. While this list of diseases that may have plagued our gathering-hunting ancestors is informative, those diseases that would have been absent are also of interest. The contagious community diseases such as influenza, measles, mumps, and smallpox would have been missing. Burnet (1962) states that there would have been few viruses infecting these early hominids. On the other hand, Cockburn (1967a, b), in a well-reasoned argument, suggests that the viral diseases found in nonhuman primates would have been easily transmitted to hominids.

Disease in agricultural populations

Given the limited list of diseases found in gatherer-hunters, it should not have been surprising that a shift to primary food production (agriculture) would increase the number and the impact of disease in sedentary populations. Sedentism would conceivably increase parasitic disease spread by contact with human waste. In gathering-hunting groups, the frequent movement of the base camp and frequent forays away from the base camp by men and women would decrease their contact with human wastes. In sedentary populations the proximity of habitation area and their waste deposit sites to the water supply is a source of contamination. While sediments could and did occur prior to the Neolithic period in those areas with abundant resources (e.g., acorns in California and marine resources in the Northwest Coast), the shift to agriculture necessitated sedentary living.

The herding of animals also increased the frequency of contact with zoonotic diseases. The domestication of animals in the Neolithic provided a steady supply of disease vectors. The zoonotic infections most likely increased because of domesticated animals, such as goats, sheep, cattle, pigs, and fowl. Products of domesticated animals such as milk, hair, and skin, as well as the dust raised by the animals, could transmit anthrax, Q fever, brucellosis, and tuberculosis (Polgar, 1964). Breaking the sod during cultivation exposes workers to insect bites and diseases such as scrub typhus (Audy, 1961). Livingstone (1958) showed that slash-and-burn agriculture in west Africa exposed populations to Anopheles gambiae, a mosquito which is the vector for *Plasmodium falciparum*, which causes malaria.

The development of urban centers is recent in human history. In the Near East, cities as large as 50,000 people were established by 3000 B.C. In the New World, urban settlements of 200,000 people were in existence by 600 A.D. Settlements of this size increase the already difficult problem of removing human wastes and delivering uncontaminated water to the people. Cholera, which is transmitted by contaminated water, was a potential problem. Diseases such as typhus (carried by lice) and the plague bacillus (transmitted by fleas or by the respiratory route) could be spread from person to person. Viral diseases such as measles, mumps, chicken pox, and smallpox could be spread in a similar fashion. There were for the first time, during the period of urbanization, populations large enough to maintain disease in an endemic form. Cockburn (1967b) estimates that populations of one million would be necessary to maintain measles as an endemic disease.

The period of urban development can also be characterized by the exploration and ex-
pansion of these populations into new areas which results in the introduction of novel diseases to groups that had little resistance to them (McNeill, 1976). For example, the exploration of the New World may have been the source of the treponemal infection that was transmitted to the Old World (Baker and Armelagos, 1988). The treponemal infection in the New World was endemic and not sexually transmitted. In the Old World there was a different mode of disease transmission. The sexual transmission of the treponeme created a different environment for the pathogen and it resulted in a more severe and acute infection. Furthermore, crowding in the urban centers, changes in sexual practices, such as prostitution, and an increase in sexual promiscuity may have been factors in the venereal transmission of the pathogen (Hudson, 1965).

The evolutionary picture of infectious disease suggests that agriculturalists faced greater infectious disease stress than gatherer-hunters. However, there exists a possible paradox that deserves further consideration. Zoonotic diseases in gatherer-hunters would likely have the greatest impact on the segment of the society that contains the producers (those between ages 20 and 40). This segment, in its daily rounds, is more likely to come into contact with the animals that are the vector of disease.

The occurrence of endemic diseases in larger urban agriculturalist areas would most likely kill the very young infants, young children, and the very old adults. In this situation, the predictability of mortality allows them to reduce birth spacing to meet the increase in mortality. Sedentary societies can wean infants earlier, allowing the women to become pregnant again. The social costs of disruption from this pattern of endemic disease mortality may not be as great as the impact of zoonotic diseases on the gatherer-hunters. Those who do survive (because of acquired immunity) will be protected from these pathogens. The protected producers segment would be able to reproduce and continue to extract the resources essential for survival.

The process of industrialization, which began a little over 200 years ago, would lead to an even greater environmental and social transformation. City dwellers would have to contend with industrial wastes and polluted water and air. Slums that rose in industrial cities would become the focal point for pov-
can have important social and biological repercussions).

Despite the pointed critique of the ecological model, we argue that an ecological perspective is a valid context in which to analyze medical systems and human populations operating within these systems. The ecological context explicitly sets health and disease in a system of mutually interacting organic, inorganic, and cultural environments. The cultural environment (economy, politics, social organization, and ideology) receives special emphasis since it is within culture that much of the behavior surrounding health and disease is played out.

The host, the target of the insults, can be studied at a number of levels. The impact of the insult can be analyzed at the level of the population, of the individual, or even at the sub-individual level (i.e., organ or tissue). Individuals are actors making choices that may or may not be environmentally constrained. In an “actor-oriented” behavioral model, we can focus on the process of coping and adapting. The rationale for this approach follows from the observation that health, disease, and illness are not simply objective, verifiable concepts but are informed by the perceptions and social relations of patient, healer, family, and community. Insults can originate from organic, inorganic, and all aspects of the cultural environment, and host response to insults entails modification or use of resources within all of these environmental subsystems.

The goals of individuals, the options available and appropriate for response, and the multiple constraints in the environment that influence response are a part of understanding the adaptation of a group. Options for response to insult are not infinite. They may be constrained by wealth, class position, ongoing and future social relations, and ideology. Rarely do individuals or at-risk groups have only one insult with which to contend; rather they must cope with multiple constraints which may augment a disease process (a drug addiction, hemophilia, psychosocial stress), limit treatment options (poverty), and even alter host goals (performance of necessary production tasks though physical exertion may have negative biological effects). By focusing on the goals, the options, and the constraints of affected individuals and/or groups, we can better evaluate the relative benefit of treatment, and thus have a more thorough measure of efficacy in response to illness. The relative benefit of treatment must be assessed with reference to flexible and multiple indicators of social and biological well-being. Assessment must depend upon the individual’s and/or group’s perceptions of goals.

Adaptation is a continuous dynamic process. Past response shapes future expectations as well as options and capacity for coping. Coping with one set of conditions in turn shapes constraints and options for coping with additional stressors. Given constraints and the context in which they occur, immediate responses are inextricably linked to long-term adaptive processes.

In employing an actor-based model of coping, no arbitrary distinction is drawn between notions of health, disease, and human behavioral response. Both ethnomedicine and biomedicine are the actor’s medical systems which offer appropriate options for response to insult. It is “insult” which is inextricably a part of the larger ecological context in which the actor operates.

The implications of this approach differ from other ecological-adaptive models in medical anthropology. A model of adaptive process conceptually locates both proximate and ultimate causation of illness within the limitations and contradictions of actor goals, options, and constraints. Rather than creating a model in service of larger social, political, and economic powers, we examine how people cope with multiple constraints and limited options, and the social and biological consequences of this process. We identify the individuals and the groups at-risk, locate the contradictions, and thus begin to recognize the needs of those at risk and the action needed to rectify this situation. The implications for change are twofold: 1) change emanates from collective action, and 2) when implementing health programs, existing coping strategies need to be accounted for so as not to remove the power, control, and predictability which already rest within the populations affected. This approach we hope serves as a theoretical framework for health and disease in general, and AIDS specifically.

APPLICATION OF THE ECOLOGICAL MODEL TO THE AIDS PANDEMIC

The ecological model applied to the AIDS pandemic allows medical anthropologists to interpret the various responses to the disease. In particular it juxtaposes the response of those individuals directly affected (the
host) and the response of the surrounding collectives—family, community, government, medical systems (environment). There is an abundance of information on the AIDS pandemic. There is a need to integrate all this information into a holistic, coherent picture. This model allows medical anthropologists to assess truly the needs of those individuals and groups affected, the coping strategies of the surrounding systems meant to meet their needs, and the magnitude and direction of the disease.

Of paramount concern are the dispositions of those at-risk and the support systems that both fail and meet their needs. Assessment of need is based upon the perceptions of those at-risk: what they see as their position in this AIDS pandemic. It is extremely difficult to document the AIDS pandemic from the point of view of the individual directly involved. It requires ethnographic descriptions of great detail.

The most difficult aspect of this pandemic is tracking the spread of infection and being able to predict its future course. The full range of the various expressions of HIV infection are not fully known (Mann, 1987a,b). AIDS is the most prevalent and severe manifestation of this virus, yet there are other diseases related to the contraction of HIV. These diseases are generally classified as “AIDS-related complex.” It is estimated that 50% of HIV-infected persons will develop AIDS-related complex (Mann, 1987a,b). In effect, the categorization of diseases manifested as a result of infection with HIV indicates that the true magnitude of this pandemic is unknown to us. The ultimate impact upon the health of the world population is unknown; the currently recognized syndromes related to HIV infection constitute a significant portion of the problem (Mann, 1987a,b). The magnitude of the pandemic and the future adverse consequences of infection with HIV are not specifically understood, yet the AIDS pandemic is recognized as a health problem of unprecedented scope. As a disease with no known cure, the only recourse is to understand the processes of transmission and the various manifestations of the HIV virus within cultural contexts.

The insult: the HIV virus

HIV which can cause the breakdown of the immunological system is paradoxically a very fragile pathogen. Its replication requires the T-cells of the immunological system. Outside of the blood or semen the virus will die quickly. Its relatively long incubation period (possibly up to a period of five years) results in a relatively long period for its potential transmission. The ability of the virus to survive in semen and blood both increases and limits the possibility of transmission. Cultural practices that result in the exchange of blood or semen increase the potential for infection.

Behaviors that create risk: perceptions, options, goals, constraints

Using data from studies conducted in 1986 and 1987, the Centers for Disease Control (CDC) estimates an average seroprevalence for men who are exclusively homosexual to be between twenty and fifty percent (Booth, 1988). The number of individuals in this group testing seropositive is between 500,000 and 625,000 (Booth, 1988). For bisexuals and men with infrequent homosexual encounters, CDC estimates a prevalence rate of five percent (Booth, 1988). These figures can be traced to characteristics of the gay community before 1980, when a fundamental “platform” of the gay rights movement was the freedom of open sexuality and the individual right to be promiscuous (Shilts, 1987). Coupled with this political stance was the commercialization of gay sex. The homosexual community was not greatly troubled by these medical consequences of the sexually transmitted disease (STD). The commercialization of gay sex was integral to the movement. Businesses of bathhouses and sex clubs grew out of the gay rights movement. These institutions were a $100 million industry across the United States and Canada, and bathhouse owners were frequently gay political leaders as well (Shilts, 1987). From a medical standpoint, these bathhouses were a breeding ground for STD.

As an at-risk group, the homosexual population is coherently organized. In response to the pandemic homosexuals have established a network of communication and support across state boundaries (Bayer, 1987). They have acknowledged the prevalence of the disease among themselves, and its association with certain behavior patterns. They have acted upon the consequences of the AIDS pandemic as it has affected their cultures. The association between AIDS and homosexuality was established early on by both the Centers for Disease Control and the media. Social, political, psychological, and
public health responses to the disease were initially linked to attitudes toward homosexuality (Altman, 1986; Shilts, 1987).

The response of the homosexual communities in the U.S. has been to cope with the multiple insult of not only the virus but also the high moral attitudes of the support systems meant to help them. Gay communities across the country have built a political infrastructure in order to serve their own needs.

Results of a recent study presented at the Third International Conference on AIDS in Washington, D.C., show a “five-fold increase” in the number of gay and bisexual men practicing celibacy. This is evidence that the homosexual community is heeding the parameters of behavior that reduce their risk for AIDS.

The response of the homosexual community to this particular biological and cultural insult demonstrates how people act as modifiers of not only their proximate environment, but of the wider sociopolitical sphere in which are located health systems. The perceptions of the homosexual community affected the perceptions of the medical community. As individuals contributing significantly to the general population of patients using these medical systems, the response of this at-risk group has been to voice what they see as their needs as a collective host shaping options of response to this insult. As a result, in the United States the cultural environment of the homosexual community has evolved to incorporate this AIDS pandemic. They have consciously recognized this insult as a part of their way of life, and have managed among themselves to change behavior that exacerbates the insult. The response and modification of perceptions on the part of the homosexual community have resulted in the response and acknowledgment of the various medical communities to begin to incorporate the needs of this particular group. This situation serves as an example of how and in what ways individuals are able to cope with the dimensions of this pandemic, and contributes to the change in treatment strategies and perceptions of the medical systems meant to meet their needs.

The use of IV drugs

Twenty-five percent of those infected with the HIV virus are IV drug users. The results of a recent survey show that the majority of Americans know how AIDS is transmitted; yet of the 12% who do not know, most are members of an at-risk group (Sullivan, 1987a). The IV drug users are predominantly the ones not being reached by AIDS education programs. According to one spokeswoman, with IV drug users, “passing out condoms and pamphlets does not work” (Sullivan, 1987a).

There are underlying problems and other constraints beyond the risk of becoming infected with the AIDS virus. IV drug users, as addicts, are more likely than other risk groups to accept being ill and running the risk of getting the virus. As an IV drug user, the sacrifice of health has already been made. As a group they are not socially or politically organized. While it is reported that drug outreach teams have had some success in persuading addicts to use clean needles and not to share them, they also say that many addicts believe they have taken adequate precautions if they let the sickest member of their group share the needle last (M. Conners, personal communication). Moreover, drug counselors report that many addicts regard the use of a condom as an admission of sickness or a compromising of their masculinity.

Of the approximately 200,000 IV drug users in New York City 150,000 are not in drug treatment programs (Sullivan, 1987a). Due to lack of governmental funding, both state and federal, there are not enough treatment facilities to meet this particular need. The response of community health care workers and local minority groups has been to loosely organize and lobby for free needle programs and more funding for treatment centers.

The contradictions are evident between the goals of the individuals directly affected and the goals of the larger community that contributes to the policy-making decisions involving treatment strategies. For the IV drug user, the options for response to this particular insult are stunted by the existence of other insults with which they must also contend. They are insults which existed before the introduction of AIDS which influence coping behavior. These insults can be generally summed up as illiteracy, poverty, homelessness, and a culture that does not inhibit drug use.

The circumstances of this debate are elucidated when seen within the larger ecological context. There are factors in the environment that indicate the magnitude of the AIDS pandemic and that can be seen in
relation to this particular debate. It is predicted that by 1990 thirty percent of the hospital beds in New York City will be devoted to AIDS patients (Sullivan, 1987b).

**AIDS in Africa**

Assessing the scope of AIDS in developing countries is difficult. Many lack the diagnostic equipment and funds necessary for surveillance of the disease (Heise, 1988). It is estimated that only thirty-five percent of the population is reached by modern health services (Heise, 1988). In Africa, 41,303 cases of AIDS have been reported by March 1990 (WHO 17Mar90, personal communication). Statistics from the World Health Organization rely on governmental reporting (Mann, 1987b). These statistics significantly underestimate the true impact of AIDS in Africa, and in the developing world in general. The Panos Institute (1987:35) estimates that AIDS will be responsible for 1,000,000 deaths by 1996.

Blood surveys measuring exposure to the virus confirm that HIV is more prevalent in urban areas of African countries than it is in the United States (Heise, 1988). In Africa the disease appears to be spreading by conventional sexual intercourse among heterosexuals. It strikes women as often as it strikes men (Quinn et al., 1988; Mann, 1987b; Altman, 1986, Marlink et al., 1987). The at-risk groups of Africa differ from the United States and Europe (Quinn et al., 1988). Because the most sexually active sectors of the population are also those who are most economically productive, many countries risk losing a significant proportion of both white-collar and blue-collar labor (Heise, 1988; Mann, 1987b). In addition, costs of prevention and care for those already infected threaten to impose a heavy financial burden on countries that may currently spend less than ten dollars per person a year on health care. There are health officials who see the threat of the AIDS pandemic as secondary to other health concerns in Africa. More common diseases, such as malaria, measles, tuberculosis, and cholera, for which we know cures, are of more importance to some health officials. In fact, the recent resignation of Mann from the WHO was precipitated by this issue. Since disease and its manifestations are a result of both biological and social factors, the epidemiology and clinical features of the infection in different countries vary (Quinn et al., 1988; Marlink et al., 1987; Mann, 1985, 1987b; Gorman, 1986a,b; Lang, 1986; Feldman, 1986). Cultural disposition is complicit in the varied manifestations; in Africa the clinical features of AIDS and the difficulty in identifying the risk factors frequently associated with AIDS in the United States have raised questions regarding the nature of the disease and the factors responsible for HIV dissemination in that continent (Curran et al., 1985; Quinn et al., 1988; Marlink et al., 1987; Mann, 1985, 1987b).

Shortly after AIDS was recognized in the U.S. it was diagnosed in African Europeans (Quinn et al., 1988). These cases in turn were traced to 24 African countries, most of them in Central Africa. Serological data has since indicated that the HIV virus existed as early as 1959 in Zaire (Quinn et al., 1988). The disease did not become prevalent until the late 1970s, as reflected by the increase in opportunistic marker diseases from statistics collected by the World Health Organization: Kaposi’s sarcoma, esophageal candidiasis, meningitis, and “slim disease.” The immunopathology of AIDS in Africa is similar to that of the United States, but the epidemiology and clinical presentation vary with country. The characteristics, spread, and mechanisms of manifestation of these endemic infectious diseases, including AIDS, are a direct result of the cultural contexts in which these diseases occur. It is in this way that paths of infection and the various clinical manifestations of AIDS throughout the world can be discerned from one another.

Perhaps no single agent plays the decisive role in influencing the rate of infection with HIV in a given population or the rate of progression of the virus. A conclusion one may draw from such studies is that frequent exposure to a number of agents may provide enough of an antigenic load to result in “immunologic modulations” (Quinn et al., 1988), causing a different natural history of HIV infection in a given population. The epidemiological considerations needed to compare the role of other infectious agents in the infectivity or natural history of HIV in populations already exposed to a number of endemic or sexually transmitted agents are extremely complex (Marlink et al., 1987). Especially in Africa, determining the pathology of AIDS depends upon the consideration of the pathology of other sexually transmitted and endemic infectious diseases, all of which have as characteristics variables that
determine their course of infection and predisposition of the host. This data is relevant only as it is placed within the context of the cultural environment, since the behavior patterns of those at-risk further determine the various characteristics of the disease, its etiology, and its spread.

Since AIDS exists within a larger, ecological context beyond the host and immediate environment, the discovery of associations, both biological and social, between the groups affected, the virus, and other health and disease processes (such as other diseases, previous medical disposition of individual affected, standard of care being offered) can aid in a more accurate prediction of the path of the virus, both in Africa and elsewhere. The process of infection and transmission depends not only on the behavior of the individuals being affected. It depends upon the behavior of the surrounding medical community and their methods of treatment and prevention. How the medical community adapts to the evolution of the actual virus and the course of the pandemic further determines the characteristics of this process.

In Africa, the epidemic has spread rapidly among populations living in malaria-endemic areas (Greenberg et al., 1988). Because AIDS and malaria are both major public health problems, concern about the possibility of mechanisms of interaction between the two diseases has been considered in a number of studies (Mann et al., 1985). Malaria is a leading cause of anemia in the developing world. Blood transfusions are often considered an essential component of the treatment of children with severe *Plasmodium falciparum* malarial infections (Greenberg et al., 1988). A study conducted on a population of children in Kinshasa, Zaire, shows that in the transfusion of the blood of children suffering from this anemia, there was no screening for the HIV antibody (Greenberg et al., 1988).

The association found between the administration of blood transfusions to children suffering from malaria and seropositivity has implications for other areas of the world where both malaria and AIDS are endemic (Greenberg et al., 1988). There is no evidence in this study of a direct biological transmission between malaria and AIDS, yet the indirect transmission is there in the form of certain treatment strategies on the part of the hospital serving these children's needs. This study can be used as an example of the ramifications of treatment practices that apparently seem to have no connection to the transmission of the virus. With knowledge of this, the implementation of alternative health care practices becomes possible. We now know that the paths of transmission can be indirect and convoluted. Other areas of similar association can be explored and may lead, as this study did, to the modification of methods for coping with this disease and its related counterparts.

CONCLUSIONS

An ecological-evolutionary perspective was presented as an approach for the study of disease in hominid evolution. A model that incorporates the interaction of the insult, the population, and the environment was used to systematically consider the diverse variables relevant to understanding the disease process. This model is extended to include the ethnomedical and the biomedical perspective in the analysis of disease-human interaction.

The role of disease in human evolution provides the background for the study of the AIDS epidemic in the modern world. The impact of evolutionary transitions on the biocultural adaptation of human populations and their disease processes speaks to the present AIDS epidemic. The rapid modes of transportation and the urbanization of the world's population result in the rapid transmission of disease from continent to continent. Even with the development of biomedical and public health programs in the many regions of the world, infectious disease continues to plague these populations.

At another level, the ecology of the AIDS epidemic is considered from the perspective of the host population bound in a cultural system that defines disease threats such as AIDS and mobilizes individual and cultural resource to meet the threat. The goals of the individuals, the options available, and the constraints that influence the response are part of understanding the adaptation of a group to a disease.

LITERATURE CITED


