



# BLUE MARBLE HEALTH: A NEW PRESIDENTIAL ROADMAP FOR GLOBAL POVERTY-RELATED DISEASES

by Peter J. Hotez, M.D., Ph.D.



#### Recommendations at a Glance

A major victory in American global health policy has been the progress on the United Nations Millennium Development Goals (MDGs), especially MDG 6 "to combat AIDS, malaria, and other diseases." Over the last decade, through US-led support for mass treatment programs and other measures, there have been great gains in reducing global mortality and morbidity from HIV/AIDS, malaria, and the neglected tropical diseases (NTDs) component of the MDGs' "other diseases." Moving forward, the current and future presidential administrations have unprecedented opportunities to build on this momentum and track record in order to eliminate some of the most important poverty-related diseases worldwide.

## Recommendation 1: Create pilot programs to link NTD control initiatives with HIV/AIDS and malaria control initiatives.

US support for the major poverty-related diseases—AIDS, malaria, and NTDs—is often in silos. There are few intersecting initiatives that address co-infections between these illnesses. For example, female genital schistosomiasis is now a major co-factor in Africa's AIDS epidemic and yet mass treatment for schistosomiasis is not currently a component of AIDS control programs. Linking the NTD programs with other initiatives will lead to better health outcomes and disease control.

# Recommendation 2: Direct 2 percent of the US global health budget annually toward a robust pipeline of antipoverty products.

There is an urgent need for new global health products, including new "antipoverty" vaccines and drugs for the MDG 6 targets. The Ebola virus outbreak highlighted the need to create new mechanisms for making these lifesaving products available. Such a stimulus could alter the current product development landscape and promote links between pharmaceutical companies and the 16 major nonprofit product development partnerships (PDPs), which bring together the public, private, academic and philanthropic sectors to quickly and cheaply develop and deliver safe, effective drugs to the people who need them most.

# Recommendation 3: Pressure the G20 member countries to take greater responsibility for reducing their own indigenous disease burdens, as well as those in neighboring countries.

The term "blue marble health" describes high rates of poverty-related diseases among the poor living wealthy countries. New findings reveal that more than half of the world's NTDs and other poverty-related diseases occur in high- and middle-income countries, including the group of 20 countries (G20) and the BRICS (Brazil, Russia, India, China, and South Africa). Given the anticipated fiscal constraints in the coming decades, a new role for the US Department of State should be to highlight the impact of poverty-related diseases in the G20, and to encourage these countries to move toward reducing, controlling, and eliminating these diseases among their own citizens.

## Recommendation 4: Create a center of excellence for NTDs and poverty-related infections indigenous to the United States.

More than 12 million Americans live with NTDs and other poverty-related infections. While recent media attention focused on the threat of the Ebola virus to the United States, widespread diseases among the poor are still ignored. The End NTD Act, introduced in Congress in 2014, proposed modifying existing USAID programs, including establishing a research and development program to address NTD and poverty-related infections in the United States.

# Recommendation 5: Build capacity for producing new vaccines and drugs in the Middle East and North Africa (MENA) region using a program of science and vaccine diplomacy.

The 2014 Ebola outbreak highlighted the roles of conflict and post-conflict in promoting NTD epidemics. The MENA region could become the next "shoe to drop" in terms of NTD outbreaks, especially in ISIL-occupied Syria and Iraq. Resources from the US science envoy program, USAID, and the US Department of State should be used to help build collaborative vaccine programs in regions of greatest need.

### Blue Marble Health: A New Presidential Roadmap for Global Poverty-Related Diseases

A new analysis reveals substantial global health gains for AIDS, malaria, and neglected tropical diseases that were first targeted by the administration of President George W. Bush ("Bush 43") in 2003 and then greatly expanded by the Obama administration. Beginning in 2017, an incoming administration will have opportunities to build on this legacy to control and eliminate poverty-related diseases—including those with pandemic potential—and to assert American leadership while being mindful of fiscal constraints.

#### Introduction

In September 2000, one of the largest-ever gatherings of global leaders—including 149 heads of state—met at the United Nations headquarters to establish a partnership for global poverty reduction and adopt a set of eight Millennium Development Goals (MDGs).¹ The MDGs primarily targeted the more than 1 billion people who lived in developing countries below the World Bank poverty level, as well as billions more who lived on less than \$2 per day. Three of the eight major goals specifically targeted improvements in global health, based in part on recommendations from the Commission on Macroeconomics and Health, a group led by the economist Jeffrey Sachs, which documented clear links between disease and poverty and how the two reinforce each other.²

#### MDG 6: "To Combat AIDS, Malaria, and Other Diseases"

One of the most significant responses to the UN's call for sustainable poverty reduction initially came from the Bush 43 administration, with an emphasis on MDG 6, to "combat AIDS, malaria, and other diseases." The major neglected diseases targeted by MDG 6, including the neglected tropical diseases (NTDs) that fall under the "other diseases" category, are listed in Table 1.

President Bush's response to MDG 6 began during his State of the Union address in 2003 when he announced the creation of the President's Emergency Plan for AIDS Relief (PEPFAR) to care for millions of people in sub–Saharan Africa and other impoverished areas living with HIV/AIDS, provide anti–retroviral drug therapies, and implement preventive measures.<sup>3</sup> In the ensuing months, he signed legislation authorizing \$15 billion for an initial five–year period—which was reauthorized in 2008 for \$48 billion—to treat at

Table 1. The Major Neglected Diseases Currently Targeted by the United States Government under the Auspices of MDG 6: AIDS, Malaria, and "Other Diseases"

Neglected Disease	Estimated number of people living with the disease or new cases annually	Comment
HIV/AIDS	29 million	1.3 million annual deaths
Malaria	165 million new cases	0.9 million annual deaths
Other Diseases		
Tuberculosis	7 million new cases	1.3 million annual deaths
Neglected Tropical Diseases	1-2 billion	The bottom billion is infected with multiple NTDs
Ascariasis (roundworm)	819 million	
Trichuriasis (whipworm)	465 million	
Hookworm infection	439 million	
Schistosomiasis	252 million	
Lymphatic filariasis	36 million	Cases presenting with lymphedema or hydrocele
Onchocerciasis	30 million	
Trachoma	4 million	Low vision or blindness cases only
Ebola virus infection	>13,000	5,000 deaths as of November 2014

Source: Modified from information and tables in CJ Murray et al., "Global, regional, and national incidence and mortality for HIV, tuberculosis, and malaria during 1990–2013: A systematic analysis for the Global Burden of Disease Study 2013," *Lancet* 384 (2014); Hotez et al., "The global burden of disease study 2010: Interpretation and implications for the neglected tropical diseases," *PLOS Neglected Tropical Diseases* 8, no. 7 (2014); and Centers for Disease Control and Prevention, "2014 Ebola Outbreak in West Africa," accessed November 7, 2014, <a href="http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/index.html">http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/index.html</a>.

least 3 million people, prevent 12 million new HIV/AIDS infections, and provide care for millions of AIDS orphans.<sup>4</sup> Then, in 2005, President Bush created a parallel initiative for malaria, known as the President's Malaria Initiative (PMI), which provided \$1.2 billion for antimalarial treatments and insecticide–treated mosquito nets over five years, with the goal of reducing malaria deaths by 50 percent in more than a dozen targeted countries.<sup>5</sup> In 2007, the Group of Eight (G8) nations matched the US commitment, while in turn the US government under President Bush became the largest contributor to the Geneva–based Global Fund to Fight AIDS, Tuberculosis, and Malaria (GFATM). Today, the GFATM is headed by Ambassador Mark Dybul, one of the first leaders of PEPFAR. Under the leadership of President Barack Obama, support for PEPFAR, PMI, and GFATM greatly expanded. It is estimated that in the decade following the launch of MDG 6, more than

\$70 billion has been provided by the US and other governments, together with the Gates Foundation, corporate philanthropies, and nongovernmental organizations, 6 to create one of the largest initiatives in the history of overseas development assistance.

In 2006, a health initiative focused on the "other diseases" component of MDG 6 was created: the Neglected Tropical Diseases (NTD) Program of the United States Agency for International Development (USAID). Through this program, hundreds of millions of people received low-cost "rapid impact packages" of essential NTD medicines delivered annually. These medicines treat or prevent up to seven NTDs found in the poorest areas of Africa, Asia, and the Americas, including ascariasis (roundworm), trichuriasis (whipworm), hookworm infection, schistosomiasis (snail fever), lymphatic filariasis (elephantiasis), onchocerciasis (river blindness), and trachoma. Except for trachoma, each of these diseases is caused by parasitic worms, which actually represent the most common source of afflictions of people who live in extreme poverty. Essentially, the entire "bottom billion" is infected with at least one NTD.7 Although the NTD Program is much smaller in terms of total dollar amounts than those for AIDS and malaria, the NTD rapid impact packages employ medicines mostly donated by pharmaceutical companies that can be provided by non-health care professionals; therefore, it usually costs less than \$1 per person annually and often less than 50 cents per person annually. Although NTDs have existed since ancient times (they are accurately described in the Bible and other texts), repeated annual treatment over a period of several years could lead to the elimination of some NTDs, such as lymphatic filariasis and trachoma.

In 2014, a newly released independent evaluation of the impact of these programs revealed impressive health gains in all three major neglected disease MDG 6 targets. The Global Burden of Disease (GBD) Study 2013, led by the University of Washington's Institute of Health Metrics and Evaluation together with dozens of global health investigators working worldwide (including this author), found significant declines in cases of HIV/AIDS and malaria by the year 2013.8 For instance, since 2005—possibly the peak of the global HIV/AIDS epidemic—the number of HIV-related deaths has dropped almost one-quarter from 1.7 million to 1.3 million.9 By interrupting mother-to-child transmission of HIV through use of anti-retroviral therapy (ART), together with expanded use of ART in non-pregnant adult and pediatric populations, almost 20 million life-years were saved. For malaria, the number of cases decreased approximately 30 percent from 232 million at their peak in 2003 to 165 million in 2013.10 Malaria mortality has also decreased from 1.2 million malaria deaths in 2004 to 855,000 deaths in 2013.11 A major conclusion from the GBD 2013 is that previously upward trends for HIV/AIDS and malaria have now been reversed, 12 with many of these gains resulting from US government support.

The USAID NTD Program for the "other diseases" component of MDG 6 began later and did not reach full-scale until the first years of the Obama administration. Nevertheless, it is estimated that since 2006, 1 billion NTD treatments have been delivered to 456 million people in 25 developing countries, including 16 in sub-Saharan Africa.<sup>13</sup> Thus, the USAID NTD Program represents one of the world's largest public health interventions,

and together with additional efforts from the British Department of International Development (DFID), it has become possible to set elimination targets for selected tropical infections, including lymphatic filariasis and trachoma. An analysis from the GBD 2010 of the major 17 NTDs, as newly defined by the World Health Organization (WHO), reveals substantial declines from 1990 to 2010 in the number of cases of selected diseases, such as ascariasis, African sleeping sickness, and leprosy. Analyses from GBD 2013 are forthcoming. However, it is clear that since the launch of the MDGs and because of the rapid early response of the Bush 43 administration and expansions by the Obama administration, there have been substantial health gains among the world's poor over the last decade. An exception is a devastating Ebola virus infection outbreak in three West African countries—Guinea, Liberia, and Sierra Leone. However, there is now a large-scale US military response to this crisis, with hopes that by providing a health care infrastructure (including hospital beds and trained staff) and safe burial practices, the epidemic will be contained there in the coming months.

Beyond the health improvements in HIV/AIDS, malaria, and NTDs, the US response to MDG 6 may also produce substantial economic gains and even cost savings that are sometimes referred to as being "economically dominant." Through a number of identified mechanisms, the diseases targeted by MDG 6 can actually cause poverty, including their deleterious effects on worker productivity, maternal health, and child growth and development. For example, chronic hookworm infection in childhood causes cognitive and intellectual deficits and substantially reduces future wage–earning; lymphatic filariasis and onchocerciasis prevent people from going to work; other diseases, such as malaria, adversely affect pregnancy outcomes and facilitate bad neonatal outcomes, such as low birth weight and decreased infant survival. Therefore, tackling these diseases can translate to substantial poverty reductions.

#### The Next US President

With the scheduled sunset of the MDGs in 2015, the next US president will face opportunities and challenges to leverage the previous successes for AIDS, malaria, and other diseases in order to control and eliminate the world's poverty-related diseases. These include the continuation of the Bush 43 and Obama legacies through the support of the mass administration of drugs and other available interventions (e.g., bed nets).

Moreover, despite the successes of these interventions, there is still the need to develop additional "tools," including new drugs, diagnostics, and vaccines, to control and ultimately eliminate the MDG 6 target diseases. Further research and development (R&D) will be required to create a new generation of such products. They might include new vaccines for HIV/AIDS, malaria, and selected NTDs. Today (and mostly through support from the US National Institutes of Health), the US government is by far the world's leading donor and supporter of R&D for these diseases, although much of that is directed toward basic research rather than product development. Therefore, some of the existing funds that support mass interventions using currently available treatments could be

redirected toward neglected disease product R&D.<sup>19</sup> I have designated such products as "antipoverty vaccines and drugs" because of their potential impact to improve economic development and lift people out of poverty in addition to improving health.<sup>20, 21</sup> In 2011, I suggested that setting aside approximately 1–2 percent of the US budget currently directed toward mass interventions for global health could pump approximately US\$100–200 million dollars annually into a robust pipeline of antipoverty products.<sup>22</sup> Such a stimulus could significantly alter the current product development landscape and encourage multinational pharmaceutical companies to expand their product portfolio to include neglected diseases, while promoting additional links with the 16 nonprofit product–development public–private partnerships (PDPs, supported by the Bill & Melinda Gates Foundation and other sources) now tasked with leading these activities but largely underfunded to complete their mission. This approach could help to ensure the timely development of new vaccines and other technologies to combat and prevent the neglected diseases (including Ebola virus infection) listed in Table 1, as well as additional NTD threats.

However, the demands of continuing America's commitment to global health and to fighting AIDS, malaria, and NTDs must be balanced in the context of fiscal realities and the mindset of the American people. In 2001, former Secretary of State Henry Kissinger outlined the four major criteria of effective American humanitarian intervention. Specifically, it should be universally applicable; resonate with the international community; be sustained by US domestic opinion; and finally, it should also be relevant to the historical context.<sup>23, 24</sup>

Of relevance to the Kissinger criteria is the religious-based context of US interventions, beginning with the Bush 43 interventions when US government funds were used to support faith-based nongovernmental organizations working in areas of international development, including global health. At the turn of the 20th century, most of the world's Christians lived in Europe and North America, whereas today, according to the Pew Research Center's Forum on Religion & Public Life, most now live in the developing countries of Africa, Asia, and the Americas. My new analysis indicates that Christians living in extreme poverty in these areas are disproportionately affected by NTDs and other neglected diseases. <sup>25</sup> For example, Christians living in poor regions of Central and South America account for almost all of the world's cases of Chagas disease, while those living in Democratic Republic of Congo (a Christian-majority country) and surrounding areas account for most of the cases of African sleeping sickness (human African trypanosomiasis). A disproportionate number of the world's parasitic worm diseases such as schistosomiasis and hookworm infection, which are the most common afflictions of poor people—are also found in Christian-majority countries. The new US president will have renewed opportunities to link neglected disease control and elimination and even possibly R&D to Christian ethics and values. Such activities could include heightened involvement from Christian-based research universities.

Also consistent with US ethics and values are revelations that NTDs may represent the most common diseases of girls and women living in poverty. Female genital schistosomiasis, hookworm infection during pregnancy, and other NTDs together may affect more than 100 million girls and women in sub–Saharan Africa. Additional information suggests that these conditions may represent important co–factors in Africa's AIDS and malaria epidemics. Thus, the USAID NTD Program may be an important back–door strategy for controlling these two diseases. Under former Secretary of State Hillary Clinton, USAID–supported global health initiatives emphasized the importance of "civilian power" and renewed their commitment to the health of girls and women. Vo far, however, the three major global health programs for AIDS, malaria, and NTDs, which were started a decade ago, remain mostly in separate silos and often without significant interactions or overlap. Integrating AIDS, malaria, and NTD programs represents a significant opportunity for a new president.

#### Blue Marble Health

The major global health initiatives launched and expanded by the Bush 43 and Obama administrations mostly target the poorest developing countries in sub-Saharan Africa and South and Southeast Asia, as well as Haiti. But in the ensuing decade, a new picture has emerged in which the line between developing and developed nations is often blurred. While sub-Saharan Africa continues to account for a substantial portion of the world's neglected diseases, a new analysis reveals that a surprising percentage of global povertyrelated diseases actually occur in wealthier economies, especially in the Group of 20 (G20) nations. Today, more than one-half of the world's cases of NTDs, such as Chagas disease, intestinal helminth infections, leishmaniasis, leprosy, and lymphatic filariasis, can be found in the G20 nations together with Nigeria. Such diseases are concentrated in pockets of intense poverty in these nations, such as in southern Mexico, northeastern Brazil, northern India, and southwestern China (see Figure 1). Thus, in many cases, the older paradigm of developing versus developed countries may be giving way to focal areas of extreme poverty located in both wealthy and poor countries—a concept I named "blue marble health" in commemoration of an iconic photo of Earth taken in 1972 by the Apollo 17 astronauts and since recognized as a symbol of peace and healing.<sup>29, 30</sup> Beyond neglected diseases and MDG 6 targets, large populations throughout the G20 countries are also affected by noncommunicable diseases, such as cancer, cardiovascular disease, and diabetes. The BRICS and other G20 countries in Asia and the Americas are increasingly affected by lifestyle changes, tobacco, and other risk factors known to promote noncommunicable diseases in North America and Europe.

A key tenet of blue marble health is that the "poor living among the wealthy" constitute a hidden but substantial burden of the world's global health disparities and neglected diseases. More than one-half of the "bottom billion" live in G20 countries, and these nations disproportionately account for the world's neglected tropical diseases, which are first and foremost diseases of poverty.

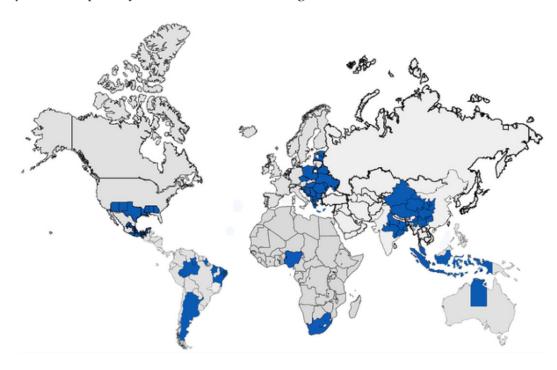


Figure 1. The Poor Living Among the Wealthy
Major areas of poverty in the G20 nations and Nigeria, where most of the world's NTDs occur.

Source: Esther Inman in Peter Hotez, "The Disease Next Door," *Foreign Policy*, March 25, 2013, <a href="http://www.foreignpolicy.com/articles/2013/03/25/the\_disease\_next\_door">http://www.foreignpolicy.com/articles/2013/03/25/the\_disease\_next\_door</a>.

The new US president can address blue marble health disparities by implementing a US foreign policy that exerts diplomatic pressure on BRICS and other G20 countries to commit or expand their commitments to their own neglected populations and diseases while simultaneously taking care of their neighbors and regions of influence.

As an example, the nation of Brazil today accounts for 80–90 percent of cases of schistosomiasis, visceral leishmaniasis, leptospirosis, and leprosy in the Latin American and Caribbean region, even though it only accounts for 34 percent of the region's population and is the leading economy in South America. Just by redoubling efforts among its own population, Brazil could substantially reduce malaria and NTDs in all of Latin America. At the same time, Brazilian intervention could help to relieve the devastating NTD burden in neighboring Bolivia—where the highest concentration of people infected with Chagas disease live—and Paraguay, two of the poorest nations in South America.

As another example of an affected G20 nation, Indonesia accounts for approximately 10 percent of the world's cases of intestinal helminth infections, lymphatic filariasis, and new cases of leprosy, 32 yet it is also the 16th largest global economy. 33 The next

US administration needs to work closely with Indonesia to help it solve its own NTD problems, while simultaneously working with neighboring Papua New Guinea, where high rates of NTDs are also found. A joint US-Australian partnership could also be created to assist Indonesia in the area of NTDs. Still other examples include China, the world's second largest economy, where NTDs are still commonly found among its poor, especially in southern and western areas, such as the Sichuan, Yunnan, and Guizhou provinces. In addition, China is investing heavily in sub-Saharan Africa, yet it contributes modestly for NTD programs beyond its border. China could be pressured to begin matching the US and UK commitment to this problem. Finally, India and China share enormous problems with each of the MDG 6 target diseases. The new US president could help to foster joint Sino-Indian public health collaborations.

At the level of R&D for new neglected disease interventions, the term "10-90 gap" has been used to describe how only 10 percent of R&D dollars go to support 90 percent of the global disease burden disproportionately represented in low- and middle-income countries.<sup>37</sup> The absence of investments in new neglected disease technologies helps to explain why an Ebola virus vaccine was not available when this infection began to spread from Guinea into Liberia and Sierra Leone. To address the 10-90 gap, the United States currently provides more than two-thirds of public financial support for neglected disease R&D to address AIDS, malaria, and NTDs, while the UK and Germany provide another 10 percent. In contrast, the BRICS and other G20 countries in Asia and the Americas have substantial biotechnology capabilities, but are estimated to currently support less than 3 percent of the total R&D dollars for global health.<sup>38</sup> Therefore, these countries must expand their national efforts for neglected disease R&D while meeting their fair share of an expected contribution to financially sustain these initiatives. They must also expand their scientific collaboration with the US or other nations. For example, some of the nations highlighted above, such as Brazil, China, India, and Indonesia, have capacity and technical expertise for producing global health vaccines. In a recent discussion paper for the US Institute of Medicine, my colleagues and I recommended that the new US Office of Global Health Diplomacy established in the Department of State under Secretary Clinton—direct some of its efforts to blue marble health initiatives, such as the ones outlined above, in addition to encouraging or pressuring overseas ministries of science and technology to play a greater role in fostering biotechnology for neglected diseases among the affected G20 nations.<sup>39</sup> The largeand middle-income G20 countries have enormous potential for leading the development and production of a new generation of global health and neglected diseases interventions, including new drugs, diagnostics, insecticides, and vaccines, whereas it is unlikely that the United States can sustain its current rate of contribution, providing more than two-thirds of global health R&D support.

Overall, blue marble health creates an opportunity for the United States to exercise global health leadership, but in anticipation of significant fiscal constraints at home in the coming years, it puts greater responsibility on all of the G20 nations for helping to pay for both major interventions directed at AIDS, malaria, NTDs, and even noncommunicable diseases, as well as R&D for new neglected disease products.

#### Neglected Tropical Diseases at Home: Real versus Perceived Threats

According to blue marble health, poverty has a central role as the most important determinant, social or otherwise, responsible for the emergence of neglected diseases. Today, extreme poverty has gained a foothold in the United States, with an estimated 20 million families living in extreme poverty and almost 2 million families living on less than \$2 per day. Therefore, one of the major benchmarks used to describe global poverty currently also applies to the United States. Just as poverty tends to concentrate in specific areas of the most affected G20 countries, it also affects a specific area of the United States, namely the American South. In 2008, I first described the hidden burden of NTDs and related neglected infections of poverty—such as Chagas disease, cysticercosis, cytomegalovirus infection, dengue, toxocariasis, toxoplasmosis, and trichomoniasis among America's poor and mostly in people of color—African Americans and Hispanics.<sup>40</sup> After establishing a new National School of Tropical Medicine in Houston, we have since found that these diseases are particularly concentrated in poor areas of Texas and the Gulf Coast. 41, 42 It is worth pointing out that while some of these diseases are imported through immigration, most are indigenous to the southern United States because of poverty, warm climate, and the fact that there are many insect vectors in the region. Surprisingly, America's neglected infections of poverty are not currently considered an important component of US public health preparedness, despite the fact that they are widespread and far more common than the diseases the US government currently invests in, such as anthrax, smallpox, avian influenza, and MERS, which currently are mostly perceived, rather than actual, threats to US populations. In all, I estimate that more than 12 million Americans live with one or more NTDs.43 These diseases trap Americans in poverty just as NTDs abroad adversely affect the bottom billion abroad.

To date, the problem of America's neglected infections of poverty has been mostly ignored despite their importance to US health and economic development. There are urgent needs to conduct surveillance studies in the affected communities in order to confirm their widespread nature and determine modes of transmission and public health efforts to control these diseases while embarking on R&D for new drugs, diagnostics, and vaccines. In 2014, the End Neglected Tropical Disease Act was introduced in the US House of Representatives (H.R. 4847) that begins to address some of our nation's most pressing NTD issues. So far a companion measure has not been introduced in the US Senate.

An incoming administration may need to make hard choices about tackling tropical and neglected diseases. As a case study, currently an estimated 300,000 Americans are living with Chagas disease, a debilitating parasitic infection of the heart that is transmitted by "kissing bugs." Most live in Texas and adjoining states and carry the trypanosome parasite; a significant percentage of dogs are also infected. Yet almost all of the infected individuals living in affected areas of the United States go undiagnosed and untreated. There is minimal US government investment in Chagas disease, and the local and state health departments have no funds to conduct the work that needs to be done. On the other hand, the federal government in 2014 is investing millions of dollars to combat biodefense

threats that will most likely not affect Americans. The US Gulf Coast is considered highly vulnerable to virus infections transmitted by mosquitoes—so called arboviruses such as dengue, chikungunya, and West Nile virus infection—and yet the investments on public health preparedness are focused on biodefense threats. A new administration may need to better adjust the balance of allocated funds toward real versus perceived infectious disease threats.

#### NTDs and Conflict: Ebola and the Next Ebola—The Middle East and North Africa

The WHO now estimates that before it is contained sometime in early 2015, 20,000 cases of Ebola virus infection will strike the three major West African countries of Guinea, Liberia, and Sierra Leone. However, additional estimates by the CDC and other organizations project that the total Ebola cases may far exceed this number. A central reason for this unprecedented Ebola outbreak is the breakdown in public health infrastructure in this region, a consequence of the fact that all three affected countries have only recently emerged from decades of war and violence. Time and again we have seen NTDs emerge in the context of conflict and post-conflict settings, together with extreme poverty. Other key examples include an outbreak of kala-azar (visceral leishmaniasis) in Sudan—which killed more than 100,000 people, many of them refugees fleeing to neighboring Ethiopia—and African sleeping sickness (human African trypanosomiasis), which also killed hundreds of thousands in war-torn areas of the Democratic Republic of the Congo and neighboring areas of Angola, Central African Republic, and Sudan.

We may now be seeing a similar situation unfold in the Middle East and North Africa (MENA). More than 100,000 cases of cutaneous leishmaniasis (also known as "Aleppo Evil") have now occurred in Syria, and we are seeing the reemergence of other important infections including polio and rabies. <sup>46</sup> The Aleppo Evil outbreak may be just the beginning. An estimated 65 million people in MENA live in extreme poverty, and this region has emerged as a major zone of widespread NTDs, especially in the poorest nations of Yemen and Egypt, where helminth infections such as schistosomiasis and others are widespread. <sup>47</sup> Several forms of leishmaniasis are important NTDs in Iran, Iraq, Libya, and Syria, while viral infections such as dengue fever, Crimean–Congo hemorrhagic fever, Rift Valley fever, Middle East Respiratory Syndrome (MERS), and Alkhurma hemorrhagic fever have also emerged in Saudi Arabia and elsewhere. <sup>48</sup> There is an extreme danger that with the recently expanded conflict in Syria and Iraq any of these specific NTDs could emerge and become a regional or even global security threat.

The MENA region may also not be unique. In the Western Hemisphere, Haiti remains vulnerable, and governmental lapses and breakdowns in public health infrastructure in Venezuela have contributed to a massive resurgence in malaria and NTDs such as leishmaniasis and Chagas disease in that country. <sup>49</sup> In a September 2014 White House summit with health ministers from more than 40 countries, President Obama appropriately emphasized important links between global health and global security.

In the coming months and years we may need to look to new global governance that anticipates the emergence or re-emergence of tropical infections in areas of conflict and as a lead component of post-conflict reconstruction. Ebola virus infection was a wake-up call, but it will not be our last devastating tropical disease epidemic. MENA could be next.

#### Vaccine Diplomacy as a US Foreign Policy Theme in 2016

Few Americans are aware that the oral polio vaccine was developed jointly between the United States and the Soviet Union in the late 1950s during the Eisenhower administration. Polio is on the verge of elimination because two Cold War rivals put aside their ideologies to work together in order to develop a lifesaving product in the years following the Sputnik launch. To date, vaccine diplomacy has not been fully explored as a US foreign policy theme even though US research institutions, universities, and biotechs have extraordinary capacity for overseas scientific collaborations. One aspect of vaccine diplomacy could follow on the heels of President Obama's 2009 speech in Cairo, when he spoke about reaching out to the Muslim world in areas that included scientific collaborations.<sup>50</sup> Several Muslim countries, such as Egypt, Indonesia, Iran, and Saudi Arabia—each members of the Organisation of Islamic Conference (OIC)—have varying degrees of vaccine development capabilities. However, US institutions have not explored potential joint vaccine development programs in any meaningful depth. Because most neglected disease products provide little financial gain, but instead return investments through poverty reduction, the major pharmaceutical companies would not likely see such American interventions as any form of competition or interference. However, vaccine diplomacy presents an opportunity for the United States to project power through its scientific prowess and the stature of its research institutions. Current and future administrations have relatively clean slates in terms of being able to explore vaccine diplomacy and make it central to overseas diplomatic efforts in the Muslim world. In the MENA region, key affected OIC countries could collaborate with US scientists to pursue the development of early- to mid-stage vaccines to combat NTDs such as leishmaniasis and schistosomiasis, which are expected to reemerge in areas of conflict or post-conflict.51 There are also great opportunities to develop a firstgeneration MERS vaccine.52

The United States could also explore vaccine diplomacy with selected Latin American and Caribbean (LAC) countries, including selected populist governments, such as Bolivia, Ecuador, and Venezuela, or even possibly Cuba under the appropriate circumstances. Both Bolivia and Venezuela in particular are under great threat from NTDs. Today, Bolivia has the world's highest concentration of people living with Chagas disease, while in Venezuela, as highlighted above, there has been a reemergence of several diseases, especially malaria, due in part to breakdowns in public health infrastructure and government–led policies. Overall there is a need for greater engagement with LAC nations, as much of the previous global health initiatives—with the exception of Haiti—have focused on Africa and Asia. A high–level summit for LAC—"A Promise Renewed for the Americas"—was held in Panama in September of 2013 in order to promote maternal and child health across the region and to reduce inequities in reproductive health. An incoming president has an opportunity to assume greater leadership on health in the Americas.

#### Conclusion

Blue marble health embraces science and vaccine diplomacy for global poverty-related diseases so that the concept could become an important US policy theme as we prepare to enter the 2020s. Based on the success of MDG 6 and other MDGs, the UN is now looking past 2015 in order to create a new set of sustainable development goals (SDGs) that will include important global health targets. The 2016 election will present opportunities for a new US president to reinvent America's commitment to global health. Two opposing forces will shape that commitment: maintaining leadership and preeminence in this area in order to continue to project power and maintain global relevance and influence and balancing such aspirations with realistic fiscal constraints. Blue marble health allows for this approach by insisting that the G20 countries implement substantial disease burden reductions and assume greater responsibility for their own neglected diseases as well as those of its neighbors. The BRICS and other G20 countries must support and promote disease and poverty reductions in Africa at a level commensurate with their other investments. Such actions could ensure continued substantial progress in the MDG 6 target diseases and even lead to the elimination of selected diseases at the district, regional, national, or even global level by 2020. Doing so under the auspices of American guidance based on more than a decade-long track record of successes will simultaneously ensure American hegemony and leadership.

#### References

- 1. "Millennium Summit," United Nations, <a href="http://www.un.org/en/events/">http://www.un.org/en/events/</a>
  <a href="pastevents/millennium\_summit.shtml">pastevents/millennium\_summit.shtml</a>.
- 2. Peter J. Hotez, Forgotten People, Forgotten Diseases: The Neglected Tropical Diseases and their Impact on Global Health and Development (Washington, DC: ASM Press, 2013), 275.
- 3. "President Bush's Global Health Initiatives Are Saving Lives Around The World," The White House, <a href="http://georgewbush-whitehouse.archives.gov/infocus/bushrecord/factsheets/globalhealth.html">http://georgewbush-whitehouse.archives.gov/infocus/bushrecord/factsheets/globalhealth.html</a>.
  - 4. Ibid.
  - 5. Ibid.
- 6. CJ Murray, KF Ortblad, C Guinovart, SS Lim, TM Wolock, DA Roberts, EA Dansereau et al., "Global, regional, and national incidence and mortality for HIV, tuberculosis, and malaria during 1990–2013: A systematic analysis for the Global Burden of Disease Study 2013," *Lancet* 384 (2014).
  - 7. Hotez, Forgotten People, Forgotten Diseases, 275.
  - 8. Murray, Ortblad, et al., "Global, regional, and national incidence."
  - 9. Ibid.
  - 10. Ibid.
  - 11. Ibid.
  - 12. Ibid.

- 13. "USAID's NTD Program," last modified October 17, 2014, <a href="http://www.neglecteddiseases.gov">http://www.neglecteddiseases.gov</a>.
- 14. "London Declaration on Neglected Tropical Diseases," <a href="http://unitingtocombatntds.org/sites/default/files/resource\_file/london\_declaration\_on\_ntds.pdf">http://unitingtocombatntds.org/sites/default/files/resource\_file/london\_declaration\_on\_ntds.pdf</a>.
- 15. Peter J. Hotez, Miriam Alvarado, María-Gloria Basáñez, Ian Bolliger, Rupert Bourne, Michel Boussinesq, Simon J. Brooker et al., "The global burden of disease study 2010: Interpretation and implications for the neglected tropical diseases," *PLOS Neglected Tropical Diseases* 8, no. 7 (2014).
- 16. Peter J. Hotez, A. Fenwick, L. Savioli, DH Molyneux, "Rescuing the bottom billion through control of neglected tropical diseases," *Lancet* 373 (2009): 1570–75.
  - 17. Ibid.
- 18. Peter J. Hotez and MT Ferris, "The antipoverty vaccines," *Vaccine* 24 (2006): 5787–99.
- 19. Peter J. Hotez, "New Antipoverty Drugs, Vaccines, and Diagnostics: A Research Agenda for the US President's Global Health Initiative (GHI)," *PLOS Neglected Tropical Diseases* 5 (2011): e1133.
  - 20. Hotez and Ferris, "The antipoverty vaccines."
  - 21. Hotez, "New Antipoverty Drugs, Vaccines, and Diagnostics."
  - 22. Ibid.
- 23. Henry Kissinger, *Does America Need a Foreign Policy?*: Toward a New Diplomacy for the 21st Century. (New York: Simon and Schuster, 2001), 352.
- 24. Peter J. Hotez, "The 'Biblical Diseases' and US Vaccine Diplomacy," *The Brown Journal of World Affairs* 12 (2006): 247–58.
- 25. Peter J. Hotez, "Global Christianity and the control of its neglected tropical diseases," *PLOS Neglected Tropical Diseases* 8 (2014).
- 26. Peter J. Hotez, and M. Whitham, "Helminth infections: A new global women's health agenda," *Obstet Gynecol* 123, no. 1 (2014): 155–60.
- 27. Peter J. Hotez, "Unleashing 'Civilian Power': A New American Diplomacy through Neglected Tropical Disease Control, Elimination, Research, and Development," *PLOS Neglected Tropical Diseases* 5, no. 6 (2011): e1134.
- 28. Peter J. Hotez, N. Mistry, J. Rubinstein, and JD Sachs, "Integrating neglected tropical diseases into AIDS, tuberculosis, and malaria control," *New England Journal of Medicine* 364 (2011): 2086–89.
- 29. Peter J. Hotez, "NTDs V.2.0: "blue marble health"—neglected tropical disease control and elimination in a shifting health policy landscape," *PLOS Neglected Tropical Diseases* 7 (2013): e2570.
- 30. Peter J. Hotez, "The disease next door," *Foreign Policy*, March 25, 2013, <a href="http://www.foreignpolicy.com/articles/2013/03/25/the\_disease\_next\_door">http://www.foreignpolicy.com/articles/2013/03/25/the\_disease\_next\_door</a>.
- 31. Peter J. Hotez, and RT Fujiwara, "Brazil's neglected tropical diseases: an overview and a report card," *Microbes Infect* 16, no. 8 (2014).
- 32. M. Tan, R. Kusriastuti, L. Savioli, and Peter J. Hotez, "Indonesia: An Emerging Market Economy Beset by Neglected Tropical Diseases (NTDs)," *PLOS Neglected Tropical Disease* 8, no. 2 (2014): e2449.

- 33. Hotez, "NTDs V.2.0: 'blue marble health.'"
- 34. K. Kline, JS McCarthy, M. Pearson, A. Loukas, and Peter J. Hotez, "Neglected Tropical Diseases of Oceania: Review of Their Prevalence, Distribution, and Opportunities for Control," *PLOS Neglected Tropical Diseases* 7 (2013): e1755.
- 35. Peter J. Hotez, "Engaging a Rising China through Neglected Tropical Diseases," *PLOS Neglected Tropical Diseases* 6 (2012): e1599.
- 36. Peter J. Hotez, SK Singh, and X-N Zhou, "Advancing Sino-Indian Cooperation to Combat Tropical Diseases," *PLOS Neglected Tropical Diseases* 7 (2013): e2204.
- 37. Peter J. Hotez, Rachel Cohen, Carol Mimura, Tadataka Yamada, Stephen L. Hoffman, and Deepali M. Patel, "Strengthening Mechanisms to Prioritize, Coordinate, Finance, and Execute R&D to Meet Health Needs in Developing Countries" (discussion paper, Institute of Medicine, January 16, 2013), <a href="http://www.iom.edu/Global/Perspectives/2013/StrengtheningMechanismsRD.aspx">http://www.iom.edu/Global/Perspectives/2013/StrengtheningMechanismsRD.aspx</a>.
  - 38. Ibid.
  - 39. Ibid.
- 40. Peter J. Hotez, "Neglected Infections of Poverty in the United States of America," PLOS Neglected Tropical Diseases 2, no. 6 (2008): e256.
- 41. Peter J. Hotez, "Neglected parasitic infections in the United States," *PLOS Neglected Tropical Diseases* 8, no. 9 (2014).
- 42. Peter J. Hotez, Kristy O. Murray, and Pierre Buekens, "The Gulf Coast: A New American Underbelly of Tropical Diseases and Poverty," *PLOS Neglected Tropical Diseases* 8, no. 5 (2014): e2760.
  - 43. Hotez, "Neglected parasitic infections."
- 44. DG Bausch, and L. Schwarz, "Outbreak of Ebola Virus Disease in Guinea: Where Ecology Meets Economy," *PLOS Neglected Tropical Diseases* 8, no. 7 (2014): e3056.
  - 45. Hotez, Forgotten People Forgotten Diseases, 275.
- 46. Peter J. Hotez, "'Aleppo Evil' بىل تەترىق: The Ulcer, the Boil, the Sandfly, and the Conflict," *PLOS Speaking of Medicine*, June 5, 2013.
- 47. Peter J. Hotez, L. Savioli, and A. Fenwick, "Neglected Tropical Diseases of the Middle East and North Africa: Review of Their Prevalence, Distribution, and Opportunities for Control," *PLOS Neglected Tropical Diseases* 6, no. 2 (2012): e1475.
  - 48. Ibid.
- 49. Peter J. Hotez, and Jennifer Herricks, "Venezuela: An emerging tropical disease and humanitarian emergency?" *PLOS Speaking of Medicine*, August 26, 2014.
- 50. Peter J. Hotez, "'Vaccine diplomacy': Historical perspectives and future directions," *PLOS Neglected Tropical Diseases* 8 (2014): e2808.
  - 51. Ibid.
- 52. Peter J. Hotez, ME Bottazzi, CT Tseng, B. Zhan, S. Lustigman, L. Du, and S. Jiang, "Calling for rapid development of a safe and effective MERS vaccine," *Microbes Infect* 16 (2014): 529–31.
- 53. Peter J. Hotez, "The NTDs and vaccine diplomacy in Latin America: Opportunities for United States foreign policy," *PLOS Neglected Tropical Diseases* 8, no. 9 (2014).
- 54. "A Promise Renewed for the Americas," accessed August 9, 2014, <a href="http://www.apromiserenewedamericas.org/apr">http://www.apromiserenewedamericas.org/apr</a>.

#### **About the Author**

Peter J. Hotez, M.D., Ph.D., is dean of the National School of Tropical Medicine at Baylor College of Medicine, where he is also the Texas Children's Hospital Endowed Chair of Tropical Pediatrics; university professor, Baylor University; president, Sabin Vaccine Institute; and fellow in disease and poverty at Rice University's Baker Institute for Public Policy.

