Forecasting the Potential Impact Viral Outbreaks will Have on the United States Tourism Industry

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Abstract

One of the biggest challenges facing the United States tourism industry will be the threat of Emerging Infectious Disease (EID) outbreaks, primarily those caused by viruses. Since most viral outbreaks originate in other parts of the world, the top Ten U.S. Cities welcoming international travelers could be immediately impacted. The potential fear factor/avoidance response of customers leading to cancellations of travel is primarily influenced by the severity of the symptoms and the mode of transmission by specific viruses. The amount of news coverage also effect show the public perceives potential hazards. City visitor bureaus and tourism industry leaders must be prepared with proactive containment procedures to minimize damages, both real and imagined.

Keywords: International travel, Outbreaks, Public Perception, Pandemic

Initial Considerations

The global threat of the next pandemic is not a question of "if" but "when" it will occur. The potential impact it will have on the United States tourism industry depends on the public perception of the risk factors presented.

According to Borenstein, (2003) since 1970, more than 35 new Emerging Infectious Diseases (EID) have been identified by scientists in the World Health Organization (WHO) and the Center for Disease Control (CDC). An emerging disease is defined as one that has appeared in a population for the first time, or that may have existed previously; but, is rapidly increasing in incidence or geographic range.

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Expansive trade and travel has allowed these diseases to quickly spread around the world. According to the CDC, viruses have accounted for seventy percent of the reported world outbreaks since 2000. These outbreaks often received extensive media coverage which greatly influence show the public perceives the potential risk and threat of a viral pandemic. (Preidt, 2008)

The U.S. tourism industry, including travel, lodging, and food service, is a multi-billion-dollar-per-year industry providing one in every eight jobs. When an epidemic is predicted, the transportation and lodging components are immediately impacted with a reduction in revenue from reservation cancellations and travelers avoidance of that region. There is the added risk to service employees 'direct exposure to potential viral hazards from interactions with guests. The food service segment faces a similar risk of infected employees and potential increases in food cost. Brown (2000) noted that often an outbreak necessitates the destruction or culling of a specific agricultural animal and the commodity prices increase due to a reduction in global supplies.

Analyzing the factors that resulted in previous viral outbreaks and determining the degree of impact they had allows forecasting of future events. Four factors were identified that influenced whether the tourism industry was affected or not. The virulence of a virus contributes to the "fear" factor, determined by the symptoms and predicted fatality percentages. The mode of transmission of the virus such as the human-to-human airborne was identified as the most contagious and hardest to avoid. Since most outbreaks originate outside the United States, U.S. cities with the highest number of international visitors and returning U.S. travelers are immediately targeted. The amount and magnitude of the media attention contributes to the aversion behavior in response to the disease and the public perception of its dangers.

Using historic and current information, this paper analyses the extent that a viral outbreak could have a ten major U.S. city's tourism industry within two weeks of its introduction. The increase in global travel has shortened the period of a pandemic occurring from one year to three months; but it is the initial confirmation of its arrival that determines the impact it will have both economically and in terms of human loss. In 1918, it took the Spanish Flu epidemic over a year to travel around the world, with today's travel, a virus can spread globally in a very short period of time.

This was demonstrated in early 2003, when the Severe Acute Respiratory Syndrome (SARS) virus spread from Guangolong province in China to thirty-seven countries world-wide in a matter of weeks (Koenig & Schultz, 2014).

It is vitally important that prior to any hint of an outbreak the tourist industry has worked closely with the community leaders, especially the local Convention and Visitors Bureau (CVB) and media. Communicating accurate information, following preventive protocol and containment will result in long term benefits. This paper explores the predictability of the economic impact of a viral outbreak, identifies which regions will be most affected. It also explains why viruses have such a huge influence on the tourism industry and why vigilant monitoring is important to reduce human suffering and financial loss.

Literature Review

The global impact of viruses affecting humans, animals, and plants has increased at an exponential rate. The world's top scientists speculate that environmental, social, and agricultural changes have helped trigger an unprecedented explosion of new infectious disease. The category of EID with the greatest potential to cause panic and disrupt entire countries' economies is viruses.

Viruses are communicable agents that cannot replicate without the presence of a host cell. They penetrate the host cell, insert their genetic material, and convert the host to a virus producing organism. There are numerous types of viruses, some contain double stranded DNA or deoxyribonucleic acid, and some are single stranded RNA or ribonucleic acid. The RNA variety is less stable than the DNA viruses and is more likely to mutate. It is difficult for an RNA code to detect a damaged protein group from the real one, so mutations are not spotted or repaired. Many more mutations take place in an RNA virus per day than occurs in the majority of organisms. When the mutated version of the virus is introduced into the population, there are no antibodies therefore; the population lacks immunity to the "new "virus (Fauci, 2005).

The University of Edinburgh Research (2003) discovered that of the 1,415 microbes that cause disease in humans 61% are carried by animals and transmitted to humans, which are classified as "Zoonotic" diseases.

After the Avian flu pandemic of 1957, where two million died, it was theorized that pigs are the "mixing bowls" of many viruses. They are just as susceptible to picking up human flu strains because their genome is so similar to that of humans. If a human flu strain and an avian flu strain should infect a pig at the same time, then the two different viruses could exchange genetic information and pick up the human gene that controls the transmission from human to human. (Brown, 2000)

In an effort to identify and respond to new zoonotic diseases before they spread to humans, the U.S. Agency for International Development (USAID) established its Emerging Pandemic Threats (EPT) program. The EPT program consists of four projects: Predict Respond, Identify, and Prevent. The Predict project seeks to identify new emerging infectious diseases that could become a threat to human health, predict partners locate their research in geographic "hotspots" and focuses on wildlife that typically carry zoonotic diseases. Their findings are catalogued into a database, a predictive map of potential disease outbreaks is created and response policies are proposed (Xenias, Erdmann, 2011). There are several different modes for viral transmission. Airborne is perceived to be one of the most dangerous, followed by contact with body fluid from a contaminated animal or person. Transmission from a vector such as a mosquito, tick, flea, or animal depends on the ease of avoidance.

Wladslaw Kowalski (2003), an Aerobiological engineer from Pennsylvania State University identified as many as 100 infectious bacteria, viruses, and fungi which can be transmitted by air. The reason we have a "flu" season or you are more likely to be exposed to a viral particle from an airplane cabin is because the air is drier. When the virus leaves the host's body as a cough or sneeze, it is encased in fluid. The droplet must be small enough to aerosol but large enough to keep its protective moisture capsule. If the air is dry enough for some of the moisture to evaporate then it can remain airborne; however, if the air is moist then it typically falls to the ground—limiting its ability to infect.

The virility of a virus is classified as being severe if it has a ten to fifty percent fatality rate to non-life threatening, which usually means flu-like symptoms. Although this may seem like a large spread, when a virus outbreak first occurs, the fatality rate is initially much higher. Long term birth defect such as microcephalus caused by the Zika virus is considered to be in the severe category.

International Travel and Tourism Exports

The U.S. Travel Association estimates that one out of every eight American jobs depends on travel, tourism and international travelers (2014). United States hosts the second largest volume of international travelers in the world, approximately thirty-two million each year. Most of them arrive or visit one of ten cities: New York City accounts for nearly one third of all international arrivals to the U.S., Florida (24 percent), California (21 percent), Nevada (9 percent), and Hawaii (8 percent). In addition, in 2014, Americans made a total of 60.7 million trips outside the U.S. borders, if you exclude trips to Mexico and Canada; chances are that almost twenty million returned through one of these major cities.

The tourism industries located in the top ten cities for receiving international travelers and returning American travelers experiences a greater potential impact for being quarantined or identified as a "hot spot". Between the years 2000-2014, WHO responded to forty-eight world-wide epidemics? Seventy percent involved viruses and the rest were caused by cholera, malaria, or plague. Table 1 shows that forty percent of the total epidemics originated in Africa, followed by twenty-six percent in Asia. Only sixteen percent of United States travelers visited either Africa or Asia as shown in Table 2.

Table 1: Geographical Origin of Viral and Non-Viral Epidemics 2000-2014

Geographical Origin	Viral Epidemics	Percentage Of Viral	Non-viral (cholera, malaria, plague)	Percentage Of Non-Viral	Total Percentage of Origin of Epidemics
Europe	0	0%	0	0%	0%
Caribbean	2	4%	1	2%	6%
Asia	8	16%	5	10%	26%
South America	2	4%	0	0%	4%
Central America	1	2%	0	0%	2%
Oceania	5	10%	0	0%	10%
Middle East	2	4%	2	4%	8%
Africa	8	16%	12	24%	40%
World wide	2	4%	0	0%	4%

Source: WHO, 2014

Table 2: United States Travelers to Overseas Destinations excluding Mexico and Canada, 2014

Region Visited by US traveler	Percentage of U.S. travelers
Africa	**1.2%**
Europe	39.3%
Asia	**14.9%**
Caribbean	22.0%
Central America	8.6%
Oceania	1.9%
Middle East	5.4%
South America	6.0%
Other	.7%

Source: ITA Office of Travel & Tourism Industries, 2014

Media Coverage

The amount of attention that the media gives a specific outbreak is determined by its severity, and what other world events are occurring at the time. Researchers at McMaster University in Hamilton, Ontario (2008) found "that a single incident reported in the media can cause great public concern if it is interpreted to mean that the potential risk is difficult to control, as with the possibility of a pandemic."

In 1999-2000, with the exception of the United States national election, not many major stories were being covered. The introduction of the West Nile Virus in New York City originating from Uganda resulted in seven deaths and sixty-two confirmed infections; but, for a city with a population of nine million, this was an almost insignificant outbreak. The fact that it was spread from infected mosquitoes and there wasn't much other news to report, it was covered daily and caused public panic. Within three years West Nile Virus had spread to thirty-four states with a death toll of twenty-two and 200 confirmed cases. Although the highest reported incidents occurred in Louisiana, *Disney World* in Florida reported a thirty percent drop in attendance during their typically peak summer months. Florida was not on the top states affected by the infected mosquitoes (Chang, 2002).

2011, in comparison, had many major news stories to report: Osama bin Laden was killed, Kate Middleton and Prince William were married, and there was unrest in the Middle East. It should be noted that a measles outbreak in the Congo killed 4,500 and was barely mentioned by the press.

Ebola had been a reoccurring epidemic in Africa since 1997; but, the headlines and media focus during the summer months of 2014, showed a public interest surrounding this issue. Google searches for information about the disease surged during the months of August and peaked as their number one search in October 2014. (Google, 2015)

However, there is a fine line between too much information and publicity and not enough. The fact that the Chinese government was aware of the SARS outbreak in 2002 and kept it to themselves resulted in mistrust and misinformation. When it finally surfaced and WHO issued a global alert, fear of travel characterized the market. According to the Smith Travel Research (STR) report (2004), the hotel performance in Hong Kong hotels during the outbreak showed an -88.9% Rev PAR change. It was estimated that the SARS pandemic cost the U.S. hotel business about two billion in lost room revenues.

Table 3: U.S. and Select Market Hotel Industry, performance 2003 showing impact of SARS on U.S.

2003	U.S. RevPAR	San Francisco	Denver	Washington, DC	Atlanta	Boston	New York
January	2.0%	-1.7%	-2.7%	5.6%	-11.2%	-8.4%	-3.8%
February	-2.6%	-0.6%	-1.4%	-0.1%	5.2%	-7.5%	-6.6%
March	-2.9%	-7.0%	3.6%	2.8%	-16.8%	-11.2%	-12.5%
April	-6.2%	-15.8%	-24.2%	-15.4%	-15.3%	-15.6%	-16.5%
May	-1.4%	-7.0%	-6.8%	-2.8%	-12.1%	-12.8%	-7.3%
June	-1.5%	-15.9%	-1.7%	3.8%	-4.3%	-12.8%	-0.8%
July	3.0%	3.4%	1.2%	6.6%	0.8%	-8.7%	0.8%
August	1.8%	5.7%	-9.2%	0.3%	-2.1%	-12.3%	-0.2%
September	2.8%	4.6%	1.7%	4.0%	1.0%	-5.5%	6.2%
October	3.4%	-1.2%	1.7%	6.5%	-1.8%	-6.4%	6.7%
November	3.4%	7.9%	-1.4%	8.7%	-2.8%	-9.0%	7.1%
December	5.1%	0.0%	-6.1%	7.3%	-4.9%	-2.3%	7.4%
Source: STR, Inc.							

In 2006, the Norovirus surfaced on commercial cruise ships resulting in 1,500 passengers becoming ill with massive media coverage. This highly contagious virus is responsible for numerous gastrointestinal illness outbreaks and is difficult to control. Anticipating huge cancelations for future cruises, the cruise line industry was relieved that there were only a three percent drop in guests.

The reason was that the cruise line went on the offensive early and often, showing crew members scrubbing every inch of the ships, reporting that only a small percentage of the passengers were ill compared to the large number of passengers. It didn't hurt have former President and Mrs. Bush and the Governor of Florida took a cruise at this time. (McDowell, 2003)

Methodology

Using an autoregressive model, we are able to forecast the potential degree of impact that a viral outbreak could have on the tourism industry located in one or more of ten major U.S. cities within two weeks of its initial exposure.

A predictive range of values is calculated using the cumulative sum of the four factors identified as contributing to an avoidance of a region: U.S. city's market share percentage ranking for number of international travelers, virility of the virus, mode of transmission; and, amount and type of media exposure.

$$P\ (x \leq 16) = \int_1^n \sum .50 \left| \alpha + .20 \right| \beta + .10 \left| c + .20 \right| d$$

Where: $P\ (x)$ = predictive value

n= 2 weeks from initial detection of outbreak

α= Market share % of top 10 major U.S. cities most visited by international travelers.

β= Severity of the viral infection with 4 being a 50% fatality rate or higher.

c= Modes of transmission with 4 being most feared.

d= Media exposure, with 4 being major coverage.

Each of the four factors was weighted based on current and historical importance. The largest factor was the cities with international travel, they were weighted by half (.50).

Severity of the infection was weighted (.2)

Modes of transmission were weighted (.1) because a person can elect to avoid some of the modes of transmission.

The media exposure was more heavily weighted (.2)

Table 4: 2014 Market shares of International Visitations to Top Ten United States Cities

2014 Ranking	City	Market Share %	Visitation (000)
1	New York City	27.8%	9,579
2	Miami	13.1%	4,500
3	Los Angeles/Long Beach	11.0%	3,781
4	Orlando	10.8%	3,716
5	San Francisco	8.8%	3,044
6	Las Vegas	8.3%	2,851
7	Honolulu	7.4%	2,563
8	Washington, D.C	4.9%	1,698
9	Chicago	4.0%	1,378
10	Boston	3.7%	1,282

Source: U.S. Travel Association, 2015

Table 5: Modes of Viral Transmissions and their weights correlated to degree of Fear

Mode of Viral Transmissions	Degree of Fear	Weights of modes of transmission
Unknown	Highest Aversion & fear	5
Human to Human	High fear	4
Airborne from sneeze or cough	High Fear	4
Arthropod vector	Moderate Fear	3
Animal to human	Easiest to avoid	2
Ingesting infected food	Easy to avoid	1
Animal to Animal	For most people not a concern unless involved in agriculture	0

Table 6: Severity of a viral outbreak

Severity of Viral Infections	Groups affected	Weighted value
10 to 50% fatality	For all age groups	4
10-50% fatality	For elderly or low-immunity	3
1% fatality		2
Flu-like symptoms lasting 2-3 days		1

Table 7: Amount of Media exposure of viral outbreak, based on frequency of television news reporting.

Amount of Media exposure	Weighted value
Reported on major network nightly news every day for 5 Consecutive days, with graphic photos of symptoms.	4
False or sensational reporting, often exaggerated risks	3
Reported at least once on major network, but primarily carried on secondary news stations.	2
Little or no media exposure	1

Results

The predictive model generated a range of potential percentage decreases in domestic and international visitors to the ten selected U.S. cities. Using Convention and Visitor Bureau data from each of those cities (2014), the decrease in the number of yearly visitors was calculated to determine the potential impact a viral outbreak could have on each city.

The city that could experience the largest decrease of visitors would be New York City. They have the highest number of international visitors, and represent a densely populated city. The predicted percentage decrease in visitors P(x) ranged from 14.4% to 15.9%; which would result in a decrease of between 8,120,000 to 8,970,000 yearly visitors. The worst case scenario would be a viral outbreak, where the mode of transmission wasn't fully understood, exhibited high mortality rates and there was a tremendous amount of media attention. Schools, service industries would close and most public transportation would cease.

The best case scenario would be to have a clear knowledge of the transmission, low severity of the malaise created by the virus and limited media attention. Table 8 details the forecasted range for decrease in both domestic and international visitors to each of the ten cities and what they could expect to lose in numbers of visitors based on 2014 visitations.

Table 8: Range of Predicted Reduction in Domestic and International Visitors to Ten U.S. cities from a Viral Outbreak based on the Predictive model and 2014CVB data

Selected U.S. City	*Domestic & international visitors for 2014	Highest Predicted % decrease in visitors P(x)	Predicted visitor reduction (000)	Predicted visitors (000) with reduction calculations	Lowest Predicted visitor reduction P(x)	Predicted Visitors reduction (000)	Predicted in visitors (000)
New York	56,400,000	15.9%	8,970	47,400	14.4%	8,120	48,300
Miami	14,600,000	8.25%	1,204	13,395	6.75%	985	13,614
Los Angeles	45,500,000	7.9%	3,594	41,905	6.4%	2,912	42,588
Orlando	62,000,000	7.8%	4,836	57,164	6.3%	3,906	58,094
San Francisco	1,800,000	6.75%	121	1,678	5.25%	941	1,705
Las Vegas	42,000,000	6.45%	2,709	39,291	4.95%	2,079	39,921
Honolulu	8,282,000	6.0%	496	7,785	4.5%	372	7,909
Washington,D.C.	20,000,000	4.65%	930	19,070	3.15%	630	19,370
Chicago	50,000,000	4.15%	2,075	47,925	2.64%	1,325	48,675
Boston	16,250,000	4.0%	650	15,600	2.5%	406	15,843

*Number of domestic and international visitors for each city was collected from each city's CVB report, 2015.

Conclusion

Every major city in the United States should have an emergency protocol and policies in place in anticipation of the next viral outbreak. How these procedures are followed will ultimately determine the amount of economic and human loss. The tourism industry must work with city leaders, medical community and the Convention and Visitors Bureau to minimize the amount of damage which could be inflicted if an outbreak is over publicized or incorrectly handled.

When the public feels they have "no control" over a situation, such as exposure to a virus, you will see a decline in the demand for tourism, transportation, retail services, and leisure activities. That feeling of vulnerability is heightened by media coverage.

Viral outbreaks are inevitable, but how we deal with them is not. To reduce the "fear" factor, it is critical that accurate information be disseminated from reliable authorities (e.g. WHO or CDC) immediately and any false or misleading rumors dealt with quickly. The tourism industry must have containment strategies in place and be able to communicate these safeguards to the public, therefore, good relations with the media is critical.

While the top ten cities will be initially impacted by a viral pandemic, it is likely that the virus will spread to secondary populations as well. The tourism industry is such an important segment of the United States economy, devastating results could occur if proactive measures are not followed.

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