"Vaccine Diplomacy": Historical Perspectives and Future Directions

Peter J. Hotez1,2,3*

1 Sabin Vaccine Institute and Texas Children’s Hospital Center for Vaccine Development, Departments of Pediatrics and Molecular Virology and Microbiology, National School of Tropical Medicine at Baylor College of Medicine, Houston, Texas, United States of America, 2 Departments of Medical Humanities and Biology, Baylor University, Waco, Texas, United States of America, 3 James A. Baker III Institute for Public Policy, Rice University, Houston, Texas, United States of America

Vaccine diplomacy is the branch of global health diplomacy that relies on the use or delivery of vaccines, while vaccine science diplomacy is a unique hybrid of global health and science diplomacy. Both offer innovative opportunities to promote United States (US) foreign policy and diplomatic relations between adversarial nations. Vaccine science diplomacy could also lead to the development and testing of some highly innovative neglected disease vaccines.

Introduction: Origins and Definitions

International cooperation for purposes of infectious and tropical disease control goes back to at least the 14th century, when early concepts of quarantine were introduced in Dubrovnik on the Adriatic Coast of Croatia [1,2], and to the later date of 1851, when Europe held its first International Sanitary Conference for multilateral cooperation to prevent the spread of cholera and, subsequently, plague and yellow fever [3]. Such efforts led to a series of international sanitary treaties and conventions and ultimately to the formation of the Pan American Health Organization and the later establishment of the World Health Organization (WHO) [3,4].

Some scholars trace our current framework for global health diplomacy to the writings of Dr. Peter G. Bourne in his role as special assistant for health issues to US President Jimmy Carter [5] and later (during the first years of the 21st century) to the launch of the Millennium Development Goals (MDGs) and the release of the “Report of the Commission for Macroeconomics and Health”, when global health was placed squarely in the international diplomacy arena [6]. Among the driving forces for these activities was an urgent need for diplomatic collaboration to combat pandemics caused by HIV/AIDS and seasonal and avian influenza, which came with the revelation that such diseases are threats to economic development and both national security and foreign policy interests [7]. There were also practical considerations concerning potential bioterrorist threats and situations that required international diplomacy, such as when Indonesia balked at sharing its time-sensitive avian influenza data or when Nigeria and Pakistan halted polio and other immunization initiatives because of religious tensions [7–11].

In 2007, foreign ministers from seven countries—Brazil, France, Indonesia, Norway, Senegal, South Africa, and Thailand—issued the landmark “Oslo Ministerial Declaration” that formally linked global health to foreign policy [12]. At that time, Kickbusch et al. defined global health diplomacy in terms of processes by which governments and civil societies both “position health in foreign policy negotiations” and create new types of “global health governance” [13,14]. More recently, Kickbusch and Lokeny defined it as a “system of organization and communications and negotiation processes that shape global policy environment in the sphere of health and its determinants” [15].

A key element of modern global health diplomacy is that “no longer do diplomats just talk to other diplomats”, but instead a variety of experts in different areas and disciplines are now brought in to solve timely global health issues [13]. Katz et al. [9] have since categorized different aspects of global health diplomacy to include the following: (1) core diplomacy, referring to “classical Westphalian negotiations” between nations leading to bilateral and multilateral treaties, such as the recent WHO Framework Convention on Tobacco Control and International Health Regulations (IHR) 2005; (2) multistakeholder diplomacy, i.e., negotiations between or among nations and international agencies such as WHO, the GAVI Alliance, United States Agency for International Development (USAID), and non-governmental organizations (NGOs); and (3) informal diplomacy, which includes peer-to-peer scientific partnerships, private funders such as the Bill & Melinda Gates Foundation, and even some government employees from USAID or the US military working more or less independently in the field due to unique circumstances [9]. Michaud and Kates have identified similar forms of global health diplomacy [16].

Kickbusch and Lokeny have also noted recently that the WHO director-general made frequent mention of health diplomacy in her remarks at the January 2013 executive session [15]. Among the factors responsible for this emphasis are globalization associated with the renewed emphasis on “soft power”, security policy, trade agreements, and policies concerning the environment and international development, as well as the inclusion of health issues as part of the United Nations and summits held by various governments and organizations and agencies, such as the Group of Eight (G8) and Group of Twenty (G20) nations, the European Union (EU), the Organization of the Islamic Conference (OIC), and the BRICS (Brazil,
Russia, India, China, and South Africa) countries [15]. Still another factor is the increasing use of health attaches embedded in foreign delegations and agencies and increasing dialogue with low- and middle-income countries [15]. With regards to the G20 (and their BRICS-country components), I introduced the term “blue marble health” to refer to the unexpectedly high neglected disease burden among the poor living in emerging economies and even some G20 countries, circumstances such that these nations could drastically reduce global burdens of neglected diseases by taking greater responsibility for their own health concerns [17,18].

Vaccine Diplomacy and Vaccine Science Diplomacy: Definitions

Beginning in 2001, the broad framework of global health diplomacy outlined above helped to generate the concepts of vaccine diplomacy and vaccine science diplomacy [19–24]. Vaccine diplomacy refers to almost any aspect of global health diplomacy that relies on the use or delivery of vaccines and encompasses the important work of the GAVI Alliance, as well as elements of the WHO, the Gates Foundation, and other important international organizations. Central to vaccine diplomacy is its potential as a humanitarian intervention and its proven role in mediating cessation of hostilities and even cease-fires during vaccination campaigns [20–22,25]. In this case, the lead actor may come from an international organization, such as WHO or the United Nations Children’s Fund (UNICEF), or an associated nongovernmental organization.

A subset of vaccine diplomacy is vaccine science diplomacy, which is a hybrid of elements of global health diplomacy and science diplomacy. I use the term “vaccine science diplomacy” narrowly to refer to the joint development of life-saving vaccines and related technologies, with the major actors typically scientists. Of particular interest, the scientists may be from two or more nations that often disagree ideologically or even from nations that are actively engaged in hostile actions. This definition is along the lines of what Katz et al. would call informal global health diplomacy based on peer-to-peer scientific interactions [9], together with elements of science diplomacy in which the representative nation projects power through its scientific prowess and reputation, as Abelson and others articulated for US science and applied technology during the Cold War [26–28] or more recently as can be seen in outreach to the Islamic world [29] and targeted initiatives for less developed countries [30]. Unlike many forms of global health diplomacy, this aspect of vaccine diplomacy is led by scientists.

An underlying theme of both vaccine and vaccine science diplomacies is that vaccines are unique in comparison to other medical or public health interventions. By some estimates, vaccines are the single most powerful intervention ever developed by humankind in terms of the lives that they save. By one estimate, modern vaccines have saved more lives than those that were lost in the World Wars during the 20th century [21–23].

The Historical Context

Both vaccine diplomacy and vaccine science diplomacy might be best understood by reviewing their historical successes (Table 1). Indeed, an interesting but little-known feature is how diplomacy is intimately tied to the initial development and delivery of many vaccines. The first vaccine discovered in modern times was in 1798 by Britain’s Edward Jenner, who found that cowpox administered as an inoculum could prevent smallpox [31]; the term vaccine is derived from vacca, the Latin term for “cow.” Because smallpox produced such devastating and massive killer epidemics (especially among indigenous populations in the New World), the first vaccine almost immediately attained international acclaim in the first years of the 19th century [31,32]. For example, from 1800 to 1805, Jenner corresponded widely and internationally and advised countries as diverse as Russia, Spain, and Turkey and Native American tribes and nations in Canada and Mexico on how to prepare and administer the smallpox vaccine [31,32]. Among the earliest examples of vaccine diplomacy, in 1801 Dr. Edward Gantt, the chaplain of the US Congress, vaccinated Native American diplomats who were visiting Washington, D.C., and in 1803 the Lewis and Clark Expedition was provided smallpox vaccine intended for Native Americans living on the western frontier, although it is unclear if successful vaccinations were actually performed [32]. From 1803 to 1815 during the Napoleonic wars between England and France, Jenner himself was called on for diplomatic functions, including prisoner releases [31]. Jenner was honored in France and wrote in a letter to the National Institute of France that “the sciences are never at war,” while Napoleon was supposed to have once stated, “Jenner—we can’t refuse that man anything” [19,31].

The next set of vaccines, including a new rabies vaccine, was developed almost one hundred years later by France’s Louis Pasteur. In a speech at the inauguration of his institute in Paris in 1886, Pasteur stated that “science knows no country, because knowledge belongs to humanity and is the torch which illuminates the world” [31,33]. Before the close of the century, scientists from the Pasteur Institute spread out to create a network of laboratories in Francophone countries in Indochina (beginning with the Saigon Pasteur Institute [1891]) and North Africa [34], especially for the preparation and administration of rabies vaccine. Around this time (from 1892–1897), Dr. Waldemar Haffkine, a Jewish scientist from Ukraine working in France and Switzerland, traveled to India in order to inoculate tens of thousands of people with his prototype cholera and plague vaccines, but he did so only after first testing the vaccines on himself [35]. Today, the Haffkine Institute in Mumbai is an important microbiology research institute.

Vaccine science diplomacy entered its golden age during the Cold War between the US and the Union of Soviet Socialist Republics (USSR). Between 1956 and 1959, Dr. Albert Sabin from the US traveled to the USSR and collaborated with his Soviet virology counterparts, including Dr. Mikhail Chumakov, to develop a prototype oral polio vaccine and test it on 10 million Soviet children and ultimately 100 million people under the age of 20 [36]. The success of the collaboration depended on each scientist going to great lengths to convince their diplomatic liaisons to put aside ideologies for purposes of joint scientific cooperation [19–23,36]. Today, the oral polio vaccine is leading to global eradication efforts. Similarly, between 1962 and 1966, the USSR pioneered a freeze-drying technique for smallpox vaccine and provided 450 million doses of vaccine to support global smallpox eradication campaigns in developing countries, while the US provided key financial support [37]. Such international collaborative efforts led to the global eradication of smallpox by the late 1970s, an effort led by Dr. D. A. Henderson [37]. Later, in the 1980s and following the visit of US Nobel Laureate Fred Robbins to India, the Indo-US Vaccine Action Program (VAP) was established to foster international collaboration in the areas of epidemiology, laboratory investigation, and vaccine clinical trials, quality control, and delivery [38].
Table 1. Historical milestones in vaccine diplomacy.

| Years       | Specific Vaccine(s)          | Actions                                                                 | Reference |
|-------------|------------------------------|-------------------------------------------------------------------------|-----------|
| 1800–1805   | Smallpox                     | Edward Jenner promotes vaccine use in Russia, Turkey, and Spain and with Native Americans in the Spanish colonies of Mexico, the Five Nations of Canada, and the United States. | [31,32]   |
| 1801        | Smallpox                     | The chaplain of Congress, Dr. Edward Gantt, vaccinates Native American diplomats visiting Washington, D.C. | [32]      |
| 1803        | Smallpox                     | The Lewis and Clark Expedition provides vaccine intended for Native Americans, but it is unclear if successful vaccinations were performed. | [32]      |
| 1803–1815   | Smallpox                     | During the Napoleonic Wars, Jenner calls for prisoner release and other diplomatic functions. In a letter to the National Institute of France, he writes that “the sciences are never at war.” | [31]      |
| 1851–present| -                            | The First International Sanitary Conference is held in Europe.          | [3]       |
| 1891–present| -                            | International network of Pasteur Institutes begins, initially in Saigon, for purposes of fundamental research and research on vaccines for rabies and other infectious diseases. | [34]      |
| 1892–1897   | Cholera and plague           | After first testing the vaccines on himself, Dr. Waldemar Haffkine travels to India to inoculate tens of thousands of people with his prototype cholera and plague vaccines. | [35]      |
| 1902        | -                            | Formation of the International Sanitary Bureau (present-day Pan American Health Organization) | [4]       |
| 1946–48     | -                            | Formation of the World Health Organization                              | [3]       |
| 1956–1959   | Polio                        | Dr. Albert Sabin travels to the USSR and collaborates with Dr. Mikhail Chumakov, ultimately testing an oral vaccine on 10 million children and then on 100 million people under the age of 20. | [36]      |
| 1962–1966   | Smallpox                     | The USSR provides 450 million doses of vaccine for an eradication campaign, while the US provides financial support. | [37]      |
| 1968        | -                            | Formation of the Fogarty International Center of the NIH                |           |
| Mid-1970s   |                              | Formation of PATH                                                        |           |
| 1980s and 1990s | Polio and other vaccines    | “Days of tranquility” for immunizations are held in more than a dozen war-torn countries. | [25]      |
| 1987        | -                            | Indo-US Vaccine Action Program (VAP) is administered under the auspices of NIAID, NIH. | [38]      |
| 1990–91     | -                            | Children’s Vaccine Initiative (CVI)                                      |           |
| 1993        | -                            | Formation of the Sabin Vaccine Institute                                | [58]      |
| 1997        | -                            | Formation of the Infectious Diseases Research Institute                 |           |
| 1997        | -                            | Formation of the International Vaccine Institute                          |           |
| 2000        | -                            | GAVI Alliance is established, ultimately providing vaccines for North Korea. | [39,41]   |
| 2001        | -                            | “Vaccine diplomacy” enters the literature.                               | [19]      |
| 2007        | -                            | Formation of program in Sustainable Immunization Financing at Sabin Vaccine Institute | [65]      |
| 2007        | Influenza                    | Under the auspices of the WHO, Brazil, India, Indonesia, Mexico, Thailand, and Vietnam receive US and Japanese grants for influenza vaccine manufacturing capacity and technology transfer. | [52]      |
| 2008        | Yellow Fever                 | Outbreak of urban yellow fever—the neighboring countries of Paraguay mobilize to ensure access to yellow fever vaccine. | [45]      |
| 2009        | H1N1 Influenza A             | Intergovernmental Meeting (IGM) on Pandemic Influenza Preparedness Framework for the Sharing of Influenza Viruses and Access to Vaccines and Other Benefits | [43]      |
| 2010        | Cholera                      | Call for international cholera vaccine stockpile as a humanitarian and diplomatic resource | [44]      |
| 2011        | -                            | Decade of Vaccines Collaboration                                         | [46]      |
| 2012        | -                            | The Global Vaccine Action Plan (GVAP)—endorsed by the 194 Member States of the World Health Assembly in May 2012 | [47,48]   |
| 2013        | Leishmaniasis and other neglected tropical diseases | Joint statement on vaccine diplomacy between US and Iran | [54]      |
| 2013        | -                            | State Department forms new Office of Global Health Diplomacy.            |           |

doi:10.1371/journal.pntd.0002808.t001
VAP is maintained under the auspices of the National Institute of Allergy and Infectious Diseases of the US National Institutes of Health (NIH) [30]. In 1990–91, a Children’s Vaccine Initiative was launched as an early attempt at global governance for developing pediatric vaccines for developing countries.

Vaccine diplomacy also flourished in the later decades of the 20th century. According to WHO’s Health as a Bridge to Peace—Humanitarian Cease-Fires Project (HCFP), vaccines and vaccinations were used to negotiate so-called “days of tranquility” in more than a dozen countries during the 1980s and 1990s, including Afghanistan, Angola, Chechnya, Democratic Republic of Congo, El Salvador, Guinea Bissau, Iraq, Lebanon, Philippines, Sierra Leone, Sri Lanka, and Sudan [25].

Modern Day Vaccine and Vaccine Science Diplomacy

Beginning in 2000, vaccines became integrated as key tools in helping developing nations achieve their MDGs and targets. Following the launch of the GAVI Alliance, many developing countries for the first time gained access to vaccines for combating rotavirus and *Haemophilus influenzae* type b (Hib), and a new vaccine for pneumococcal vaccine was developed [39,40]. Partly because of these interventions, child mortality was reduced by almost one-half [40]. Included among these activities was GAVI’s important work in providing vaccines for North Korea and other fragile states [41].

Among the initiatives relevant to vaccine diplomacy in the 21st century are international efforts to ensure universal or equitable access for low- and middle-income countries to urgently needed vaccines for diseases of pandemic potential. It was noted that many developing countries were on the “outside looking in” when it came to having access to influenza vaccines, including the vaccine for the H1N1 pandemic influenza in 2009 and prototype H5N1 avian influenza vaccines [42,43]. As a result, Indonesia went through a period in which it refused to share timely influenza surveillance data with the WHO [42]. It was noted that IHR 2005 did not adequately spell out provisions on providing equitable access for vaccines [43], and it was probably not intended for this purpose. In 2009, an Intergovernmental Meeting (IGM) was held on pandemic influenza preparedness as a means to establish a framework for sharing influenza and other vaccines with developing countries [43]. Issues of developing country access again arose when cholera emerged in sub-Saharan Africa and Haiti; there was no mechanism to rapidly mobilize cholera vaccine, and calls went out to stockpile cholera vaccine as a humanitarian and diplomatic resource [44]. Also, in 2008 when yellow fever vaccine supplies were depleted during the first urban yellow fever outbreak in the Americas in decades, countries neighbor- ing Paraguay helped to ensure that the vaccine was made available in that country [45]. In 2012, following the earlier launch of the Decade of Vaccines Collaboration [46], the Global Vaccine Action Plan (GVAP) was endorsed by the 194 Member States of the World Health Assembly as “a framework to prevent millions of deaths by 2020 through more equitable access to existing vaccines for people in all communities” [47]. A World Health Assembly resolution was adopted that recognizes access to vaccines as a fundamental right to human health [48]. The diplomatic community was also called on to address critical issues of noncompliance for polio and other vaccines intended for vulnerable populations living in Islamic countries. In 2003, a boycott of polio vaccinations in three northern Nigerian states from fears that the vaccine was contaminated with antifertility drugs (in order to sterilize Muslim girls) necessitated diplomatic intervention from the Government of Malaysia and the OIC [49]. Similar interventions are now required in Pakistan, where the Taliban and other extremist groups have assassinated vaccinators and other aid workers [50]. Some assassinations may have been carried out in retaliation for the Central Intelligence Agency (CIA)’s alleged role in establishing a fake vaccination campaign in Abbottabad, Pakistan, as a ruse in order to confirm the identity of members of Osama bin Laden’s family [51]. Such activities represent a significant setback to vaccine diplomacy.

Of relevance to both vaccine and vaccine science diplomacy, in 2007 under the auspices of the WHO and the Global Pandemic Influenza Action Plan, six countries—Brazil, India, Indonesia, Mexico, Thailand, and Vietnam—received grants from the US and Japanese governments to establish in-country manufacturing capacity for influenza vaccines [52].

Future Directions and Moving towards a Framework

While the historical and modern-day track records of vaccine and vaccine science diplomacy are impressive, they have not yet led to an overarching framework for its expanded role in foreign policy. Establishing such a framework might be especially useful for US foreign policy.

In 2009, President Obama traveled to Cairo where he spoke out about engaging scientists in the Muslim world and extending a hand in science diplomacy [53]. Despite the establishment of a valuable US Science Envoy program, to date such activities have not led to substantive joint vaccine partnerships despite the observation that several Islamic countries in the Middle East and Asia, including Egypt, Indonesia, Iran, and Saudi Arabia, have some capacity for vaccine product development [23]. With an Iranian scientist from the Tehran University of Medical Sciences, Dr. Mohammed Rokni, I recently advocated launching such efforts between the US and Iran and provided as an example the opportunity for developing a vaccine for leishmaniasis, which has devastated areas of conflict in the Middle East and North Africa [54]. Similar opportunities exist in order to partner with nations such as Cuba, which has considerable technical expertise both in producing and delivering vaccine [55], and possibly even countries such as North Korea, which has some technical capabilities [56].

Our Sabin Vaccine Institute and Texas Children’s Hospital Center for Vaccine Development (Sabin), a nonprofit product development partnership (PDP) that uses industry practices to develop and test neglected disease vaccines, could occupy a key niche in vaccine diplomacy. Sabin’s vaccine portfolio targets neglected tropical diseases (NTDs) that specifically affect the poorest people living in low- and middle-income countries. Because NTDs have been shown to promote poverty through their adverse effects on worker productivity, the health of girls and women, and child development, the vaccines under development at Sabin are sometimes referred to as the “antipoverty vaccines” [57,58]. Moreover, most of the diseases targeted by the Sabin portfolio of vaccines occur in countries of direct relevance to vaccine diplomacy (Table 2) [59]. For example, more than one-third of the world’s cases of hookworm infection, ascariasis, and trichuriasis occur in nations of the OIC, i.e., the world’s Muslim countries (Figure 1), while almost one-half of the cases of schistosomiasis occur among the OIC countries [59]. Furthermore, both cutaneous and visceral leishmaniasis have emerged as the most
significant infections arising in settings of ongoing conflict, with the former affecting hundreds of thousands of people in Syria and Syrian refugees, while the latter was the leading killer in the war between northern and southern Sudan during the 1980s and 1990s [60]. Some of these diseases are also widespread in some Latin American countries where leaders have expressed varying degrees of anti-American sentiment. While Sabin is currently conducting joint vaccine development with public-sector vaccine manufacturers in Brazil and Mexico, it is ready to embark on joint vaccine development with countries such as Cuba, Indonesia, and Iran, i.e., nations with either strained or even overtly hostile foreign relations with the US in past and recent years. As a form of projecting soft power with both allies and potential adversaries, such activities are consistent with what former Secretary Hillary Clinton termed “civilian power” [24].

Beyond US foreign relations, there are opportunities for vaccines to promote cooperation between Asian nations. For instance, each of the largest Asian countries, i.e., China, India, Indonesia, Japan, and Vietnam, has capabilities to develop and produce new vaccines [56,61]. China and India engaged in overt hostilities in 1964, while China’s recent territorial claims in the East China Sea have sparked fresh tensions in the region [61]. Both Sabin and another PDP, the International Vaccine Institute (IVI) based in Seoul, Korea [62], could help mediate vaccine diplomacy between these nations. In addition, Brazil, which also has major vaccine capabilities, has initiated South-South partnerships with Lusophone Africa and could become an important actor in vaccine diplomacy [63]. Vaccine manufacturing organizations associated with many of the key OIC and Asian nations targeted for vaccine science diplomacy belong to the unique Developing Countries Vaccine Manufacturers Network (DCVMN) [64]. Both the GAVI Alliance and WHO could have key roles in coordinating these activities. These organizations also have a key role in a new Sustainable Immunization Financing

Table 2. Sabin PDP vaccines under development of potential relevance to US foreign policy interests.

| Disease Targeted (Approximate Number of People Affected) | Affected Geographic Areas of Interest to US Foreign Policy Interests | Stage of Development |
|----------------------------------------------------------|---------------------------------------------------------------|----------------------|
| Human hookworm infection (400 million)                   | OIC countries in Africa, the Middle East, and Asia           | Phase 1              |
|                                                          | India and China                                              |                      |
| Schistosomiasis (250 million)                            | OIC countries in Africa and the Middle East                   | Completed current good manufacturing practice (cGMP) manufacture |
| Ascariasis and Trichuriasis (>800 million)               | OIC countries in Africa, the Middle East, and Asia           | Preclinical          |
|                                                          | India and China                                              |                      |
| Leishmaniasis (10 million)                               | Areas of conflict in the Middle East and North Africa, including OIC countries | Preclinical          |
| Chagas disease (7–8 million)                             | Venezuela, Ecuador, Bolivia                                  | Preclinical          |
| SARS (None currently)                                    | China                                                        | Preclinical          |

doi:10.1371/journal.pntd.0002808.t002
program inaugurated with Gates Foundation support by Dr. Ciro De Quadros at the Sabin Vaccine Institute, which focuses on 12 African countries, five Asian countries, and one Central Asian country [65].

Today, the Division of International Relations of the NIH’s Fogarty International Center maintains an important role in promoting international agreements between the US and governments throughout the world [66]. In the coming years, vaccine and vaccine science diplomacy activities could become incorporated into the new US State Department Office of Global Health Diplomacy [67], as well as into the WHO and its regional offices and within organizations such as the Bill & Melinda Gates Foundation and the Carlos Slim Health Institute. The power of vaccine and vaccine science diplomacy has been underexplored despite a noble track record that included promoting peace between the Cold War powers of the 1950s and 1960s, which also led to the development, testing, and delivery of two of the most important 20th century health interventions, i.e., the freeze-dried smallpox vaccine and oral polio vaccine, and the resulting global eradication of smallpox and near elimination of polio. The historical lessons from these accomplishments still have critical relevance to global health and blue marble health.

References

1. Tognotti E (2013) Lessons from the History of Quarantine, from Plague to Influenza A. Emerg Infect Dis 19: 254–259. Available: http://wwwnc. cdc.gov/eid/article/19/2/12-0312_article.htm. Accessed 7 December 2013.
2. Feldbaum H, Lee K, Michaud J (2010) Global health and foreign policy. Epidemiol Rev 32: 82–90.
3. Fidler DP (2001) The globalization of public health: the first 100 years of international health diplomacy. Bull World Health Organ 79: 842–849.
4. Fee E, Brown T (2002) 100 years of the Pan American Health Organization. Am J Publ Health 92: 1880–1889.
5. Winko S, Deardorff J (1978) A partnership for international health care. Public Health Rep 93: 114–123.
6. Hotez PJ (2013) Forgotten People, Forgotten Diseases: The Neglected Tropical Diseases and their Impact on Global Health and Development. 2nd Edition. Washington (D.C.): ASM Press. 275 p.
7. Michaud J, Kates J (2013) Global health diplomacy: advancing foreign policy and global health interests. Glob Health Sci Pract 1: 24–28.
8. Peterson S (2002) Epidemic disease and national security. Security Studies 12: 43–81.
9. Katz R, Kornblet S, Arnold G, Lief E, Fischer JE (2011) Defining health diplomacy: changing demands in the era of globalization. Milbank Q 89: 503–523.
10. Kauffmann JR, Feldbaum H (2009) Diplomacy and the polio immunization boycott in northern Nigeria. Health Affairs 28: 1091–1101.
11. Fidler DP (2010) Negotiating equitable access to influenza vaccines: global health diplomacy and the controversies surrounding avian influenza H5N1 and pandemic influenza H1N1. PLoS Med 7: e1000249.
12. Kaufmann NR, Feldbaum H (2009) Diplomacy and the polio immunization boycott in northern Nigeria. Health Affairs 28: 1091–1101.
13. Fidler DP (2010) Negotiating equitable access to influenza vaccines: global health diplomacy and the controversies surrounding avian influenza H5N1 and pandemic influenza H1N1. PLoS Med 7: e1000249.
14. Labonte R, Gagnon ML (2010) Framing health and foreign policy: lessons for global health diplomacy. Global Health 6: 14.
15. Kickbusch I, Lokeny M (2013) Global health diplomacy: five years on. Bull World Health Organ 91: 139–150A.
16. Michaud J, Kates J (2013) Global health diplomacy: advancing foreign policy and global health interests. Glob Health Sci Pract 1: 24–28.
17. Hotez P (2013 March 25) The disease next door. Foreign Policy. Available: http://www.foreignpolicy.com/articles/2013/03/25/the-disease_next_door. Accessed 29 May 2014.
18. Hotez P (2013) NTDs V.2.0: “Blue Marble Health”—Neglected Tropical Disease Control and Elimination in a Shifting Health Policy Landscape. PLoS Negl Trop Dis 7: e2570.
19. Hotez P (2001 May-Jun) Vaccine diplomacy. Foreign Policy 124: 68–69.
20. Hotez PJ (2001) Vaccines as instruments of foreign policy. EMBO Rep 2: 862–868.
21. Hotez PJ (2002) Appraising Wilson’s Ghost: The expanded role of the new vaccines in international diplomacy. In: CBAC Health and Security Series. Occasional Paper 3. Washington (D.C.): Chemical and Biological Arms Control Institute.
22. Hotez PJ (2006) The “biblical diseases” and US vaccine diplomacy. Brown J World Affairs 12: 247–258.
23. Hotez PJ (2010) Peace through vaccine diplomacy. Science 327: 1301.
24. Hotez PJ (2011) Unleashing “civilian power”: a new American diplomacy through neglected tropical disease control, elimination, research, and development. PLoS Negl Trop Dis 5: e1134.
25. World Health Organization (2014) Health as a Bridge for Peace - HUMANITARIAN CEASE-FIRES PROJECT (HCFP). Available: http://www.who.int/hac/techguidance/hcfp/cease_fires/en/#. Accessed 25 January 2014.
26. Abdouo, PH (1972) Science, technology, and diplomacy. Science 178: 701.
27. Rabkin YM (1988) Sciences between the superpowers. New York: Priority Press. 119 p.
28. Schweitzer GE (1989) Techno-Diplomacy: US-Soviet Confrontations in Science and Technolo- gy. New York: Plenum Pub Corp. 320 p.
29. Zewail AH (2010) Science in diplomacy. Cell 141: 204–207.
30. Federationev NV (2009) Science diplomacy in the 21st century. Cell 136: 9–11.
31. Baxin H (2000) The Eradication of Smallpox: Edward Jenner and the First and Only Eradica- tion of a Human Infectious Disease. New York: Academic Press. 246 p.
32. Pearson, JD (2004) Medical diplomacy and the American Indian: Thomas Jefferson, the Lewis and Clark Expedition, and the subsequent effects on American Indian health and public policy. Wicazo S Review 19: 105–130.
33. Chura L (2012) Global science can bolster diplomacy. Nature 491: 527.
34. Pasteur International (2014) History in Move- ment. Available: http://www.pasteur-international.org/sp/easyfire/pasteur-international-en/institut-pasteur-international-network/history-in-movement. Accessed 10 December 2013.
35. Waksman SA (1964) The Brilliant and Tragic Life of WMM Haffkine, Bacteriologist. New Brunswick (New Jersey): Rutgers University Press. 90 p.
36. Swanson W (2012) Birth of a cold war vaccine. Sci Am 306: 66–69.
37. Henderson DA (2009) Smallpox: the death of a disease. Amherst (New York): Prometheus Books. 334 p.
38. NIAID (2012) Indo-U.S. Vaccine Action Pro- gram (VAP). Available: http://www.niaid.nih. gov/about/organization/dmid/indo/Pages/ default.aspx. Accessed 25 January 2014.
39. Gavi Alliance (2014) Korea, Democratic People’s Republic of (the). Available: http://www.gavialliance.org/country/dpr-korea. Accessed 10 December 2013.
42. Fidler DP (2008) Influenza virus samples, international law, and global health diplomacy. Emerg Infect Dis 14: 88–94
43. Fidler DP (2010) Negotiating equitable access to influenza vaccines: global health diplomacy and the controversies surrounding avian influenza H5N1 and pandemic influenza H1N1. PLoS Med 7: e1000247.
44. Waldor MK, Hotez PJ, Clemens JD (2010) A national cholera vaccine stockpile—a new humanitarian and diplomatic resource. N Engl J Med 363: 2279–2282.
45. Andrus JK, Ropero AM, Ghisays G, Romero S, Jauregui B, et al. (2011) Yellow fever and health diplomacy: International efforts to stop the urban yellow fever outbreak in Paraguay. In: Roskam E, Kickbusch I, editors. Negotiating and Navigating Global Health: Case Studies in Global Health Diplomacy. Singapore: World Scientific Publishing Company. pp. 391–403.
46. Decade of Vaccines (2014) Vision. Available: http://www.dovcollaboration.org/about-us/vision/. Accessed 25 January 2014.
47. World Health Organization (2014) Decade of Vaccines—Global Vaccine Action Plan 2011–2020. Available: http://www.who.int/immunization/global_vaccine_action_plan/en/. Accessed 25 January 2014.
48. World Health Organization (2014) World Health Assembly Resolution. Available: http://www.who.int/immunization/global_vaccine_action_plan/en/GVAP___World_Health_Assembly_Resolution.pdf. Accessed 25 January 2014.
49. Kaufmann JR, Feldbaum H (2009) Diplomacy and the polio immunization boycott in northern Nigeria. Health Affairs 28: 1091–1101.
50. Scientific American (2013 April 16) How the CIA’s Fake Vaccination Campaign Endangers Us All. Available: http://www.scientificamerican.com/article.cfm?id = how-cia-fake-vaccination-campaign-endangers-us-all. Accessed 14 December 2013.
51. Shah S (2011 July 11) CIA organized fake vaccination drive to get Osama bin Laden’s family DNA. The Guardian. Available: http://www.theguardian.com/world/2011/jul/11/cia-fake-vaccinations-osama-bin-ladens-dna. Accessed 14 December 2013.
52. World Health Organization (2007 April 24) WHO facilitates influenza vaccine technology transfer to developing countries. Available: http://who.int/mediacentre/news/notes/2007/np18/en/index.html. Accessed 25 January 2014.
53. Koenig R (2009) US takes steps to use science to improve ties to Muslim world. Science 326: 920–921.
54. Hotez PJ, Rotki MB (2013 November 6) Next steps in U.S.-Iran diplomacy: vaccines. Pacific Standard. Available: http://www.psmag.com/navigation/health-and-behavior/next-steps-in-us-iran-diplomacy-vaccines-69542/. Accessed 29 May 2014.
55. Andrus JK, de Quadros CA, Castillo Slorzano C, Roses Periago M, Henderson DA (2011) Measles, rubella eradication in the Americas. Vaccine 29: D91–D96.
56. Hotez PJ (2013 January 24) A reunification Rx for Korea. Los Angeles Times. Available: http://articles.latimes.com/2013/Jan/24/opinion/la-oe-hotez-korea-vaccine-diplomacy-20130124. Accessed 29 May 2014.
57. Hotez PJ, Ferris MT (2006) The antipoverty vaccines. Vaccine 24: 5787–5799.
58. Hotez P (2011) A handful of ‘antipoverty’ vaccines exist for neglected diseases, but the world’s poorest billion people need more. Health Aff (Millwood) 30: 1080–1087.
59. Hotez PJ (2009) The Neglected Tropical Diseases and Their Devastating Health and Economic Impact on the Member Nations of the Organization of the Islamic Conference. PLoS Negl Trop Dis 3: e339. doi: 10.1371/journal.pntd.0000539
60. Hotez PJ (2013 July 19) Another bad thing about war: insect-borne diseases. Global Post. Available: http://www.globalpost.com/dispatches/globalpost-blogs/commentary/insect-borne-diseases-wars-middle-east-africa-leishmaniasis-chagas. Accessed 29 May 2014.
61. Hotez P, Singh SK, Zhou XN (2013) Advancing Sino-Indian cooperation to combat tropical diseases. PLoS Negl Trop Dis 7: e2204.
62. International Vaccine Initiative (2012) Training and Technical Assistance. Available: http://www.ivi.int/web/www/02_07_03. Accessed 14 December 2013.
63. Allmedia C, Fieres de Campos R, Buss P, Ferreira JR, Fonseca LE (2009) Brazil's conception of South-South "structural cooperation" in health. Fiocruz. Available: http://www6.ensp.fiocruz.br/repositorio/sites/default/files/arquivos/343-1635-2-PB.pdf. Accessed 14 December 2013.
64. DCVMN (2014) Members. Available: http://www_dcvmn.org/members. Accessed 14 December 2013.
65. Sabin Vaccine Institute (2014) Sustainable Immunization Financing (SIF) Program. Available: http://www.sabin.org/programs/vaccine-advocacy-education/sustainable-immunization-financing-sif-program. Accessed 25 January 2014.
66. Fogarty International Center (2014) Division of International Relations (DIR). Available: http://www.fic.nih.gov/About/Staff/Pages/International-Relations.aspx. Accessed 25 January 2014.
67. US Department of State (2014) Office of Global Health Diplomacy. Available: http://www.state.gov/s/ghd/. Accessed 14 December 2013.