SCIENCE

EDITORIAL

The Microbial Wars

In the 1930s, a visitor to a hospital would have found the wards filled with victims of infectious diseases such as pneumonia, tuberculosis, typhoid fever, and encephalitis. In 1985, the visitor would have found many patients suffering from organic diseases such as cancer, heart disease, and stroke rather than from an infectious disease. This dramatic shift led some officials to proclaim in the 1980s that the era of microbial diseases as a threat to mankind had passed, but declaring a triumph over the wily bacterium and its henchman the virus was premature. The bacteria and viruses have mutated, so many drug-resistant strains now threaten to overwhelm the very hospitals and health care systems that had temporarily reduced their importance. In a test sample in Hungary in 1988, 58% of the *Streptococcus pneumoniae* strains tested were resistant to penicillin, and 70% of children carrying *S. pneumoniae* were also resistant to backup antibiotics like erythromycin and tetracycline. The situation is not unique to Hungary but is being repeated in all the countries of the world. It was dramatized recently in the United States when a beloved entertainer died suddenly of a microbial infection caused by a drug-resistant strain.

The result is a war in which humans, using refrigerators, sanitation, boiled water, and antibiotics try to kill, starve, and subdue the microbes. The microbes fight back by developing new pathways, new proteins, and new strategies for survival that are as ingenious as those devised by humans out to destroy them. It is a war involving millions of lives, causing pain and tragedy. One doctor, interviewed by this editor, said, "When these new drug-resistant strains become endemic in hospitals, you will be safer staying home than going to a hospital unless you have a truly dread disease."

In this issue of *Science* (coordinated by Barbara Jasny), a number of distinguished authors give their perspectives on this emerging threat. Richard Krause puts the potential for new plagues in historical context and suggests that plagues arise during times of change in social customs, demographic shifts, and technological discoveries. Mitchell Cohen discusses the epidemiological data that show the steady increase of illness and deaths resulting from multi-drug resistance in the hospital and the community. Barry Bloom and Christopher Murray discuss the great killer tuberculosis, which was documented in the time of Hippocrates. This disease was subdued for a while in more recent times by drugs but is now reemerging in terrifying numbers. Harold Neu discusses the molecular strategies used by bacteria to evade antibiotics. Irwin Kuntz has discussed the practice of drug design, certainly one of the weapons that will be used against the bacteria. The potential for rational drug design, although in its infancy, should increase rapidly, because of our increased knowledge of protein structure and the enormous capacity of computers. Classical microbiological techniques will also be needed, and genetic engineering provides powerful new tools of its own.

However, the solution requires more than scientific breakthroughs. According to the authors of this series, the problems have been compounded by our lack of vigilance. Patients must be disciplined enough to complete courses of antibiotic therapy and not quit when they feel better. Doctors should not overuse antibiotics, and we must recognize that we have a global problem. Future strategies and societal problems are discussed by Ann Gibbons in the News & Comment section.

Action on the scientific and social fronts will be needed because the bacterial systems are very clever, and the crisis is here. Already, people are dying in large numbers in the most advanced hospitals in the world, and the drug-resistant strains are spreading even more rapidly where hospital and sanitation conditions are more primitive. Those who believed a plague could not happen in this century have already seen the beginning of one in the AIDS crisis, but the drug-resistant strains described in this issue, which can be transmitted by casual contact in movie theaters, hospitals, and shopping centers, are likely to be even more terrifying to a population that is now highly sensitized to the risks of one part of trichlorethylene per billion. Because of the capacity of microbes to adapt to new circumstances, there will probably be a continuing battle for many years, a subterranean war in which complacency and lack of determination can result in pain and death.

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