Infectious diseases continue to be the leading cause of death worldwide and the third most common cause of death within the United States.\textsuperscript{1} Fifty years ago, many scientists believed that the battle against infectious diseases was over, but the identification of over 30 new human pathogens, including Ebola, HIV/AIDS, and Hantavirus, within the last two decades has shown that this battle is still raging.\textsuperscript{2} Globalization promotes the emergence and re-emergence of infectious diseases. Throughout history, human migration has exacerbated the spread of infectious diseases. The technological advances made in transportation have revolutionized travel, greatly expanding the number of travelers, as well as the distances and the speed at which they travel. In 2002, the World Tourism Organization registered approximately 715 million international tourists.\textsuperscript{3} One can travel from continent to continent within a matter of hours and around the globe within 36 to 72 hours—well within the incubation period of most infectious diseases.\textsuperscript{4} When an infected individual arrives at his destination, a deadly infectious agent may also be disembarking with him.

Severe acute respiratory syndrome (SARS) is a good example of these new threats. It is one of the latest infectious diseases to emerge and has proven to be exceptionally rapid in its spread and virulent in its clinical manifestation. SARS is characterized by a high fever of 38 °C or greater, a nonproductive dry cough, shortness of breath, and a history of exposure to a SARS patient or travel to an area with a known outbreak. Other symptoms include general flu-like symptoms, such as headache, overall discomfort, and body aches. A small percentage (10-20%) of patients also develop diarrhea and most develop pneumonia.\textsuperscript{5}

SARS first originated in Guangdong, a southern province in China, in November 2002. Due to a cover-up by the Chinese government, the disease went undetected by the international community until February 11, 2003. SARS was then first carried out of China on February 21, 2003 by an infected doctor, and within days, it spread to Hong Kong, Vietnam, and Singapore. As doctors and citizens from these countries began to travel around the world, so did SARS. It presented the real potential for a global epidemic. Therefore, on March 15, after having received news of over 150 cases globally, the World Health Organization (WHO) declared SARS a worldwide threat. While WHO regarded every country with an international airport to be at risk for SARS, the United States escaped any outbreaks, despite the introduction of the virus from travelers returning to the U.S. from overseas. Malik Peiris of the University of Hong Kong attributes the escape of any outbreak to “mainly dumb luck.”\textsuperscript{6}

The United States’ escape of any outbreak was attributed to dumb luck in part because the superspreader that was believed to be responsible for spreading SARS beyond China did not travel to the United States. Most SARS cases could be traced back to one such superspreader, a Chinese doctor who became infected while treating patients in his hometown, located within Guangdong Province. In February, he traveled to Hong Kong, where he passed the disease on to
at least 13 other individuals in the hotel where he stayed. Four of the infected occupants of this hotel also became “superspreaders,” infected individuals capable of spreading a disease to a disproportionate and large number of people. Most infected cases usually only spread SARS to an average of three other people, while superspreaders transmit the infection to at least 10 other people. These superspreaders facilitated outbreaks in Toronto, Hong Kong, Vietnam and Singapore, while the other nine individuals safely returned to their home countries without creating the same ripple effect. An additional factor in SARS limited spread within the U.S. was that the first SARS case did not appear until after the WHO global alert was issued and until after the outbreak in Toronto had begun. The first wave of the outbreak in Toronto alerted the U.S. public health officials to the fact that this disease was not merely a disease of Asians and that it could also spread to this country.

It is uncertain, however, whether the measures taken by the CDC were responsible for the lack of SARS outbreaks in the United States. One reason for this skepticism arises from the seasonal nature of coronaviruses. Coronavirus infections have the tendency to increase in incidence during the winter months and then dwindle during the warmer months of the year. The SARS outbreak subsided in July 2003, consistent with the seasonal nature of these viruses. A second reason for the uncertainty in the efficacy of the CDC’s actions surfaces from an examination of the disease spread within the European Union and the public health measures implemented there. Only 33 cases and one death were reported in a total of eight countries. While one might attribute the low incidence of SARS in Europe to extensive public health measures, further inspection reveals that only limited public health precautions were taken in Europe. In contrast to the measures instituted in the United States, the main measures taken by the European public health officials were screening of individuals entering and exiting European countries and disseminating general information on symptoms of SARS and what to do if one should become ill. Contact information was also maintained for at least 14 days on all individuals entering European countries from SARS-infected countries. Contrasting the public health measures of the United States and Europe suggests that the extensive public health measures enacted in the U.S. may not have lead to fewer cases of SARS.

Considering this information and the current knowledge that the SARS epidemic of 2002-2003 did not lead to significant morbidity and mortality even in the most severely affected areas, was the extensive U.S. response warranted? On one hand, one could make the assertion that the measures enacted were appropriately aggressive given the unknown nature of the agent. However, enacting aggressive measures was not a universal response, as evidenced by the more conservative reaction in Europe. These conflicting reactions and on the part of nations presented with similar information regarding the emerging SARS epidemic encourages the contrast of the magnitude and expense of the U.S. response to SARS to that of West Nile virus and influenza, two other infectious disease threats occurring in the U.S. at the same time as the threat of SARS was being considered.
Because the circumstances of SARS are likely to be repeated when new pathogenic agents with similar modes of transmission are discovered in the future, the following questions were posed: Within the United States, was the public health and general public reaction to SARS proportional to the actual impact of the disease? How did it compare to West Nile virus and influenza? Did an increased perception of risk for SARS influence how the American public reacted to this novel disease, as compared to how it reacts to West Nile virus and influenza? Most importantly, were the measures taken and the reaction to SARS ones that should be repeated with other new emerging diseases?

To answer the question of whether the public health and general public reaction to SARS was proportional to the actual impact of the disease, as compared to West Nile virus and influenza within the United States, disease impact and disease reaction were quantified for each disease. It was hypothesized that the reaction to SARS outweighed the actual impact of the disease and that the reaction to SARS was also greater than the reaction to the two comparison diseases. Disease impact included information about the incidence and mortality rates of each disease. Specifically, the number of cases and the number of deaths for a given period of each disease were reported. These results reveal that a large number of Americans were infected with influenza as compared to West Nile Virus and SARS and highlighted the great disparity in the number deaths due to each disease, with by far the greatest number of deaths stemming from influenza. The mortality rates of SARS (0%) and influenza (0.06-0.12%) are considerably smaller than that of West Nile virus (6.8%). In summary, these combined results display that both influenza and West Nile virus impose a considerable disease toll on the United States. The impact of SARS, however, was minimal.10,11,12

The public health reaction was gauged by the amount of money spent by the CDC for each disease during 2002. The most money ($38.3 million) was spent on West Nile virus, followed by SARS ($16 million). Only $4 million was spent on influenza.13 The extraordinary expenditure on SARS, however, becomes particularly clear when viewed as CDC expenditure as an investment per case per disease; the CDC expenditure for SARS equaled over half a million for each case. This contrasts dramatically with the nine cents being spent per case of influenza in 2002. While this is not an exact estimate of how much it costs to control each disease, this information provides an idea of how the CDC is prioritizing its budget.

The public reaction was assessed by the combined number of newspaper articles printed about each disease in The New York Times and Washington Post and by the economic impact of each disease. Although the time period covered by the SARS outbreak was approximately four months less than the time period when influenza was endemic in this country, more than ten times the number of articles was published for SARS than for influenza. This corresponds to an average of 2.73 articles per day for SARS and only 0.62 and 0.21 for West Nile and Influenza respectively. Additionally, while the length of the articles on West Nile virus and influenza were somewhat similar (average of 546.18 and 506.98 words per article, respectively), the average number of words per each SARS article was considerably longer (824.15 words).
Review of the literature for studies addressing the economic impact of disease illuminated the fact that not many studies focusing on this aspect of epidemics have been performed. Acknowledging the lack of research in this field and the obvious economic impact of SARS, Lee and McKibbin (2003) published a study on the global economic impact of the disease. They estimated SARS to have had a substantial impact on the economies of China and Hong Kong. A 1.05% decrease in gross domestic product (GDP) was estimated for China, while a 2.63% decrease in GDP was estimated for Hong Kong. Lee and McKibbin also concluded that the economic impact inflicted by SARS did not result from the consequences of the disease itself for affected people. Instead, the major economic impact resulted from the behaviors of individuals within these economies in response to fear and uncertainty.

Overall, this assessment of disease impact and disease reaction support the hypothesis that the public health and public media reaction to SARS exceeded its impact, as well as the impact of influenza and West Nile Virus. This was illustrated by the disproportionate amount of CDC funding and number of newspaper articles allotted to SARS when compared to the much lower incidence and mortality rate of SARS in the United States. Despite the considerable toll that influenza exerts on this country, CDC expenditure per case was tiny. The number of newspaper articles published about influenza was hardly significant in comparison to the enormous threat of the disease to the health of the American public. Furthermore, the results of the Lee and McKibbin study indicate that the economic repercussions attributed to SARS were not due to medical risks but instead came from individuals’ behaviors in response to fear and uncertainty. Although their study did not directly assess the economic impact for the United States, their conclusions regarding the marked impact of individuals’ behaviors in response to fear and uncertainty above actual medical risks raise a large concern for the United States. The Lee and McKibbin study demonstrates that even in the United States where the medical risks of SARS were miniscule and the public health and media reactions were disproportionately large, the impact of fear and uncertainty could have enormous economic repercussions.

To answer the question of whether individuals’ risk perceptions for SARS, West Nile virus, and influenza influenced their reactions to these diseases, an online survey targeted at UVA students was developed. This survey consisted of a series of questions about participants’ background knowledge, thoughts, and opinions about these three diseases. Certain questions where designed to evaluate participants risk perceptions of each disease and to assess what fright factors contributed to these perceptions. The fright factors explored were inescapability, perceptions of health professionals’ knowledge, and the availability heuristic. It was hypothesized that the public viewed SARS to be a greater risk than either influenza or West Nile virus. Of 1600 students sampled, 503 participants to provided complete responses to the online survey. Overall, the results from this survey did not confirm the hypothesis that participants would view SARS as a greater risk than either influenza or West Nile virus. Students had risk perceptions that were consistent with the actual threats of the diseases. Also, the fright factors mentioned above did not have an impact on participants’ levels of worry.
The overarching goal of this research has been to address the questions of whether the public health reaction to SARS was commensurate with the relative threat it posed to the U.S. public and whether it is a model that should be repeated with other new emerging diseases. The results strongly suggest that the reactions to SARS were based on non-empirical, subjective measures of risk rather than scientific, objective measures. Documented measures of disease impact showed that the medical impact of SARS was minimal in the United States, particularly when compared to the simultaneous threats of influenza and West Nile virus. However, both the public and the public health reactions directed more resources and attention towards SARS, as indicated by CDC expenditures per case and the media coverage of each disease. The non-objective nature of the United States’ response is further illustrated by the inconsistency in worldwide public health measures, demonstrating that no scientific assessment of risk was consulted when determining the public health reactions to be implemented in response to SARS. Furthermore, Lee and McKibbin concluded that the economic impact inflicted by SARS did not result from the consequences of the disease itself for affected people, but from fear and uncertainty. Combined with the other measures of disease reaction and of disease impact, the current study illustrates how the American response to SARS, one driven by emotional, subjective measures of risk, presented a risk perhaps as great as the risk of the virus.

In this increasingly global society, SARS illustrates how the consequences of disease can travel just as quickly as the virus itself. SARS also demonstrated that an increasingly important consequence of disease has now become economic impact. Previously, economic impact from disease only arose if there was also a substantial medical impact; with SARS, however, there was very little medical risk and impact, but considerable economic ramifications. This effect was primarily due to the basis on which public health measures were enacted: fear and uncertainty, rather than objective, scientific assessments of risk, medical impact, and economic impact. As such, the reaction to SARS is not one that should be repeated in the future, and to avoid doing so, it is necessary to create models that can assess medical risk, global spread, and economic consequences rapidly and accurately. In order to do so, international collaboration and communication must be encouraged so information of disease outbreaks becomes available as quickly as possible.

Selected References: