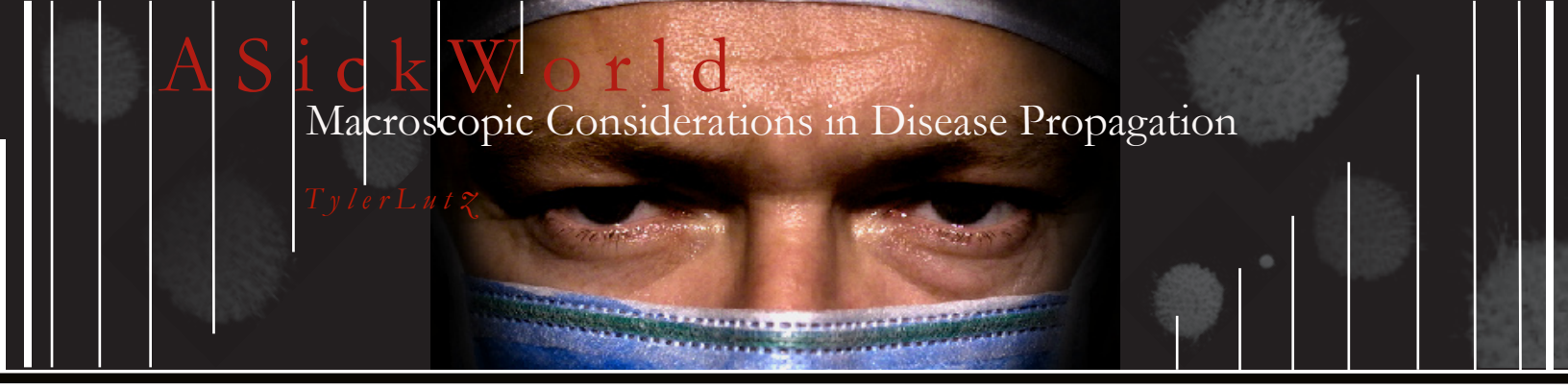

A Sick World

Macroscopic Considerations in Disease Propagation

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Wash your hands before eating, get plenty of sleep, avoid unnecessary contact with sick people - we have all become accustomed, especially during times of flu outbreaks or other impending pandemics, to receiving a barrage of information and tips about the measures that we as individuals can take to reduce our own susceptibility to diseases. But leaving the question of disease propagation and prevention on this individual basis fails to present a full picture of how diseases really spread, for achieving this higher level of understanding requires us to consider the link between larger social structure and disease. The interesting question then becomes, "to what extent can such properties of a society or region as its structure and wealth influence its susceptibility to disease?" Appreciating this new question would provide insight into, for instance, why disease allowed the Conquistadores to gain an upper hand over the Native Americans and why it did not happen the other way around, or into why pandemics such as AIDS have proven to be particularly devastating to developing countries. But more importantly, answering it will provide us with a stronger grasp on how we, as members of both local and global communities, should direct our efforts against infectious disease in the present and the future.

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Economic Considerations

Let us first dispense with a few superficial and on the whole not particularly enlightening ways of understanding macroscopic disease propagation. As recent history has shown with regards to diseases such as polio, a society that synthesizes a vaccine and can produce sufficient quantities of it such that either all at-risk groups can be protected or that the effects of herd immunity come into effect is better able to cope with the given disease. Furthermore, it seems reasonable to say that a society possessing the resources to either educate people about preventive measures or to immediately treat individuals infected with typically non-fatal diseases such as pneumonia would experience fewer casualties from the disease than a society lacking such resources, which is why the World Health Organization reports that pneumonia is a leading cause of death among children "worldwide and particularly in developing countries" (WHO 2009).

In addition, we can imagine that a society willing and able to undergo drastic measures such as total quarantines or the downright expulsion of the infected individuals from society (such as what many ancient societies did to counter the infectious disease leprosy) would be less susceptible to such diseases. The implementation of such measures, however, is of course only plausible in rare and extreme circumstances, and indeed, it is wholly ineffective if the means of propagation is not social contact but rather some external vector such as mosquitoes.

Though the aforementioned considerations are indeed significant, they still too pose only a partial and unfulfilling answer to our inquiry into disease propagation on a macroscopic scale. For in the end, they can all be seen to be strongly correlated to the economic viability of a given society, thereby suggesting that the ideal disease deterrent is nothing more than a strong economy. There is indeed compelling evidence to bolster this standpoint; according to a British Depart-

ment of Health report in 2002, the death rate from disease in England declined from 369 to 9 per 100,000 in the period from 1901 to 2001, a drastic decline which the Department attributed to better sanitation and health measures, regulations made possible through increased economic prosperity (Roberts 2006). Furthermore, the WHO reported in 2002 that "the risk of intestinal infectious disease is highest among the poor" and that "50-70% of the burden of diarrheal diseases, measles, malaria and lower respiratory infections in childhood is attributable to under nutrition," which is in turn associated with economic standing in extreme cases (Roberts 2006). But following this logic to its reasonable end seems to indicate that, by the time the global human population has reached the apex of its economic development, infectious disease will simply no longer be an issue. Can we really count on that? The issue is complicated by two considerations; first, infections and plagues very often hinder development, either simply through reducing the workforce or more foundationally by weakening a specific sector of the economy, thereby rendering the very notion of a disease-free economic 'apex' unrealistic. Secondly, as we will see, development can indeed increase the susceptibility of a society to disease! In any case, it is clear that economics alone does not provide the whole story – at least not for those of us stuck in the 21st century.

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It may appear as though the preceding discussion has oversimplified the mechanisms of disease, and this is indeed the case. The propagation of disease is a matter of contact, but we must further specify the nature of this contact before proceeding. The one mode of disease propagation over which a society can often have virtually no control is in utero transmission, whereby a disease is passed from mother to child. Transmission by vectors such as mosquitoes, fleas, or ticks is another possibility for the nefarious pathogens, though one vastly easier to counteract through such simple prevention measures as mosquito nets or spraying. The most interesting form of transmission is interpersonal transmission, which can occur through physical or sexual contact with an infected person, or else through contact with contami-

Figure 1. Increasingly intertwined global social and economic networks caused SARS to skyrocket to an international concern.

nated feces or through droplets suspended in air through coughing (Sattenspiel 2009). Because of this interpersonal mode of transmission, it is reasonable to guess that increased contact between societies – be it through travel or war - can ly increase a society's chances of contracting a disease (Sattenspiel 2009). There is much historical evidence to support this theory; it is widely acknowledged that one of the most devastating consequences of the First World War was not directly related to the military conflict, but was rather the catastrophic Spanish Flu, whose propagation was dramatically expedited by not only the injured health system and economic infrastructure across Europe but also the contact between soldiers during the war. A modern day analogy to the Spanish Flu is the SARS pandemic, which became a global concern only because of the prevalence of air travel to and from countries afflicted with the disease. Contact seems to be an inevitable consequence of a globalized economy, and it thus seems that, even as countries improve their own health networks, increased contact with other regions will directly result from the development of the global economy, counteracting any potential positive consequences of such economic progress.

Figure 2. From the Florentine codex of Conquest-era Mexico. Smallpox proved to be among the most powerful weapons in the Spanish arsenal.

Agricultural Development

Let us momentarily turn our attention away from the spread of disease and instead towards its origin. Numerous historical studies have found a strong correlation between the domestication of animals and the incidence of disease in humans (Sherman 2006). The reasons for this appear to be twofold; firstly, domestication historically coincides with sedentary lifestyles and thus urbanization, which increases interpersonal contact. Secondly, since a large portion of human diseases can be traced back to animal diseases (smallpox to cows, measles to dogs, HIV to chimpanzees, SARS to civet cats, etc.) domestication of animals increases the society's contact with these infectious diseases (Sherman 2006). As a society develops agriculturally and socially, it must face the diseases associated with domestication, and it should eventually acquire a collective immunity to such diseases. When such highly developed societies come into contact with other societies with lower agricultural development status and without exposure to the associated diseases, a dramatic decimation of the

> "Diseases helped cause Mexico's population to fall from 20 million to about 1.6 million, a precipitous decline which cannot be attributed exclusively to the guns of the Spaniards."

population can occur. Examples of such decimation include Spanish conquest of the New World, during which smallpox and other diseases helped cause Mexico's population to fall from 20 million to about 1.6 million, a precipitous decline which cannot be attributed exclusively to the guns of the Spaniards (Smallman-Raynor 2004). Why didn't the infection occur in the opposite direction and decimate the Spaniards instead? UCLA professor Jared Diamond argues that it was a combination of a difference in the amount of time since agricultural development occurred as discussed above and a relative difference in the number of trade routes and domesticated animals. By 1492, the Native Americans had not developed the same sort of richly intertwined trade network as was present

Figure 3. South Africa is the country with the largest number of people living with and dying from AIDS.

in Eurasia, a network which favored the geographical spread and development of the disease and hence the progression towards natural immunities to these. Furthermore, Diamond sets the number of domesticated animals in the New World at no more than 5 (the turkey, guinea pig, llama, Muscovy duck, and dog), as compared to the vastly larger number present in Eurasia (Diamond 1992). The Europeans had had contact with a larger number of animal species and thus had developed immunity against far more diseases than the Natives did, explaining at least in part why the Europeans had a biological advantage over the Natives.

We cannot deny that economic considerations play a driving role in the efforts to prevent disease in our modern world, but, especially in a climate of limited budgets, money certainly cannot be counted on to solve all the problems of infectious diseases. Since we have seen that the propagation of disease is strongly dependent on patterns of interpersonal contact and agricultural development, we should not focus solely on economic solutions but rather, as citizens of a world where complete isolation is no longer possible, take another look at our social organization as a factor in disease propagation. In developing integrated solutions to the infectious diseases which our planet faces and in ascribing responsibility for the mitigation of these diseases, we cannot ignore the patterns of contact between societies and our agricultural history.

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