

PATHOGENS—MAKING A COMEBACK?

By James R. Chastain, Jr., PhD, PE, MPH



In March, I was able to attend the International Conference on Emerging Infectious Diseases in Atlanta. The biennial conference sponsored by the Centers for Disease Control and Prevention and the World Health Organization provides an opportunity for medical and public health researchers to share their findings on a wide array of disease status, treatment and research needs from around the globe. Obviously, Avian Influenza (bird flu) was the subject of many papers, but that was just one of many diseases addressed. Numerous presentations were made that also discussed the factors contributing to these emerging (or reemerging) diseases. Because of the advances in medicine and public health over the last century, it is easy to adopt a complacent attitude toward the threats that these diseases present.

Whether the avian flu ever develops into a human threat or not, a repeating theme of the conference was that it is highly likely that we will face a pandemic(s) of some sort within our lifetime. Why make a statement like that? Don't we have modern medicine and state-of-the-art technological means to fight diseases?

While we do have technological tools that are orders of magnitude more advanced than previous generations which can produce marvelous results, it must be remembered that there are other trends moving against us in that battle, too. We live in an ecosystem that is highly interdependent and changes are occurring. Those changes will ripple through the system in ways we really don't understand at this point. To elaborate on this in detail is well beyond the scope of this article, but it might be useful to sketch some of the key drivers.

Recall that human infectious diseases are caused by pathogens that circulate through the environment. They are (or have been) associated with other species which can act as hosts, reservoirs, amplifiers, or vectors of the disease. As with the avian flu, in its current form it is primarily lethal to bird species, but has limited effect on humans. The concern is that it will follow the pattern of many of our current endemic pathogens and mutate to a form that is highly infectious to humans. A study of the history of plagues and diseases show this to be a repeating pattern. The means by which these changes occur typically are associated with intimacy of species contact, the number and frequency of contacts and the susceptibility of the various hosts.

As a starting point, let us acknowledge that among other things food, water, energy and appropriate forms of shelter are key components to sustainable life. Considering food only for the moment, we understand all forms of life are in competition for protein. Directly or indirectly every living being survives at the expense of others. The endless transfer of protein is a primary component of the food chain (actually better characterized as the food web). Everything from the smallest virus to the largest animal competes in this arena. Given this setting, consider the following factors: (a) increased human population, (b) intensification of agriculture, (c) globalization of trade and (d) global climate change.

Countering the increasing improvements in medical technology is the significant increase in world population. The United Nations estimates that in 1997 there were approximately 5.7 billion people on earth and by the year 2020 there will be approximately 7.5 billion people. It is helpful to divide the population estimates into assessments of the developed countries and the developing countries. This breakdown is presented in Figure 1.

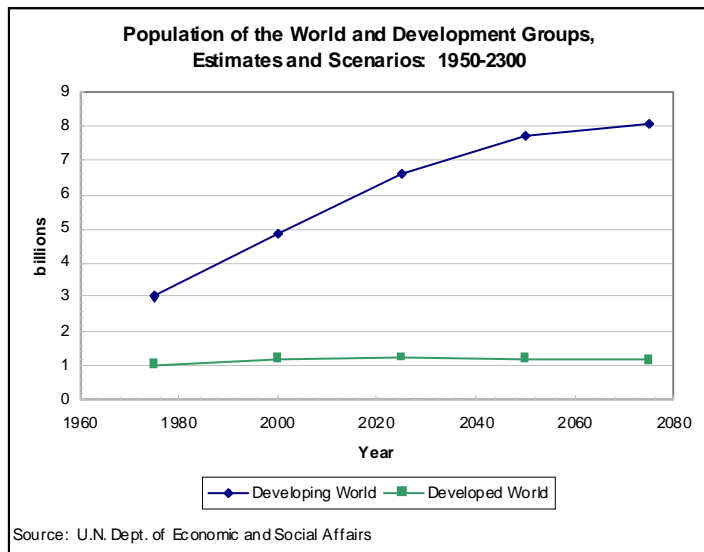


Figure 1

Notice that while the population of developed countries is projected to stay relatively constant, the population of developing countries is growing at a rapid pace. When one considers the economic implications of this population increase, the need for additional food, water, energy, shelter, and employment is sobering. This is not to necessarily predict a Malthusian future because technological developments can work to address some of these needs, but it does require a serious assessment of the implications.

In order to feed the world population, it is necessary not only to produce sufficient foodstocks but also to distribute them where needed. Using meat consumption as one component of the needed protein in a diet, the United Nations Food and Agriculture Organization and the International Food Policy Research Institute have estimated the necessary meat consumption trends over time (see Figure 2).

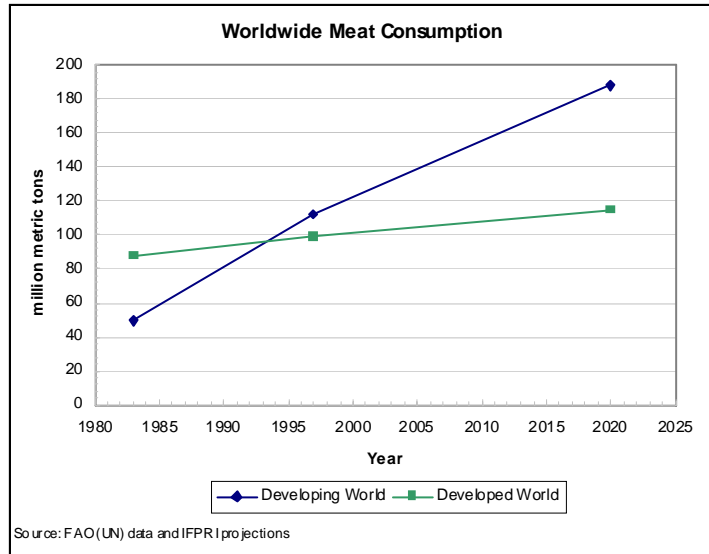


Figure 2

At this point let's pause to consider the implications of these graphs. There will be a marked increased demand for food, water and other services. Unless the developing areas can make significant improvements in relatively short order, there is an increased risk of famine and pestilence in certain areas. A malnourished population has always been associated with increased risk of disease. Also, because of the need for meat products, there tends to be a close physical association with food animals (chickens, pigs and cattle) with family or population units in the developing countries. It so happens that many disease mutations occur as a result of these associations. In this setting you can imagine their view of outsiders sweeping in and ordering them to kill their poultry or livestock (as health authorities are doing with the avian flu). Given that the fact that those animals represent a key part of their dietary and economic sufficiency, destroying them, even with compensation, is a difficult thing. As the population grows and such demands are made, will there be sufficient food replacement volumes available to those who have lost their animals? Maybe...or maybe not...depending on the magnitude of the purge events and the ability to timely transport adequate replacements to target areas.

Since the end of World War II and especially over the last 30 years, there has been an amazing expansion of trade and interlinking of world economic interests. This globalization of trade has resulted in many economic benefits and has been spurred by improvements in transportation and technology. One factor that impacts public health is the speed at which diseases can travel across the globe. Figure 3 presents an interesting graphic that highlights this fact. In addition to the speed with which people (and diseases) can quickly move from one area to another, the trade in livestock and food products also is moving with increased range across the globe. According to a recent article in Nature magazine, a number of experts believe that global trade (legal and illegal) is more of a threat to flu migration than the seasonal migration patterns frequently mentioned in the news.

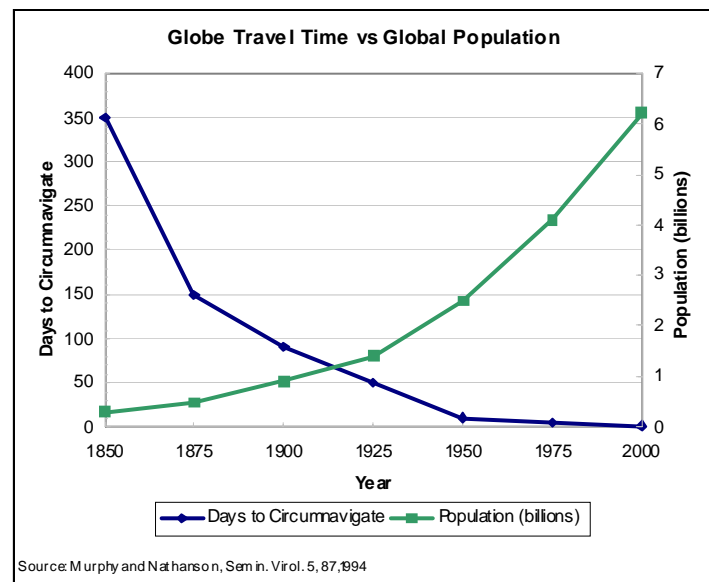


Figure 3

Among the comments that they make is that diseases tend to migrate from east to west while avian flyways are primarily north and south. No doubt all these factors play a part in the spread, but they make a very strong case for the impact of human trade on the migration. This factor (especially smuggling or unmonitored trade) can only become an increasing issue if widespread culling of birds or animals is required as a disease control measure.

Also, if the global warming trends continue to manifest themselves as many predict, major impacts on weather events and temperature trends could follow. This in turn has a direct relationship to disease patterns and development. As global warming patterns establish themselves, they will encourage changes in ecosystems and will foster increased microorganism growth and geographical range. This is already being seen in Alaska and other polar areas where glacier melt and habitat stresses are beginning to manifest. Polar zones and coral reefs are among nature's more sensitive indicators of this global climatic stress. As one studies infectious disease development over time, common themes are tropical climate areas, population concentrations and/or movement, poor hygiene, close contact with animal populations (esp. pigs, chickens, cattle, dogs) and their associated vectors (fleas, ticks, mosquitoes). All of these factors are emerging in increasingly strong relationships as outlined above.

While dramatically improved microbiological tests and vaccines are available, our ability to manufacture sufficient doses of the vaccine to respond to a pandemic event is woefully limited when compared to the population to be treated. As the world population increases, the competition for access to manufacturing capability and supplies will be fierce, unless significant improvements in cycle times can be achieved.

While some of the presentations presented at the conference were disconcerting, we are still better prepared than past generations. The primary message was one of renewed diligence in combating microbial enemies that are taking new forms. From a local perspective, community planning to deal with the management of widespread illness will be important because needs will quickly outstrip the medical/public health infrastructure's ability to respond. Businesses should develop a strategy for operating during a crisis event such as a pandemic. This is difficult, but some guidance is available and more will be developed in the future. For the time being, it may be helpful to refer to the following websites for information:

http://www.uschamber.com/issues/index/defense/pandemic_influenza.htm

<http://www.pandemicflu.gov/plan/businesschecklist.html>

<http://www.whitehouse.gov/homeland/pandemic-influenza.html>

Dr. Jim Chastain is the President of Chastain-Skillman, Inc. He has a Bachelor of Science in Civil Engineering (honors) and Master of Engineering from the University of Florida. He also has a Master of Public Health and Ph.D. from the University of South Florida. He is a registered Professional Engineer with over 30 years of experience and is a Diplomat of the American Academy of Environmental Engineers. He can be reached at (863) 646-1402 or jrchastain@chastainskillman.com.

© 2006 Chastain-Skillman, Inc. This article is taken from the 3rd quarter 2006 issue of Consultant's Update, a publication of Chastain-Skillman, Inc.