COMMENTARY

The Potential Impact of Border Security Upon Prevalence of Infectious Disease

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ABSTRACT

In the U.S., migration has been documented to affect the prevalence of infectious disease. As a mitigation entity, border security has been recorded by numerous scholarly works as being essential to the support of the health of the U.S. population. Consequently, the lack of current health care monitoring of the permeable U.S. border places the U.S. population at risk in the broad sectors of infectious disease and interpersonal violence. Visualizing border security in the context of public health mitigation has significant potential to protect migrant health as well as that of all populations on both sides of the border. Examples of how commonly this philosophy is held can be found in the expansive use of security-focused terms regarding public health. Using tools such as GIS to screen for disease in people before their entrance into a nation would be more efficient and ethical than treating patients once they have entered a population and increased the impact on the healthcare system. (*Disaster Med Public Health Preparedness*. 2018;12:554-562)

Key Words: Public Health, Infectious Disease Medicine, Disaster Medicine, border control

One of the less discussed policy aspects of human migration has been the potential for significant effects on public health by increased spread of infectious disease. A basic aspect of the regulation of migration in any nation involves border security. Visualizing border security in the context of public health mitigation has significant potential to protect migrant health as well as that of all populations on both sides of the border. Efficient policy for effective health security would be expected to result in desirable outcomes in public health, while inefficient or conflicting policy that weakens health security would likely work against it.

As human health is not a self-maintaining ordinance, its nature as a continuum requires proactive efforts.[1] As a whole, the monitoring of and helping to maintain the health of populations, including but not restricted to the United States, requires a multiplicity of public and private institutions and a variety of professional fields to ensure it is working toward its most effective state possible.[2] As with all potentially fragile entities, the health of the American public requires a security system for it to remain viable.[3] Examples of how commonly this philosophy is held can be found in the expansive use of security-focused terms regarding public health. Two examples of this are "food security" and "health protection." Food security refers to a stable environment with readily available nutritious and safe food.[4] Health protection is defined as the fortification of persons against illness or harm through education, public policy, medical care, and physical security.[5]

At its most fundamental level, the security of public health could be seen as that of the physical security necessary to maintain public health. While not immediately apparent to some, the security provided by a national government is a broad arena, which has been declared in the United States as securing public health as a primary, top priority.[5] Especially when considering migration, the border of the nation can be identified as the most basic physical structure protecting the health of a nation.[6] Therefore, considering the US border in terms of the interaction of health protection of both migrant and current resident populations could then reasonably be identified as a critical policy issue touching public health in America today.

The migration of human populations has been recorded as a concern for public health in North America since the very beginning of the migration of Europeans into the continent.[7] The spread of infectious disease, such as smallpox, to Native Americans upon contact with Europeans in the 16th century is a profound example of this. The introduction of smallpox to the Aztec population is supported by a multiplicity of studies and scholars as a strong contributor to the deaths of an estimated 10-18 million Aztecs.[8-10] In addition, the identification of Salmonella DNA from 16th century Aztecs shows that additional "plague" causes could have also existed,[11] either independent of Hernan Cortez's introduction of Europeans to the Aztec Capital Tenochtitlan or perhaps also as a result of Salmonella introduced by Europeans.[12] We know that other diseases have been referenced to have affected the Aztecs. This is just one striking illustration of the significant effects which even a small foreign population can have upon the public health of an unprepared, relatively unprotected nation.[13]

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While much debate understandably surrounds the topic, one contemporary answer to the problem of foreign-sourced pathogens is border security.[14] Often viewed as measures for counterterrorism and trade regulation in the United States, recent observations of infectious disease phenomena have encouraged the medical and security communities to seriously reconsider their roles and tactics regarding infectious disease and border security.[15]

ILLUSTRATION OF BORDER SECURITY VULNERABILITY: TUBERCULOSIS (TB), SEVERE ACUTE RESPIRATORY SYNDROME CORONAVIRUS (SARS-COV), AND EBOLA

TB

The 2, separate cross-border TB cases of Andrew Speaker and Gonzalo Garcia show how a lack of concise policy, policy implementation and cooperation in the United States can endanger the public health through contact with infectious disease. In the United States, TB has a prevalence of <10 cases per 100,000, one of the lowest rates in the world.[16] Of course, this statistic does not mean that people in the United States are incapable of becoming infected and infecting others with this disease, as was amply shown in these important cases. In 2007, Andrew Speaker, an American citizen, had been positively diagnosed with drug-resistant TB.[17] Before exiting the nation for Europe the severity of his condition was apparent enough to influence Fulton County, Georgia medical officials to propose Speaker's quarantine.[18] However, there was a delay in diagnosis and lack of timely communication between local, state, and federal authorities. Speaker was able to travel to France, Greece, Italy, the Czech Republic, Canada, and back to the United States as a TB-infected traveler.

The institution of the isolation of individuals to prevent disease propagation and the accompanying federal law on this issue is complex, but it does enable federal and or state authorities (dependent upon the state) to quarantine an individual with an infectious disease.[19] When considering institutional measures, it is the responsibility of clinics, hospitals, and other medical practitioners to report to the State Government and or Centers for Disease Control and Prevention (CDC) any cases of highly infectious disease as defined by law.[20] State and local authorities are immediately responsible for quarantines of hazards within their borders whereas the federal government is liable for concerns of a foreign origin.[19]

Regardless of the US Government's capability to do so, Andrew Speaker was not forcibly isolated in the initial stages of his disease, despite his hazardous medical status. Speaker later argued that his medical practitioner had not adequately expressed the severity of his illness, nor the magnitude of danger which Speaker posed to the health of multiple international populations.[17] However, Speaker's medical practitioners documented their knowledge of the hazard and reported it to the state of Georgia.[21] Regardless, responsible authorities found themselves unable to detain him due to a lack of interagency operability.[17]

In the same year, a separate drug-resistant TB case was documented in Gonzalo Garcia, a Mexican national, who was able to cross the US/Mexico border over 20 times regardless of his known condition.[22] Garcia was not undocumented: he had a visa for his travels across the US/Mexico border. By US law, visa acquisition includes a medical screening for the purpose of preventing the international spread of disease. However, Garcia was not detained and therefore proceeded to endanger an unknown number of people during his travels.

While these 2 cases were serious, it is troubling that such events are apparently not outliers, and point to a consideration of the impact of major outbreaks if cross-border disease transmission is not contained. This can be seen in the fact that drug-resistant TB has become an increasingly alarming issue along the US/Mexico border.[23] When one considers the highly significant TB epidemics in India[24] and China,[25] the importance of this hallmark of public health, the prevention of disease, is evident in this critical intersection of border security and public health as well. India has the highest rates of TB worldwide, with 84 cases per 100,000 individuals.[26] While most TB is latent and not active, some estimate infection rates to be as high as 40% of the total population of India.[27] According to the World Health Representative Office of China, roughly 1 million new cases of TB occur every year.[28] An increasing concern in China is its rise in multi-drug-resistant TB, which was estimated to have an incidence of roughly 100,000 in China in the year 2012.[28] Thankfully, the prevalence of TB in China is reported to be improving, decreasing from 134 cases per 100,000 individuals to 66 cases per 100,000 in 2010.[29]

Considering that the prevalence of TB in many other nations is significantly higher than in the United States, proactive efforts to maintain an appropriate level of security to prevent the entrance of this disease, and to help the migrants thus identified and remove further infection on the other side of the border as well is logical and of mutual benefit to all. To expedite this process, policies on the local, state and national level must be able to coordinate and synchronize to ensure that authorities at each level, including medical, public health, and law enforcement (3 groups that do not always coordinate easily), are aware of the prevalence of diseases such as TB and measures to be taken accordingly. If border security and public health policy are weak or fail to efficiently cooperate, negative trends in public health such as a rise in drug-resistant TB can only be expected.

SARS-CoV

The SARS-CoV global pandemic that began in 2002 is an instructive example of how public health and border control are inseparable elements of safe and efficient

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mitigation efforts in response to an epidemic.[30] The SARS-CoV is a pathogen with a high mortality rate which causes a "severe acute respiratory response" which is equitable to a very serious pneumonia in those infected.[31] This virus made nations panic at its approach, and reeling in its wake[32]; the ever growing rates of globalization, especially that of the ease of migration, create a much more complicated situation than would have been present before the invention of air-travel.[30] The migration of people created a path for the migration of the pathogen, increasing the scope of possible infection to wherever the infected were able to physically locate.[33]

SARS had its first documented outbreak in South China's Guangdong Province beginning in late 2002. By the end of 2003, 1512 people were documented as having been infected by SARS in Guangdong, with only 58 deaths occurring. SARS was first detected in February of 2003 in Hong Kong, after a 65-year-old doctor from Guangdong had checked in to the Hong Kong hotel. This breach in public health security ultimately infected about 1750 people in the territory.[34] Further, a former flight attendant who also stayed at the Hong Kong hotel in February was 1 of the 3 cases linked to the outbreak of SARS in Singapore a month later.[35]

SARS was first recognized in Toronto, Canada, when a woman arrived in Toronto from Hong Kong in 2003. Her presence is thought to have resulted in the transmission of SARS among 257 persons in several Toronto hospitals. As a result, the World Health Organization (WHO) issued a travel advisory recommending limiting travel to Toronto.[36] Between the years 2002 and 2003 8096 cases of SARS-CoV manifested internationally, with 774 resulting in death.[37]

In the United States, only 74 "probable cases" of SARS were reported by the CDC, but no deaths occurred.[38] The discrepancy between Canada's incidence of disease and fatalities with the United States' is striking. In the United States, the battle against SARS focused on early detection and rapid implementation of infection control and isolation.[39] The Bush Administration in the United States gave immigration and customs agents the authority in detain any arriving persons who even appeared to have symptoms of SARS.[40] This resulted in the separation of possibly infected individuals from the healthy population much sooner than in Canada, where the disease had already been introduced into the population before quarantine and border controls were enforced.[41] Studies suggest that heightened prevention procedures in the United States, utilizing immigration and customs agents[40] along with health care workers,[42] has significantly contributed to the lack of SARS transmission in the United States when compared with other nations.

Outbreaks of pathogens such as SARS and TB have spawned a school of thought that suggests the most effective method for mitigating the risk of pathogen-initiated disasters is a synchronized collaboration between public health and national security authorities.[43] Salinsky and Gursky suggest that emergency preparedness and health protection are the way of the future for public health, and they advocate more security-based elements such as risk-based resource allocation and regional planning to ensure that the system remains contemporary.[44] Interoperability regarding public health is widely recognized as fundamental within the medical realm.[45] However, while internal interoperability is foundational, external interoperability between public health and security is vital for forward progression.[46]

Ebola

The immigration of only 2 individuals infected with the Ebola virus into the United States caused serious upheaval and societal disruption despite the fact that these 2 individuals were both US citizens and under strict quarantine.[47]

In September 2014, the first laboratory-confirmed case of Ebola was diagnosed in the United States in Thomas Eric Duncan, a Liberian man who had recently migrated to Texas from Liberia.[48] Duncan did not develop his Ebola-like symptoms until 4 days after arriving in United States, prompting him to seek medical care at Texas Presbyterian Hospital of Dallas. At first Mr Duncan was not diagnosed with Ebola, mainly due to his denial of having contact with anyone who was ill, and sent home. However, once his symptoms worsened and his travel history was considered, CDC recommended testing for Ebola, for which he tested positive.[48] His condition was fatal: Duncan died October 8, 2014.[49] Two medical practitioners at Texas Presbyterian Hospital also tested positive for Ebola, linked to their interaction with Duncan, however both have fully recovered.[50]

In October of 2014, The New York City Department of Health and Mental Hygiene reported a case of Ebola in medical aid worker Dr Kent Brantly, who had returned to New York City from Guinea, where he had served with Doctors Without Borders. The diagnosis was confirmed by CDC later that month, and by mid-November, Dr Brantly was discharged, fully recovered, from Bellevue Hospital Center.[51]

While international media coverage and discussion of Ebola stirred up relevant questions regarding Ebola and migration, this attention also exacerbated the issue. In Liberia and Sierra Leone, some governmental policies have been punitive enough to cause many individuals infected with Ebola to avoid care and detection which further encouraged the spread of the disease,[52] as seen in the case of Mr Duncan.

This recent outbreak of the Ebola virus exemplifies how immigration can have a serious effect on the spread of infectious disease.[53,54] One of the most crucial elements to preventing the outbreak of an infectious disease like Ebola is

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to isolate the infected individuals. The reasoning behind this is that isolation will break the chain of transmission.[52,55]

The public concern on this subject can be even more readily seen when considering the un-quarantined immigration nurse Kaci Hickox from Sierra Leone. While debate surrounded her medical state upon arrival, even after she was declared pathogen-free, many persons thought she should still be kept in isolation.[56] While the reaction of American society was mostly due to gargantuan amounts of media coverage and disturbing symptoms of Ebola,[56,57] a lesson applicable to all forms of infectious disease can be learned. That lesson is: infectious disease is spread from person to person, and therefore immigration is commonly agreed upon by both the public and scientific sectors as a hazard for the introduction of disease.[52,58-61]

This conclusion does not mean that immigration should be halted, but rather than those responsible for the safety of public health should be given the information and tools they require to make wise decisions regarding this issue.[62-64] Indeed, simply possessing these tools has obviously not been enough, as judged by the imperfect outcomes seen thus far in cross-border transfer of disease. The ability to give immigrants the care they need, and citizens the protection to which they are entitled is a difficult but vital and achievable outcome for the stability of the nation. The actualization of this outcome is a constant struggle due to the gap that often exists in the primary missions that are perceived between security and public health officials, whose goals are not always aligned. The growth of these 2 elements as a synchronized system is imperative to the future of cross-border disease control.[65]

Undocumented Immigration and Public Health

The hazard for the spread of infectious disease is elevated in the presence of any human migration,[60,62,66] but especially that of undocumented immigration.[67] Migrants, documented and undocumented, carry with them elements of their past, including disease.[68] If immigrants to the United States are not regulated in a public health sense, then what they bring with them, especially in terms of health status, cannot be regulated either. Logically, undocumented immigration could then result in the undocumented spread of infectious disease, which is a formula for creating significant impediments to the role of public health protection.[69] The spread of Hansen's disease (HD)[70] and the concern of Herd Immunity[71] are examples of how undocumented immigration impacts public health in the United States.[72] Undocumented immigration has the potential to put the United States at risk for outbreaks of infectious disease, while simultaneously masking the individual source of the threat.[73] This makes mitigation of the potential danger that much more difficult to achieve.

Higher levels of infectious disease have been recorded as a recurrent factor in the presence of undocumented immigration.[69,74] Several studies on this issue report that these people may carry diseases of which they are unaware, indifferent to, or for which they cannot allocate diagnosis or treatment.[75,76] Therefore, when individuals migrate from one nation and enter another they may unintentionally share negative elements of their past, such as TB or other infectious diseases.[77] Evidence such as this indicates that undocumented immigration can unintentionally foster the spread of infectious disease.[76,78,79]

Diseases that were previously exempt from the United States can now be found in persons arriving as undocumented immigrants within the borders.[80] For instance, in 2007, a disproportionate incidence of HD (commonly known as leprosy) was reported in the state of California (CA). Only 3 of the 42 cases recorded in CA in 2002 were found in native-born citizens, and the rest were found in immigrants.[70] If diseases such as HD mostly originate from countries outside the United States, how can undocumented people with the disease be treated (for their benefit) and be prevented from infecting others if their presence in the Nation is unknown?

One of the many functions of the US immigration system is to ensure that the health of the American public is not put at risk from visitors.[81] While legal immigrants are required to be screened for diseases such as active TB, plague, cholera, and other specific diseases[82] before entering the country, undocumented immigrants obviously are not. It has been shown in numerous studies that the majority of undocumented immigrants do not seek medical care until forced by a medical emergency.[83-85] This is attributed to a myriad of reasons including the fear of legal retribution such as deportation,[86] a lack of financial means,[87] or traditional health care practices.[88] Therefore these people may not only be unintentionally bringing in dangerous pathogens upon visiting our nation, but through their own actions lowering the likelihood to personally receive treatment.[89] It has been reported that there are roughly 12 million undocumented immigrants within the United States at this time.[90] While there is a widespread misconception that all undocumented immigrants are native to Mexico, the Pew Research Center reported in 2015 that in fact roughly half of undocumented immigrants are not Mexican. Rather, the Center suggests that Mexican immigration is decreasing, while undocumented immigration from areas such as Asia, the Middle East, the Caribbean, and Central America is growing.[91] From this one nation, some estimate the new arrivals of undocumented immigrants from Mexico to be 600,000 each year, with roughly 400,000 deported back to their home nation.[49]

Herd immunity is the specific threshold percentage of immunity required within a population for that population to be realistically able to prevent outbreaks of certain diseases.[92] Consequently, it is widely argued that undocumented immigration poses a serious threat to Herd Immunity because the clandestine presence of non-immunized individuals tips this

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balance—but without the knowledge of responsible authorities.[71,93,94] If we have reports which assure us that the required 75% of the US population is immunized for chicken pox, in reality due to the high levels of non-immunized undocumented immigrants the populations' sum immunity would likely to be much lower than the assumed threshold statistic. Such a circumstance places the United States in the dangerous position of being significantly at risk, yet unaware and therefore not responding appropriately to the actual real risk.

Recommendations for Protecting Migrants and Residents

Because migration is a significant determinant of public health in the United States, appropriate migration policy is needed to protect the health of the entire population, including the undocumented immigrants. At this time, there are policies in place that would work efficiently toward this end if executed as written, and other policies which can be improved upon to help meet this goal. There are also several tools which could be used to better the United States' methods of migration monitoring and infectious disease control. These include the strategic employment of the Early Warning Infectious Disease Surveillance (EWIDS) program, E3 Network, Geographic Information Systems (GIS) approaches, and existing federal resources such as the FEMA Commissioned Corps.

The well-respected Epidemic Intelligence Service (EIS), established in the 1950s by the CDC, was created to ensure a proactive monitoring of disease trends in incidence and distribution across the international spectrum. The WHO has utilized EIS to support its efforts, and this is an obvious focal point in the intersection of preventing infectious disease in relation to border security.[21] Overall, the improved effectiveness of border health security as a function of immigration reform would be a much needed force to further protect our society; and especially regarding the protective function of public health.

One example of effective border health security intervention is the EWIDS program. This type of program embodies a multitude of methods which aid in the detection, identification and report of infectious disease outbreaks along US international borders.[95] Not only effective in the United States, the EU has utilized this tool in several separate instances, and with documented results in public health protection.[96]

The European Environment and Epidemiology Network is an example of potentially useful border health security information sharing. Created to monitor environmental signs of epidemics, the Network (nicknamed the "E3 Network") attempts to predict disease outbreaks and offers tactics for mitigation.[97] Through a combination of proactive human expertise in the area of epidemiology and a well-established, secure, up-to-date geodatabase, the E3 Network not only ensures that those utilizing it have access to the most current information, but is a hopeful portent of future approaches in border health security in that it suggests possible solutions to the epidemiological or environmental issue presented.[98] Specifically, the E3 Network aided in preparation for the West Nile virus epidemics beginning in 2010 by noting elements such as temperature deviations and volume of international travelers. The European Centre for Disease Prevention and Control (ECDC) has used the E3 Geoportal to create a blueprint of how disease threats might present themselves in Europe up to the year 2020 (ECDC, 2013).

In the United States, a combination of GIS, census data and other available data sets are widely used to assess the health of the public on both sides of the US/Mexico border by the U.S. Geological Survey (USGS) regarding factors such as availability of clean water, disease outbreak and the sources of environmental contaminants.[99] One specific study used a similar system to identify water borne diseases and contaminants such as hepatitis, ameba, lead and arsenic poisoning along the US/Mexico border. This study surveyed everything from active monitoring databases, studies over large, geographically relevant areas, and meta-studies regarding environmental health.[100]

America's Shield Initiative (ASI) demonstrates the potential functionality of these tactics. Established by DHS in 2004, ASI utilizes sensors, cameras, and more recently GIS systems and shared databases with other security agencies to enhance border security.[101] This system is focused at the present primarily on counterterrorism efforts,[102] yet slight modifications in how this system is employed could greatly enhance our knowledge in the spread of infectious disease across our borders.

Information sharing is commonly recognized as an asset to mitigating disasters,[103,104] especially when concerning infectious disease.[105] For a better realization of how border security effects public health, a broad but in-depth accumulation of information system such as ASI for both public health and border security through shared databases would be invaluable.[106] In past outbreaks of infectious disease such as Ebola, the importance of information sharing and disease mapping have been identified imperative to mitigation, preparedness, response and recovery.[107,108]

The utilization of geodatabases such as the E3 Network by security and public health officials would be one answer to question of data upon which to base mitigation efforts. Of course, communication and coordination between the public health and security elements of the US Government does take place on occasion, such as in the midst of specific crises within FEMA.[109] Issues regarding public health in the border regions of the United States deserve attention more continually, rather than only in crisis. In fact, the call for immigration reform due to public health concerns such as immigrant deaths and infectious disease is a call a multiplicity

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of international voices have joined, but every voice represents a variation in opinion how that reform should be done.[110-112] Regardless, the common desire for the safety of human beings in regards to immigration could likely aid the creation of a much needed and effective border security-focused element of the public health system.

Since March 2003, FEMA has been a component of the Department of Homeland Security.[113] This transition coincides with the dawning realization in our society regarding the vital nature of the symbiotic relationship between public health, preparedness, and security, which has been uniquely realized to some extent within FEMA functions. FEMA states clearly in its disseminated literature that, "FEMA's mission is to reduce the loss of life and property and protect communities nationwide from all hazards…."[114] Therefore, commissioning FEMA to observe, report, and provide possible mitigation responses to issues along the border relating to security and public health would be within FEMA's stated mission. This would likely require the creation of a new or reorganized team within the Agency, staffed with individuals from the fields of security, medical, public health, geography and other relevant arenas to ensure that the best, most efficient and humane efforts were put in place. The integration of the functions of health-related units such as the DHS Office of Health Affairs with health regulating authorities in DHHS is a complex process, and yet could produce highly fruitful outcomes in integrating health protection and border security.

CONCLUSION

In the United States, migration has been documented to affect the prevalence of infectious disease. As a mitigation entity, border security has been recorded by numerous scholarly works as being essential to the support of the health of the US population. Consequently, the lack of current health care monitoring of the permeable US border places the US population at risk in the broad sectors of infectious disease and interpersonal violence.

Because human health requires maintenance and proactive intervention, it is becoming increasingly evident that a health security system is necessary for the conservation of the public health as a whole. Therefore, the border of the Nation could be identified as a fundamental level of security for public health in the United States. This preeminent feature of the importance of border health security has been amply demonstrated by the historical experience in numerous countries by the health impact of the security of their state border, or lack thereof.

Interventions such as the EWIDS, EIS, GIS programs and other geodatabases are highly advantageous existing elements which border security and public health officials can increasingly utilize to significant effect. The manpower and resources required to use tools such as these, especially in screening for disease in people before their entrance into a nation, would doubtlessly be difficult and complex. However, the evidence suggests that once established, such systems would be more efficient and ethical than treating patients once they have entered a population and increased the impact on the health care system. The public health of the nation would be well served if an agency with appropriate power such as FEMA were tasked to create a team of appropriate persons to oversee the best strategies for the synchronization of border security and public health.

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Authors' Contribution

Christiana Dallas performed an analysis of the literature on public health and border security, compared and contrasted ideas and drew conclusions for future application. She wrote a manuscript containing her findings. Curtis Harris and Cham Dallas reviewed, critiqued, and edited the manuscript written by Christiana Dallas. All authors read and approved the final manuscript.

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