

Emerging Infectious Diseases: Nursing Responses

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Nursing has important roles to play in the prevention of infectious diseases and in the care of persons and families who have such diseases, and it must assume leadership for these roles.

The specter of the potentially disastrous effects of an outbreak of an emerging infectious disease has received widespread attention in the scientific community, political arenas, and the national media. In addition to being the topic of special scientific sessions such as that of the New York Academy of Sciences¹ and being featured in several recent popular books^{2,3} and movies, it has also been the focus of several conferences sponsored by the Institute of Medicine (IOM)^{4,5} and of a new journal, *Emerging Infectious Diseases*, by the National Center for Infectious Diseases, Centers for Disease Control and Prevention (CDC).

In the decade following World War II, it was widely believed in the United States that infectious diseases had been conquered and that infections could be treated by antimicrobial therapy or prevented by vaccination, good sanitation, and environmental controls. This belief was reinforced when it was declared that the goal of the worldwide eradication of smallpox was achieved in 1977. Indeed, by the 1960s, this sense of complacency led to decreased funding for both basic and clinical research related to infectious diseases and to a decline in stringent infection control strategies and the erosion of the public health infrastructure in the United States. This

sense of well-being was shattered by the recognition of the acquired immunodeficiency syndrome (AIDS), which was found to be caused by the human immunodeficiency virus (HIV); by the resurgence in cases of tuberculosis, many of which were found to be multidrug-resistant; by the identification of outbreaks of infectious diseases that were previously unknown in the United States; and by the identification of outbreaks of infectious diseases that had not previously been known to exist. In 1995 the American Academy of Nursing (AAN) spotlighted the problem of emerging microbes and sponsored a session and discussion on this topic. The purpose of this article is to provide an overview of the problem of emerging infectious diseases, summarize the discussion at the recent AAN meeting, and discuss implications for nursing with regard to policies and nursing roles.

OVERVIEW

In January 1996, 36 international medical journals simultaneously published articles on the danger of infectious diseases. The U.S. death rate from infectious diseases rose 58% between 1980 and 1992, and such diseases became the third leading cause of death in 1992.⁶ In addition to causing death, infectious diseases exact an economic and social toll and cause personal suffering. Persons in tropical countries continue to bear the brunt of infectious diseases. More than

1 million children die of malaria in sub-Saharan Africa each year, and, worldwide, 35 to 60 million persons contract dengue each year.⁷

Emerging infectious diseases may be defined as "infections that have newly appeared in a population or have existed but are rapidly increasing in incidence or geographic range."⁸ Emergent infectious diseases may be new diseases that are caused by a newly evolved organism or an organism that has undergone a mutation resulting in a new strain; they may result from the introduction of the organism to humans from another species; or they may result from dissemination of the organism from its existence in a small, circumscribed range of infection⁹ (which may not even be apparent or cause only slight illness) to susceptible populations. In the latter scenario, immune and genetic factors of the host also play a role. Humans may become more vulnerable to infection by microbial organisms and to disease development because of stress, use of drugs, or malnutrition. Emergence may also refer to the recognition of an existing disease that had

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previously been undetected or the reappearance of a known disease that had previously declined in incidence or was thought to be under control (re-emergence).¹⁰ Re-emergence of diseases may occur because of the development of resistance to antimicrobial agents (as with gonorrhea), breakdown in public health measures (as

with tuberculosis), and other reasons. Also included under the umbrella of emerging infectious diseases are agents that already existed and were widespread in humans but are newly recognized (e.g., herpesvirus 6, now known to cause roseola) and association of an infectious agent with a chronic illness (e.g., *Helicobacter pylori* and peptic ulcer disease).⁹

Use of new laboratory techniques and the development of new reagents has resulted in the identification of some infectious agents that were not previously recognized. In some cases, the organism was probably present all along but was not looked for. The majority of these recent "discoveries" have been viruses. However, parasites, bacteria, and fungi have all been associated with emerging infectious diseases. The term "microbial traffic" has been used to describe the movement of microorganisms to new species or new individuals.^{9,11}

Whereas some emerging infectious diseases may seem exotic, many are less so. They may include middle-ear infections in children caused by drug-resistant pneumococci, severe diarrhea such as the cryptosporidiosis outbreak in Milwaukee, Wis., as a result of contaminated water, and giardiasis seen in children at day care centers.¹² In some countries the "umbrella" of malaria obscures the true cause of other fevers and diseases.¹³ "New" infectious diseases are more likely to be identified in populations with a low background rate of endemic diseases, good health care resources, and relative affluence.¹⁴ Examples of some outbreaks of emerging infectious diseases are provided in Table 1.

FACTORS CONTRIBUTING TO EMERGENCE/RE-EMERGENCE

A variety of social, environmental, and medical conditions and changes, some of which occur indirectly, contribute to the emergence and re-emergence of infectious diseases. For example, the outbreak of hantavirus pulmonary syndrome in the United States in 1993 was thought to be the result of a chain of events: heavy rain in the Southwest led to an abundance of pine nuts and grasshoppers, which allowed deer mice, which are the primary reservoir for the hantavirus, to flourish. The rains also drove the deer mice from their underground burrows, providing more opportunities for humans to come into contact

Table 1. Examples of Selected Newly Emerged Human Pathogens and Diseases^{1,2,7,8,15-17}

Disease	Causative organism	Date first outbreak recognized
AIDS	HIV	1981
Ehrlichiosis infection	<i>Ehrlichia chaffeensis</i> (rickettsia)	1989
Hantavirus pulmonary syndrome	Hantavirus	1993
Hemorrhagic fevers		
Argentine	Junin virus	1952
Bolivian	Machupo virus	1959
Brazilian	Sabiã virus	1994
Ebola	Ebola virus	1976
Lassa	Lassa virus	1970
Rift Valley	Rift Valley fever virus	1977
Venezuelan	Guanarito virus	1989
Legionnaires' disease	<i>Legionella pneumophila</i>	1976
Lyme disease	<i>Borrelia burgdorferi</i>	1975
Toxic shock syndrome	<i>Staphylococcus aureus</i>	1979-80

with the hantavirus-contaminated excreta and saliva of the mice. The result was acute illness that occurred mostly in persons in the "four-corners" area of the United States. Hantavirus variants have since been found in 20 states.¹⁸ Many infectious diseases depend on vectors such as ticks or mosquitoes to facilitate their contact with humans.

In addition to microorganism-related factors, other factors that influence the emergence or re-emergence of infectious diseases include social and behavioral changes, climate changes, environmental alteration, political upheaval, migration and transport, natural disasters, travel, demographic shifts, the erosion of public health infrastructure decreasing surveillance, prevention and control, decline in experts in areas of infectious diseases, economics, and health care advances and technology (Box 1).^{1,2,7,8,10,15,17,18}

Some of the categories in Box 1 overlap. For example, changes in our society have led to increased use of salad bars and fast-food and other restaurants and more exposure to contamination and person-to-person spread of disease, as well as inadequate supervision of processing, storage, distribution, and preparation of meat. An example of the diseases that can result is *E. coli* O157:H7 infection; this strain produces toxin that can cause a spectrum of illness, including severe hemorrhagic colitis and hemolytic uremic syndrome.

Outbreaks have occurred as a result of undercooked hamburgers and also through food at salad bars.¹⁹

ROLE OF THE NURSING PROFESSION AND PRACTITIONER

Nurses can have an impact in the field of emerging infectious diseases through the development of policies with regard to surveillance, prevention, and control, through applied research, and through nursing practice. Several professional groups have published recommendations regarding the control of emerging infections; most notable are those by the CDC, the Committee on International Science, Engineering, and Technology (CISSET) of the U.S. President's National Science and Technology Council, and the IOM.^{4,12,20} The AAN group endorsed these recommendations, which are summarized in Table 2 under the categories of surveillance, prevention and control, applied research, and infrastructure. Recommendations for the nursing community and for the AAN that resulted from the 1995 meeting are also listed in Table 2.

For the individual practitioner, the degree of involvement through nursing practice will depend on the nurse's scope of practice, expertise, and location. Nurses should incorporate an epidemiological perspective into their practice, and nursing education programs should provide the

Box 1. Examples of Factors in Emergence of Infectious Diseases

Social Changes and Human Behavior

- Increased use of child care centers can result in the spread of diseases such as giardiasis and cryptosporidiosis
- Changes in sexual mores leading to earlier and freer unprotected sexual behavior can result in gonorrhea and HIV infection
- Increased available time for recreation and a wider scope of recreational activities can bring people in closer contact with vectors for diseases such as for plague or tick-borne diseases such as Rocky Mountain spotted fever
- Recreational drug use has increased and can lead to HIV infection in persons who inject drugs
- Widespread travel and exploration results in the potential for encounter with infectious disease agents and the transport of infected persons into countries where the agent and the disease it causes are not endemic, as with the importation of malaria and cholera into the United States; microorganisms or their vectors may also be transported (e.g., ships are believed to have transported *Vibrio cholerae* from Asia to South America, where a massive outbreak occurred in 1991 to 1993)
- Importation of foods from developing countries in which sanitation may be inadequate can result in the spread of cholera and enterotoxigenic *Escherichia coli*

Environmental Alterations

- Agricultural practices can result in the spread of disease (e.g., in Venezuela in 1989, the clearing of a forested region stirred up dust contaminated with cotton rat excreta, which led to Venezuelan hemorrhagic fever; in another instance, when maize began to be grown in a particular area, this new crop supported large populations of vesper mice that carried the Junin virus, the cause of Argentine hemorrhagic fever)
- Irrigation projects and building of dams can alter water levels, resulting in increases in mosquito populations; for example, after the construction of the Aswân Dam in Egypt, a great increase in Rift Valley fever was noted
- Limits on deer hunting lead to an increased deer population with a greater potential for exposure of humans to the tick that carries the organism causing Lyme disease
- Reforestation can lead to greater animal, vector, and tick populations that can result in diseases such as Lyme disease
- Altering wooded areas for recreation or for building homes can result in a greater exposure of humans to animal, vector, and tick populations, which can lead to disease such as Lyme disease

Disasters and Wars

- Earthquakes lead to conditions such as crowding and malnutrition, poor sanitation, contaminated water and food, and aerolization of excreta in dust (e.g., coccidioidomycosis followed the 1994 Ventura County earthquake in California)
- Wars, civil conflicts, and political unrest lead to malnutrition, sexually transmitted disease outbreaks, crowding, poor sanitary conditions, stress, migration of population, and more; diseases preventable by vaccination, such as diphtheria and polio, may appear, as occurred in the former Soviet Union in 1993 and 1994

- Floods lead to water-borne diseases such as cholera
- Famine leads to malnutrition and decreased host immunity and resistance, resulting in a population with greater susceptibility to infectious diseases

Demographic Factors

- Population growth leads to crowding and provides a greater pool of people who are susceptible to infectious diseases; the crowding allows easier transmission from person to person
- Population composition has an impact on the spread of disease because populations with large numbers of elderly people or very young people may be susceptible to disease outbreaks as a result of inadequate immunity and other reasons
- Migration of humans can lead to exposure of the migrants to diseases that are endemic in the new location that then take on epidemic characteristics in the new population (e.g., the increased incidence of coccidioidomycosis in southern California); the resident population can also acquire disease from the immigrant (e.g., cases of neurocysticercosis in New York City believed to have been transmitted by immigrant household workers); in addition, moves from rural to urban areas may bring organisms that were formerly limited to causing disease in a few people to larger susceptible populations; furthermore, if immigration is illegal, immigrants may not seek health care for infectious illness, thus allowing further spread
- Poverty leads to malnutrition, poor sanitation, decreased host immunity and impaired resistance, exposure to pollutants and toxic waste (for example, poor persons may eat fish caught in local contaminated waters), increased stress, and more conditions favoring exposure to and spread of diseases

Climactic Changes (Global Warming, Weather Patterns, Jet Stream Changes)

- Increased rainfall can result in rodent proliferation and hantavirus pulmonary syndrome
- When changes in ocean temperatures result in warmer ocean surface temperatures, increased algae and "red tides" may result, leading to poisoning from certain shellfish

Health Care Advances and Technology

- Organ and tissue transplantation can lead to immunosuppression, or the donor may be infected with a transmissible disease; for example, Creutzfeldt-Jakob disease has been acquired from corneal transplants
- Immunosuppressive drugs for treatment of cancer, arthritis, and other disorders can lead to susceptibility to opportunistic infections such as *Pneumocystis carinii* pneumonia
- Widespread use of antimicrobial therapy can result in the development of microbial resistance, leading to increased incidence and frequency of diseases such as multidrug-resistant tuberculosis or chloroquine-resistant malaria
- New technology can lead to the spread of disease (e.g., contaminated human growth hormone injections have led to Creutzfeldt-Jakob disease)
- Medical devices such as indwelling catheters and mechanical ventilation can lead to nosocomial infections

Table 2. Recommendations/Goals Related to Emerging Infections

CDC	CISET	IOM	Nursing/AAN
Surveillance			
<p>Strengthen notifiable disease surveillance at state and local levels</p> <p>Establish two physician-based Sentinel Surveillance Networks</p> <p>Establish four population-based Emerging Infection Epidemiology and Prevention Centers</p> <p>Strengthen and link four existing sites for a global consortium</p>	<p>Establish regional disease surveillance and response networks</p> <p>Develop a global alert system</p> <p>Assist WHO to establish global surveillance of antibiotic resistance and drug use</p>	<p>International infectious disease surveillance for the U.S. should be coordinated by the CDC</p> <p>The U.S. should take the lead in promoting development and implementation of a comprehensive global infectious disease surveillance system</p>	<p>Support, interpret, and disseminate to the nursing community recommendations made by other leading agencies (e.g., CDC, CISET, and IOM), focusing on implications for nursing</p>
Prevention and control			
<p>Develop additional means to deliver laboratory and public health information informing health professionals about emerging infections and antimicrobial drug resistance</p> <p>Develop and implement guidelines for prevention of opportunistic infections in immunosuppressed persons</p>	<p>Encourage and assist other countries to make infectious disease detection and control a national priority</p> <p>Preserve existing U.S. government activities that enhance the ability of other countries to prevent and control emerging health threats</p> <p>Work with private and public sectors to improve U.S. capacity for emergency production of diagnostic tests, drugs, and vaccines</p>	<p>Introduce measures to ensure availability and usefulness of antimicrobials and to prevent emergence of resistance</p> <p>The EPA should develop and implement alternative, expedited procedures for licensing pesticides</p>	<p>Collaborate with other professions and policy making groups in mutual support, endorsement, and evaluation of global strategies to prevent or reduce the threat of emerging microbial diseases</p> <p>Communicate with other nursing groups and recommend that they develop and disseminate to their own constituencies policies and standards to prevent the spread of emerging infections</p> <p>Identify mechanisms to promote appropriate prescription and use of antimicrobial agents</p> <p>Address strategies to enhance host resistance and immune competence</p> <p>Take leadership in major initiatives to focus on preventive strategies</p> <p>Take an active role in science literacy of students in grade K-12</p>
Applied research			
<p>Reestablish extramural program to support emerging infectious disease prevention and control activities</p> <p>Initiate prevention effectiveness studies to assess impact of food preparation guidelines</p>		<p>The U.S. Public Health Service should develop a comprehensive computerized infectious disease database</p> <p>Expand and coordinate NIH; support research on agent, hospital, vector, and environmental factors that lead to infectious disease emergence</p> <p>Increase research on surveillance and control; costs and benefits of prevention, control and treatment; diagnostic tests</p> <p>NIH should increase priority of personal and community health practices relevant to disease transmission</p>	<p>Promote in nursing education and curricula a population-based, epidemiologic, system approach for nursing practice and research</p>
Infrastructure			
<p>Provide state-of-the-art training in diagnosis and testing for laboratory personnel</p> <p>Establish a public health laboratory fellowship</p>	<p>Ensure reliable lines of communication between local and national medical centers and between national and international reference facilities</p> <p>Identify regional and international resources to provide diagnostic reagents for low incidence diseases</p> <p>Identify and strengthen WHO Collaborating Centers</p> <p>Establish authority of U.S. government agencies to make most of effective use of their expertise to build worldwide surveillance and response network</p> <p>Enhance collaboration between U.S. agencies</p> <p>Rebuild U.S. infectious disease surveillance</p>	<p>Develop and implement strategies to strengthen state and federal efforts in U.S. surveillance</p> <p>Allocate additional resources to the CDC to enhance the NNIS</p> <p>Expand CDC's Epidemic Intelligence Service and Field Epidemiology Training Program</p> <p>Continue support of the Department of Defense overseas infectious disease laboratories</p> <p>Ask Congress to consider legislation to fund a program for training in public health and related disciplines</p> <p>U.S. should develop a means for generating stockpiles of vaccines and a "surge" capacity for vaccine development and production</p> <p>Priority and funding should be afforded to develop pesticides and other measures to suppress vector-borne diseases</p>	<p>Serve as a clear voice among policy makers for support of public health, advocating support for public education, public health infrastructure, and policies that protect the environment and promote ecological balance</p>
<p><i>EPA</i>, Environmental Protection Agency; <i>NIH</i>, National Institutes of Health; <i>NNIS</i>, National Nosocomial Infections Surveillance System; <i>WHO</i>, World Health Organization.</p>			

foundation for knowledge in the area of infectious diseases. Some ways in which nurses may act to prevent or intervene include the following:

- Educate clients about risks and personal hygiene, which can include guarding against tick exposure; cooking meat thoroughly and eating thoroughly cooked meat; using safer sex techniques; washing one's hands after using the toilet, changing diapers, or exposure to fecal matter; and appropriate use of antibiotics to decrease inappropriate use of over-the-counter drugs and inappropriate requests for antibiotics from a provider.
- Use of infection control procedures; it is important that nurses have the ability to institute appropriate controls and to educate patients, visitors, family, and personnel about infection control and appropriate hand washing.
- Maintain awareness of unusual disease clusters, outbreaks, or illnesses, and be especially alert for unexplained deaths in young people.
- Institute or participate in immunization programs for adults and children, educate patients about the importance of immunization, and facilitate access to and availability of immunizations for those who need it.
- Use techniques to enhance client adherence to medication regimens to prevent treatment failure and development of microbial resistance.
- Participate in environmental cleanliness programs in the community and in the institution; this can encompass such items as adequate ventilation, air pollution, and basic public health measures such as safe water, elimination of places where birds roost and sources of standing water, and rodent control.
- Examine prescribing practices to ensure appropriate use of appropriate antibiotics.
- Be an advocate for clients in regard to environment.
- Obtain thorough patient histories, including an assessment of travel history, recreational activities, and potential exposures in the workplace, home, and community; for example, the

manner in which workplace clothing in certain environments is handled can be important in transmitting infections and toxins to the home.

- Assess diet practices (for example, the use of unpasteurized milk) and teach clients about proper nutrition and food handling.
- Promote breast-feeding in countries in which there is a high risk of contamination of milk or infant formula.
- Train local people in health education and practices with use of culturally acceptable and locally accessible material and practices.

This is by no means an exhaustive list. Other important environmentally related questions may be found in the IOM publication "Nursing, Health, and the Environment."²¹

CONCLUSIONS

Efforts by humans to improve health and living conditions through such practices as using antibiotics to treat infections, improving agricultural practices, and expanding technology may have unintended consequences. Infectious diseases are emerging, re-emerging, and increasing in the United States, taking a toll in both morbidity and mortality. The fact that microorganisms now have quicker and greater access to susceptible populations has truly resulted in a global community with regard to infectious diseases. Nursing has important roles to play in the prevention of infectious diseases and in the care of persons and families who have such diseases, and it must assume leadership for these roles. ■

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