SOCIAL, BEHAVIORAL, AND DEMOGRAPHIC FACTORS IN EMERGING INFECTIONS*

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There has been one rather dramatic emergent disease in our lifetime: HIV. It came at a time when we thought that we had defeated most infectious diseases. Many people would like to dismiss the importance of the HIV pandemic; they see it as something that does not affect "people like me," and that, therefore, it is a myth that heterosexual AIDS exists. Obviously, that point of view is ludicrous.

HIV has utterly defeated us as a public health community. It has overwhelmed the planet. It now exists in every country in the world. It has made its way into continents well after the whole world knew what it was, how to prevent it, and how individuals should protect themselves. Nevertheless, we have been utterly unsuccessful in stopping this virus's relentless surge across the world.

SOCIAL IMPACT OF AIDS AND OTHER DISEASES

One of the realities that I have seen firsthand, and those who have looked at HIV in the developing world have undoubtedly seen, is the devastating social impact this disease is having. I am reminded of a photograph of a group of Tanzanian children, accompanied by an adult. In fact, the "adult" was only 19 years old at the time the picture was taken; the rest of these children were orphans. In one village in Tanzania, a 19-year-old adolescent was the elder raising all the other children, because all the adults in the village had died of HIV. This

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sort of thing is not uncommon. I have been in villages in Africa where no adults are left except the very elderly, which in African terms means people in their 40s and 50s, and the post-adolescent adults that one hopes are not already infected.

There are wild estimates of the numbers of orphans created by HIV. The US Agency for International Development has estimated that 355 million orphans will be in Africa by the year 2000. That roughly translates to 11% of all under-15-year-olds on the sub-Saharan parts of the continent.

There is also a clearly increasing infant mortality due to the death of the mother, father, or both, with a 15% increase in Zambia in infant mortality between 1984 and 1994.

In the US, the epidemic of HIV and other epidemics of bacterial diseases, tuberculosis (TB), and others are driven by a different set of social factors. Clearly, crack cocaine, which entered New York City in 1985, roughly, and the rise in heroin use in our society have played a very crucial role in the emergence of a variety of diseases. We tend to focus on HIV because it is so obvious. If you inject a virus into your bloodstream, you will get a disease. But several other diseases are associated with intravenous and crack cocaine smoking use, and they are associated in ways more complex and more difficult to confront.

We have tried desperately in this country to control our drug epidemic. Every president in my adult lifetime has declared a war on drugs in the US. Every president and every Congress have passed laws that increase the expenditures for arrests and drug control. Yet, it is very clear that narcotics, cocaine, and illicit drug use continues to rise in our society. It rises not just out of a sense of social alienation or out of the stereotyped communities. In fact, the majority of intravenous drug users are white and are men.

I think that much gets missed because people look for the stereotyped drug user patients, which often translates into looking for African-Americans from Harlem. A great deal of disease gets overlooked.

Many diseases are associated with the drug use environment. For example, about 6% of all the people incarcerated in New York City in the 1920s had malaria associated with injecting heroin or opium, and it was discovered that, by cutting the product with quinine, heroin dealers eliminated the problem. In fact, there are a variety of ways that it seems those who deal in and distribute drugs in the streets of New York, Chicago, and Houston are wiser than the infectious disease specialists. They seem to know that they are dealing in dangerous products, not just directly toxic, but also with secondary dangers. They do not want their clients to die. It is not in their interest, just as it is not in the interest of most

viruses to kill off their hosts. It is not in the interests of the parasitic drug dealers to kill off all potential clients. For a long time, they also have been dealing on the streets in antibiotics and associated drugs that might be useful for smoothing a bum trip and getting people over infections and overdoses.

I think we must consider very carefully what all that polydrug climate does to contribute to the emergence of antibiotic-resistant bacteria, how it plays a part in endocarditis incidence, and what role it has been playing in the emergence of multidrug-resistant TB. We also should consider from a global perspective what communities like this represent as ecologies for disease emergence.

Infectious diseases are the most common cause of death in the world. Even many of the things that might be attributed to other causes, such as many neoplasms, will be associated with infectious diseases. Yet, clearly they do not represent commensurate expenditures or devotion of resources globally.

We see the emergence and re-emergence of infectious disease crises all over the world. They are coming at a time when our own agencies responsible for monitoring such matters find themselves woefully deficient. For example, a report has been issued by the Centers for Disease Control and Prevention (CDC) that indicates very clearly that the deterioration of municipal and state public health systems in the US is imperiling the capacity of our federal public health system. After all, just as the World Health Organization (WHO) cannot go into any country unless invited, CDC cannot enter a state unless invited; it cannot enter a specific outbreak or epidemic unless invited. That means that the state or municipality has to know what is going on within its boundaries. Yet, what we see now all over the US is that cutbacks have taken a severe toll. The budgetary crisis of the US began at the municipal level. Most of the severe public health cutbacks at the municipal level hit hardest in the mid-1980s. By the late 1980s and early 1990s, similar levels of slash and burn were hitting state public apparatuses. At the time of the New York Academy of Medicine conference in 1995, Congress had just rescinded all the \$88 million amassed for construction of a new, much-needed facility at CDC, and there was talk of further slashes for fiscal 1996 and 1997. Further, the White House was scrambling to have CDC's infectious disease division and its Biosafety Laboratory (BL3) construction project saved "at roughly 50% of that which had been amassed" until then. This budget cutting meant that the BL3 facility, for example, which was much, much needed, would probably not be able to be constructed for another decade because, even under the White House proposal, CDC would only have half of the funds needed for construction.

"HOT" TOPICS

I do not think that medical specialists, who judge diseases by rational scales, have any sense, or can even begin to comprehend, what one report of flesh-eating bacteria meant to the average member of the European and American public. It captured imaginations like nothing I have ever seen before, certainly in ways that HIV never has and in ways that a far greater threat in New York City, multidrug-resistant TB, never did. There is something about the ghoulish notion of some creatures crawling over the body and eating flesh that seems to have captured the American public. Unfortunately, it skews the public's sense of priorities and of where expenditures should go.

Something else captured the attention of the American public and the global public in September 1994. That, of course, was the pneumonic plague outbreak in India, which became the subject of every single news organization's major coverage during that two- or three-week period. I was struck by the fact that I was one of the only reporters I know who actually went to Surat, India, during the plague, walked the streets where most certainly the disease managed to emerge, and studied the ecology and social situation there. The world sensationalized the plague outbreak, and certainly India suffered deeply in economic terms (one estimate was \$2 billion lost to the Indian economy, a staggering amount for that economy) as a result of the global concern about plague in India and the various ways in which countries boycotted Indian goods and human transport.

It was easy to sensationalize the pneumonic plague when it occurred. Very important lessons can be learned and studied about the ecology that supported the emergence of this long-silent form of *Yersinia pestis*.

When the bacterium first made its way into Indian streets, it did so having previously emerged under earthquake conditions in the eastern part of the state of Maharashtra, the capital of which is Bombay. In that area, there had been a major earthquake in the first week of October 1993. It was a devastating earthquake for Indians: 10,000 people perished immediately; 52 villages were decimated. People became terrified; they left their villages and abandoned their housing, a not unwise thing to do as aftershocks continued to collapse buildings. Many people used their housing and old buildings as storage bins for family goods and grains from their harvest; then they locked them and walked away.

It took a while for the World Bank and Indian government to mobilize for reconstruction of the villages. Essentially, they created little domed structures and deposited them all where the villages had been. By June 1994, people started coming back to the villages.

Not long after that, in August 1994, strange reports began to come from this very remote area: people opened up the long-sealed former homes and various structures and were overwhelmed by fleas. One report I saw described a man who could not see because there were so many fleas in front of his face. There also were reports of people being overwhelmed by the number of rats and mice that had exploited the stored grains. Although rebuilding had begun, the area still lacked most of its prior infrastructure, which was not extensive to begin with, especially its public health clinics.

As people got sick and the rates of illness increased, so did the level of anxiety. In a few villages, infection rates exceeded 10% of the village population. This was the bubonic form of the plague. Many people felt there was nobody there to take care of them; the local clinic had never been rebuilt since the earthquake, so they did what people in this area have done for years. They went to Surat.

Why Surat? A, because it was accessible by train, and B, because there is 0% unemployment there. Surat is a textile and diamond-polishing center. The area requires totally nonskilled labor, and plenty of jobs were available. Most rural villagers in that immediate area, particularly young men, would periodically go to Surat in order to make cash, perhaps in the agricultural off-season. People were familiar with Surat; they knew the area, and they came into town, arriving just before the festival of the elephant-headed god, Ganesh.

At that time, Surat was experiencing the worst monsoons in memory. The river had flooded over its banks; many neighborhoods were submerged completely. The waters had just begun to retreat a few days before the festival of Ganesh, but there still were very few places where people could do what one does during the festival of Ganesh: make elephant statues, drink and be merry, and go to the nearest body of water, which in this case could have been the river Tapti. There, they would celebrate with many other people and eventually dump their statues into the body of water.

Because the Tapti had swollen severely and the riverbank was unstable, there was far less solid ground to stand on: hundreds of thousands of people congregated on spaces about the size of a football field. Somewhere in those crowds were people who had fled the Maharashtra bubonic plague area and were untreated. Therefore, at least some of them had acquired the pneumonic form of the disease.

The day following the festival of Ganesh, the first seven cases showed up in the Surat civil hospital.

The staff at the hospital handled their plague outbreak very well. They identified it quickly, they responded quickly, and the civil service physicians stayed on the job. Of course, everybody else abandoned ship. All the other doctors left

town; all the pharmacies were locked, and the pharmacists fled. Most of the nurses locked up and left town, and every single private hospital dumped all their patients on the streets, locked up, and the staff left town. But, the civil servants hung in there.

Among the many things they did by way of control efforts and to quell the international criticism of India were actions that probably put individuals at other health risks. For example, DDT powder was applied on the streets of Surat, an unnecessary measure because there were no fleas and no large infestation of rats in Surat; transmission there was entirely person to person with no vector intermediary. The vectors were quite a long way away, but measures such as this were taken to salvage the Indian economy and international image of India.

They also brought in members of an unusual Hindu cult that specializes in worship of a rat-related god and that eats rats. They brought the cult in to capture as much food as they wanted in Surat.

WIDESPREAD TRANSMISSION: TRAVEL AND EVOLVING MEGACITIES

Elsewhere in the world, what everybody worried about in this case of plague, and more recently in the case of Ebola, is that someone who was infected would get on an airplane and travel to the wealthy world. There are good reasons to be concerned as our global village shrinks: while we have dodged the bullets so far, eventually something will arrive. In New York City, John F. Kennedy International Airport is the place. There has been a dramatic increase in the use of commercial airlines. The International Air Transportation Association expects the 1990 figures to be exceeded almost logarithmically by the year 2000.

All over the world, we are witnessing the most dramatic urbanization process in human history. Never before have so many human beings abandoned their rural roots and moved into cities. Within the cities, we are witnessing population explosions that are astronomical. The birth rates within the cities almost invariably exceed the birth rates in the rural areas and so do sexually transmitted disease rates—as do all the rates of everything associated with densely compacted human beings and disease.

The evolving megacities of today are different from the great cities of the past. Modern megacities are not growing at the slow pace at which New York and London became megacities. While New York and London were witnessing booms economically, they also were able to build appropriate infrastructures to accommodate the influx. In Calcutta, however, people are living beneath bridges; living conditions can only be described as acute squalor. There is no running

water in the evolving megacities. There is no sewage and no provision of basic health services for most of the people in the megacities.

Many people in the megacities are living as if they were still in their villages. They bring the village ecology with them: the livestock, the chickens, the dogs, the pigs, the cats; they live in housing that resembles the housing structures the people were accustomed to in their villages, but do so under incredibly dense conditions.

As a result of this, we are seeing the emergence of urbanized, formerly entirely rural, disease syndromes. For example, leishmaniasis and schistosomiasis are appearing in urban settings. We also are seeing, in the squalor, constant interactions, not only of the humans and their livestock directly in these concentrated settings, but also of the excreta of all the above mixed into whatever is called the water supply.

I think it is difficult for those who have not traveled in developing countries and in these megacities to fathom the complexity of this ecology from the microbial point of view. If there is going to be a time when a disease previously confined to pigs, for example, will find a way to jump species, this is the ecology in which it will happen.

INCREASED RISK IN THE DEVELOPED WORLD

We have increased our human density in the developed world, but have done so at a pace slow enough that we could accommodate the needs of our increasingly compacted population. In places such as China, India, Indonesia, Mexico, and, prior to the civil war, Rwanda, increases in density have been far more rapid.

In the US, our overall population density is low, but we are increasingly putting members of our population in housing situations that are incredibly dense, particularly prisons and jails. I have seen estimates, in congressional reports, that between 70% and 90% of the increase in American jail and prison populations is associated with the war on drugs, not necessarily with increases in incarceration of violent criminals. What we see now is that, because our jails and prisons are overcrowded, more and more people are in a revolving door cycle: they come in from slum communities and go into the jail or prison system, perhaps Rikers Island, for example, for four, five, or six days. Then, they are back on the streets again. Then, they go to trial. They get convicted, they go back into the jail or prison system, and then they are paroled very quickly.

We are seeing, therefore, an interchange of the ecologies of the community and the ecologies of the jail or prison. The pace at which the human flood tide is going back and forth is increasing as the time for parole shortens and the

prison sentences shorten. We know this played a huge role in the emergence of the TB problem in New York City.

Globally, TB, according to a recent WHO report, is out of control. WHO now concedes that one of the biggest contributors to the current global TB crisis is, in fact, the very methods that were used to try to control TB around the world, which is to say, promotion of standard isoniazid-rifampin therapy without close observation and guaranteed use of the full duration of drug treatment. This has certainly contributed globally to the burden of drug-resistant TB and also has contributed to the burden of infectious individuals in the general society.

We also currently are experiencing a global crisis with cholera, with at least four different types of cholera now simultaneously making their way around the world. The same phenomenon obtains with malaria, which we set out to eradicate in the 1960s; today, malaria rates exceed those seen before the eradication program commenced.

EMERGING INFECTIONS: AN ECOLOGICAL PERSPECTIVE

All over the world, in the megacity environments, we see people living in proximity to water sources that will support the breeding of insects that can serve as vectors for disease and, of course, also as sites for passage of diseases carried via the gastrointestinal tract.

We are also doing medical procedures that put people at risk. Such procedures include transplants and, most recently, transplant of baboon tissue, which may carry organisms into immunosuppressed human beings. Globally, we are witnessing astronomical rises of sexually transmitted diseases, all focused around the megacities and, mainly, major transport and shipment routes going to and from the megacities.

A final word should be said about Ebola. We need to look very closely at why Ebola virus emerged in Kikwit, Zaire, and ask the ecologic questions I was trying to raise about the emergence of pneumonic plague in India.

The shorthand answer is, we are looking at an ecology in which there was no government, in which the president had personally looted an estimated \$5 billion to \$7 billion from the national bank, and his close buddies, acolytes, and sycophants had looted about another \$10 billion, according to Central Intelligence Agency estimates. The currency, the zaire, was worth less than half a cent. It took about a 20-pound satchel of zaires to buy a tank of gas. There was in Kikwit no industry, no employer. There was only one paved road. There were virtually no cars, no running water, no electricity, and no telephones. There was nothing that would make this thing qualify as a city except 400,000 human beings.

The way that those human beings supported themselves and managed to find

the wherewithal to feed their children was through a very strange, integrated ecology that involved walking vast distances to the edge of the forest, which is getting deforested and pushed back continually, and harvesting bananas and so on, and, as was the case with the index case, burning the forest down to make charcoal to bring back to sell as fuel.

Somewhere in that ecology is the reservoir for this virus, an ecology that has been hunted into devastation and, in the case of most large animals, into extinction. (In spring 1998, I returned to Kikwit, finding that, remarkably, conditions had worsened as a result of the 1997 civil war. The Kikwit hospital had absolutely no soap or hygienic materials. The roads out of Kikwit were destroyed, making the city a virtual island accessible only by air. The general impoverishment of the population had reached perilous levels.) So, stay tuned. It may be that an Ebola virus source will finally be found, or there one day may be another Kikwit Ebola crisis.