The Case against Polio Eradication

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Abstract

The poliomyelitis (polio) viruses have been a detriment to the global population since first gaining notoriety in the nineteenth century. In the wake of polio epidemics since then, much progress has been made worldwide to eradicate the viruses. An astounding 99% of the globe is now fully vaccinated against them. Despite these massive efforts, there remains one last percent, famously characterized as the "final inch," of the world that is still subject to the pathogens (Bernstein et al., 2009). The question that remains is whether or not the worldwide eradication effort can ever succeed. If not, should a control program be implemented instead to mitigate the effects of polio? This paper approaches this question with case studies of Cuba, India, and the Congolese Republics. It concludes that the eradication campaign cannot succeed in annihilating the polio viruses due to the following: 1) the future burden of finances on the international community, 2) the possibility for polio to erupt from just a single case of vaccine-derived poliovirus, 3) historical evidence based on the smallpox campaign and other polio country case studies, 4) the declining amount of support and enthusiasm for the current campaign, and 5) the implications this global health fight has on arenas such as trade, bioterrorism/national security, and collective memory. The international health community must re-evaluate its strategy to combat polio in order to fully and properly address this lethal problem.

Keywords: polio, eradication, Cuba, India, Republic of Congo, Democratic Republic of Congo

Introduction

Polio eradication has been widely debated since the World Health Assembly formally launched its campaign in 1988. In subsequent years, various regions in the world achieved polio-free status, with the Americas doing so in 1994, followed by the Western Pacific in 2000 and Europe in 2002 (Global Polio Eradication Initiative, 2011). In 2011, 23 years after it was first targeted, polio remained an epidemic in only sub-Saharan Africa and South Asia. Specifically, four endemic states of Afghanistan, India, Nigeria, and Pakistan currently exist, though an additional four states have gained "re-transmission" status, namely, Angola, Chad, Democratic Republic of Congo (DRC), and Sudan (ibid). (Note: at the time of this writing in April 2011, these were the only endemic states. India achieved zero cases of polio in 2012. Nigeria has begun a retransmission of polio.) Regardless, these classifications represent substantial decreases from their peaks in 1988.

Although one might assume that all states are in favor of eradication, this is not the case. Controversies have arisen within the past decade regarding the continuation of the global eradication program. Eradication optimists maintain that eradication is within reach and that polio will undoubtedly be vanquished within the next few years—just as had been done with smallpox in the last few decades. Several persuasive cases have been argued at the international, national, and even municipal levels supporting the cause. A notable example includes Dr. Margaret Chan's "The Case for Completing Polio Eradication" plea published in 2007 (Chan, 2007).

On the other hand, eradication pessimists question how practical polio eradication actually is. Many refer to the repeated delaying of eradication as an unreliable timetable with some doubting that eradication is a plausible goal at all. They then assert that a control campaign would be exponentially more efficient in controlling the deadly effects of polio. A greater examination into both sides' arguments is necessary before determining whom holds greater validity.

What is certain about the polio eradication debate is that it is an international problem that remains on the forefront of diplomacy and foreign affairs. With globalization prompting an increasingly easy transmission of polio across borders, governments at all echelons need to focus on this key issue. The

global polio eradication campaign sits at the intersection of science, technology, and international affairs; it is precisely for this reason that it must be examined carefully, especially considering the current and future consequences that the disease provokes. This paper analyzes all of the above from a global health perspective, utilizing country case studies as well as some basic medical facts and history of the disease.

The Science behind the Virus

Despite their proximity to universal eradication, polioviruses continue to threaten the global population (Kareff, 2010). Spreading as an infectious disease through water contaminated with human fecal matter, poliomyelitis is prone to extensive and brisk outbreaks (Bernstein et al., 2009). Polio usually affects children under five years of age due to their weak immune systems. However, children of all ages are susceptible to the disease without a vaccine (ibid). Although the viral infection is most commonly referred to in its singular form, "polio," there is more than one virus that acts as a causative agent. In fact, three types of wild poliovirus (WPVs) exist worldwide. Additionally, eighteen other viruses are often mistaken as polio due to similar symptoms and pathways of infection(Sabin, 1991). Although approximately 90 percent of infected persons will appear asymptomatic, the remaining percentage can exhibit symptoms ranging from a slight walking disability to complete paralysis or death (Global Polio Eradication Initiative, 2011).

Like many other viruses, the polioviruses usually enter the host (in this case, humans) via the oral route and migrate to the gastrointestinal tract where they propagate. This is the point at which polio typically becomes asymptomatic, as the virus relocates itself into the bloodstream as a dormant infection. In about 5 percent of cases, however, the virus actually enters the host's bloodstream as an infectious version and continues multiplying. Flu-like symptoms including headaches, fever, and general malaise typically accompany this phase of the viruses' pathogenesis. Finally, in about 1 percent of cases, polio enters its final and most damaging phase by infecting the central nervous system. Invading motor neurons, polio can cause paraplegia or total paralysis. Most alarmingly, this process can happen within a few hours following primary infection. Despite this small rate of progression, the viruses' lethal effects obviously represent a major public health concern (SAPPSS, 2011).

Fortunately, vaccinations have existed for roughly 50 years to battle the contraction of polio. Two types exist to protect against the viruses: 1) oral poliovirus vaccine (OPV), a two-droplet mixture of highly weakened viruses administered orally and 2) inactivated poliovirus vaccine (IPV), an injection containing dead viral samples administered directly into the bloodstream (both contain all three WPVs). The advantages of one form of the vaccine versus the other depend primarily on the country in which they are distributed. For instance, countries like India prefer the OPV as it is much easier to distribute than the IPV injection and can be produced between eight and twelve cents per dosage (Gregg 1984; Global Polio Eradication Initiative, 2011). Conversely, states such as the U.S. lean toward the IPV as the risk of contracting polio from the inactivated viruses in the vaccine is much lower (Roberts & Enserink, 2004). Though neither is perfect—the WHO recommends three doses to grant immunity—the polio vaccines are one of the main reasons that this disease's prevalence has decreased significantly over the past century (McKenzine, 2011).

Factual Background: the Current Eradication Campaign and its Origins

The distinction between control, elimination, and eradication of a disease is necessary to understand the current global campaign completely. Disease control occurs when the rate of contraction exists at a level below that which would be expected if any form of resources were dedicated toward its management (Barrett, 2004). Successful control campaigns thus rely on high rates of surveillance, proper diagnosis, and adequate infrastructure to facilitate these activities (Gregg, 1984). Control campaigns are limited to certain geographical areas. Some diseases that are currently controlled include cholera in various African countries (Dowdle, 1999).

Conversely, disease elimination results when the temporary incidence of a disease reaches zero (ibid).Measles is an example of a disease that has been eliminated in several areas around the world. Elimination is not the same as eradication, however, as there is always a possibility for the disease to

arise if a host were to somehow contract it. Finally, disease eradication occurs when the rate of incidence of a disease permanently reaches zero (ibid). Only smallpox and rinderpest have been fully eradicated globally. One might consider the objective for all international health campaigns as somewhere in between a control campaign or an all-out eradication of a disease.

Currently, several organizations have partnered in the international campaign for polio eradication. Headed by the World Health Organization (WHO), groups including UNICEF, the Rotary Foundation, the Center for Disease Control and Prevention (CDC), and the Gates Foundation have all allotted funds and manpower to curtail the disease (WHOa, 2011). The WHO's call for a resolution to eradicate polio has been in full effect since 1988 with an international army of approximately four million working to combat it (Bernstein et al., 2009).This combined effort led to only 650 new cases diagnosed in 2011, a 99 percent decrease since the peak of 350,000 in the late 1980's (See Table 1).

The global polio eradication campaign maintains comprehensive strategies and criteria in order to fulfill its ultimate goal. For any country to be certified as polio-free, the Initiative provides the following conditions:

(1) *Achieving certification-standard surveillance*
(2) *Ensuring access to a WHO-accredited laboratory*
(3) *Ensuring containment of WPVs and vaccine-derived polioviruses (VDPVs)*
(4) *Completing the certification process* (Global Polio Eradication Initiative, 2011)

Condition 1 ensures that national governments enact high levels of surveillance to constantly survey new cases of polio-induced paralysis. Condition 2 substantially decreases the response time between WHO labs and cases in the field to identify properly WPVs. Condition 3 also includes a provision dictating that a country cannot contract a new case of polio for three consecutive years after it applies for certification. Finally, condition 4 provides the political framework through which the coalition of organizations fighting polio may formally award eradication status.

Historically, the polio eradication campaign has been compared to the smallpox eradication campaign. Achieving success just ten years after its official launch, the smallpox campaign laid a vital framework for other diseases' eradication programs. For example, the program refined the classification and performance of epidemiologic surveillance by ensuring that all healthcare providers knew and understood the importance of such surveillance (Gregg, 1984). These advancements were crucial for proper collection, transmission, and processing of surveillance data from the field, which are all critical goals for any eradication campaign.

However, it is necessary to explain several distinctions between smallpox, polio, and the diseases' subsequent eradication campaigns. As previously mentioned, three viruses can cause polio, effectively tripling the possible causes of the disease. In contrast, smallpox can only be contracted via the *Variola* virus (though it does have two strains, -*major* and –*minor*) (Sabin, 1991). Additionally, smallpox always causes a very unique type of rash upon infection, while90 percent of polio cases appear asymptomatic. Polio is not nearly as easy to detect or diagnose as smallpox—especially in areas lacking proper healthcare infrastructure and surveillance. Given this consideration, eradication workers must assume hundreds of other infected people whenever they discover any one case of polio-induced paralysis. Therefore, the polio eradication campaign had to adjust for these differences, among others.

Case Studies: Cuba, India, and the Congolese Republics

Cuba. The Cuban case presented many very note-worthy developments toward the formation of the global polio eradication campaign. This country was the first in the world to eradicate polio in 1962, proving that the campaign could be successful in other tropical and developing countries (ibid). Utilizing its highly dictatorial government, the Ministry of Health employed several "Committees for Defense of the Revolution" (CDRs) as agents for eradication initiatives (ibid). These grassroots organizations were able to operate successfully in every municipality within a week, and the initiative caused a drastic drop in the cases of paralytic polio thereafter. The Committees continued hosting National Immunization Days (NIDs) for eight years thereafter in order to administer all three doses of OPV to every newborn child; Cuba eliminated polio shortly thereafter in 1970 (ibid).

The Cuban success story relied on unique political and geographic factors. First, nationalism significantly helped rally the cause. One of the greatest motivations for eliminating polio from the island spawned from a desire to beat the regional hegemon, the U.S. Furthermore, that the island was a self-contained entity with a skewed ratio of emigration to immigration aided the effort. Lastly, Cuban specialization in healthcare (in response to the departure of medical professionals to the U.S. after the Revolution) assisted in focusing manpower and funds toward the eradication goal. The aforementioned CDRs and their NIDs performances were a great example of this intersection of political and health aims. All the above elements allowed Cuba to demonstrate a method for disease eradication in the Americas, a feat that was achieved in 1994 (Global Polio Eradication Initiative, 2011). Many countries aspire to emulate the Cuban model for their own purposes.

India. Despite the global improvement with polio over the last few decades, India's high population density poses a unique challenge to the disease. Specifically, the virus continues to be rampant in the states of Uttar Pradesh and Bihar, causing 42 cases in 2010 (See Table 1). Luckily, types 2 and 3 have been fully eradicated in the country, leaving only type 1 left to combat. NIDs have been underway for a few years now in the spirit of the Cuban campaign. Improvements in 2011 figures regarding diagnosed cases of polio have been indicated, however, with only one case having been reported to date (Kareff, 2010).

There are some exceptions to this trend, however, that may pose issues for polio's ultimate eradication in India. Namely, religious views towards the OPVs and compliance with WHO guidelines regarding vaccine storage and distribution appear to be the greatest hurdles India will face. The sizeable Muslim minorities in both Uttar Pradesh and Bihar of 18 and 16 percent, respectively, are the most unlikely citizens to have their children vaccinated (ibid). Citing concerns ranging from fear of "American imperialism attempting to sterilize [their kids]" to sentiments of "marginalization from state and local governments," these residents most often forego the vaccine (Bernstein et al., 2009). Moreover, India does not maintain optimal conditions in its cold chain distribution of vaccines(See Figure 1). A recent study evaluating the administration of OPVs in rural India found that only 48 percent of rural sub-health centers stored their vaccines in adequate conditions; the national average of 60.4 percent appeared only slightly better (Sumant et al., 2007). Thus, India must confront these two predicaments before its "stagnant" progress toward polio eradication can be fulfilled (Andrus et al., 1997).

The Congolese Republics. Both the DRC and the Republic of the Congo (RoC) have witnessed recent resurgences of the polio epidemic. The WHO has listed both as states in which "re-established transmission" is in full effect (Global Polio Eradication Initiative, 2011). The fundamental cause of the reemergence of WPVs in the DRC is due to the state's porous borders. Cases started multiplying in the DRC last year with origins from an outbreak four years prior in Angola (WHOb, 2011). Furthermore, the DRC is widely recognized as having one of the weakest surveillance systems on the continent (Roberts & Enserink, 2004). Both these hurdles will be undoubtedly difficult to overcome given the unstable political situation in the region. Nevertheless, Kinshasa recently launched a national initiative coordinated by each governor of the DRC's 16 provinces in which both of these difficulties will be targeted and strengthened (WHOc, 2011).This initiative also included provisions to carry out joint NIDs simultaneously with neighboring states to lower the risk of polio transmission.

Just as the DRC imported polio from its neighbor, so did the RoC from both its Congolese brother and Angola. While surveillance and porous borders were also causal, yet another factor was at play: a "lost generation" of vaccinated inhabitants aged 15-25 comprised those who contracted the disease most frequently (Fominyen, 2011). In other words, after the disease had been absent for more than the WHO-recommended three years, the RoC felt that it had adequately eradicated polio within its borders and did not administer further vaccines. This proved tremendously detrimental to the country's eradication efforts as 384 people acquired the virus in 2010 alone (McNeil, 2010). This problem was only aggravated when an ineffective batch of vaccines were used to treat the outbreak. Brazzaville has subsequently applied for international aid from the global eradication campaign and successfully immunized its citizens since then, resulting in just one case year-to-date (Laméris, 2010). The RoC is

not technically out of the woods though as polio continues extensively in both the DRC and Angola.

Can a Polio Eradication Campaign Ever Succeed?

The question that remains is whether a global polio eradication campaign can ever succeed, especially in light of current country cases as well as the campaign's history. Several sources, written throughout the past three decades, convey a very optimistic tone regarding the status of the polio campaign. Approximately $4 billion has been spent on the eradication campaign thus far, and it is estimated that another $1.2 billion would finally conclude the process (Arita et al., 2006). Recent financial holes totaling anywhere from a few million to one billion dollars have been generally covered with the entrance of aforementioned auxiliary groups, such as Rotary International. Therefore, eradication optimists view this missing 23 percent of funds as relatively easy to acquire.

What these financial estimates miss are two major considerations: 1) the discount rate of the eradication program and 2) historical background with the smallpox campaign. The discount rate, or a financial adjustment for current figures that take into account future costs such as inflation, is a necessary tool in order to fully understand the financial footprint of the global eradication program. In the case of this program, it is more likely that a greater value than $1.2 billion will be necessary in order to combat polio. Next, these figures were estimated in light of the smallpox campaign. For example, eradication optimists note that international eradication program costs a mere $100 million; what it forgets to mention is that recipients of these funds additionally contributed twice that amount in order to administer vaccination and surveillance needs (Andrus et al., 2006). No estimates for the amount of funds that recipients of current polio-affected states currently exist.

Next, eradication optimists often laud the role that OPVs have fulfilled in the eradication process and emphasize that they are more beneficial than costly (McKenzie, 2011). Since they are cheap and easy to administer, it is true that they are the main cause of the decline in epidemic polio cases. However, these attributes cannot outweigh one major biological factor of the vaccines: they contain live samples of the viruses. Several epidemiologists have warned of the future use of OPVs for this reason. Roland Sutter, the current Coordinator of the Global Polio Eradication Initiative, describes how there is an augmented risk in the reintroduction of any infectious disease—especially after eradication—due to the increase in population that has never been in contact with the disease (Cáceres & Sutter, 2001). One can only imagine the havoc a VDPV case would have on a population that has not been inoculated. Unfortunately, the switch to IPV is impossible in the foreseeable future due to its status as an "orphan technology." There is a need for this technology, but a corresponding market does not in many parts of the world (Weiss, 2011). Without this switch, however, the ultimate probability of the eradication campaign is ambiguous. (Note: At the time of this publication, the Global Polio Eradication Initiative had recently announced that it would convert to administration of IPVs only.)

Finally, eradication proponents frequently use statistics in order to further their message. While it is true that substantial progress has been made in decreasing the amount of cases of polio worldwide since the Initiative's start, these numbers do not truly convey the entire scenario. For instance, the year 2010 witnessed 1,292 new WPV cases in nineteen countries (See Table 1). While this is an enormous decrease from the peak in the late 1980's, this number might still be too far away from a practical level for the eradication campaign's goals. One estimate suggests that, until these numbers decrease to 500 new cases in 10 countries per year, eradication as envisioned under the WHO's plan is simply not feasible (Arita et al., 2006). The reasons for these include inadequate surveillance and globalization's effects on the spread of diseases. The number of worldwide polio cases has been oscillating in an intermediate range for about five years now. This does not bode well for the eradication campaign, especially given other forecasts which claim that eradication is more likely during earlier stages of such programs rather than after a continuous stagnant number of new cases per year (Barrett, 2004).

Additionally, practical lessons from the three aforementioned country cases have much to teach us regarding the elimination program's prospects. Though the Cuban case served as a successful example by which to model the current campaign's outlooks and operations, it was a very unique and probably irreproducible event. Cuba is a well-monitored, relatively small area compared to regions

such as sub-Saharan Africa and South Asia. Furthermore, it is highly unlikely that the grassroots committees that the socialist government employed there can assemble in states that lack strong, centralized governmental structures.

An examination of the Indian case provides several insights as well. Cultural norms—especially religion—are highly permeable in the mindset of a society. If the large Muslim minority in India continues refusing to accept the free OPVs, more authoritarian measures will be necessary in order to ensure that each child receive the vaccine. This is currently a stance that the Indian government is unable to take given the fractional nature of its ethno-federalism system. Moreover, surveillance and administration of the entire vaccine cold chain is inadequate in India. In fact, most regions suffering from polio pandemics face these same issues and are only very slowly attempting to reform their procedures. Besides, vaccinating only 85 to 90 percent cannot avoid epidemics—a full 100 percent is essential (Gregg, 1984). This is simply impossible given the rates of compliance of vaccination teams, especially in the Indian countryside.

Finally, both Congolese Republics demonstrate the difficulty that developing countries face with eradication campaigns. Specifically, the porous borders of many sub-Saharan African nations pose the greatest challenge toward eradication in this region. As the Republic of Congo case shows, even when one state has succeeded in preventing new cases of WPV for three years, it is still susceptible to resurgence of the disease due to its neighbors. Improvements in both surveillance and diagnosing are necessary to combat these measures. The eradication program may not have enough psychological support to achieve complete implementation given these experiences.

A final counterargument against abandoning a polio eradication program and transitioning to a control program is that support for a control campaign will inevitably decrease with shrinking funds and desire to continue implementation. While this may be true, the psychological effects of not fully carrying out an eradication program are surely even worse. The international community tends to lose enthusiasm and support for any eradication programs after ten to fifteen years of its execution (Arita et al., 2006). It is also no secret that any type of eradication program requires very high levels of political, economic, social, and even international support. While control programs also entail this problem of credible commitments, the fact that their absolute cost is "a fraction of what it will take to interrupt transmission" must not be ignored (Roberts & Esnerik, 2004). It is ultimately a matter of financial feasibility that the world switches from an eradication program to a control campaign for polio's demise.

Furthermore, global health in general has several implications in the international arena. Support for anything, including control programs, decreases with time, but with such a pressing issue that continues claiming the lives of thousands every year, it is unlikely that the world will abandon a control program. The impacts on trade that polio has sustained have yet to be tallied, however it is safe to recognize that its absence bodes well for business and commerce. Additionally, epidemics in general can pose threats to national security. Insufficient resources may be allocated to the eradication of the disease if war and/or other civil disturbances occur simultaneously in a country (Dowdle, 2011).Given that 23 countries that were once free of polio witnessed resurgences in the year 2009, many states at this time feel the disease is here to stay (WHOa, 2011). Polio has battered several nations in the recent past, but only after several generations will this piece of history be forgotten.

It is for the above reasons that a polio control campaign is more likely to succeed than a global polio eradication campaign. Given the stark differences in healthcare systems, infrastructure, climate, and cultural norms within each of the countries with epidemic polio cases, it appears that control is the only objective that the international health community can meet at this time (Barrett, 2004). Though a control campaign is advantageous in that it reduces the transmission rate of a disease to a level significantly below epidemic proportions, the global health sector must take into consideration the continued existence of the disease if this path is ultimately chosen. Therefore, countries with endemic WPV should ensure that their health systems and governance structures have enough resources to contend with the disease's presence. This includes improvements in the polio supply chain, surveillance systems, and diagnosis procedures to promote swift and effective action wherever necessary. Moreover, the world must

prepare itself for a long battle against this debilitating illness.

Conclusions and Policy Recommendations

The global polio eradication campaign has undoubtedly achieved progress that some rendered unimaginable in the past centuries. Declining the rate of prevalence of global polio cases by a couple orders of magnitude has been achieving with only a handful of diseases before. Despite this progress, it appears that the global eradication campaign has reached its limit. (Note: At the time of this publication, the Global Polio Eradication Initiative had also recently announced that it extended its goal of eradicating polio by three years to 2018. This deadline has been moved back repeatedly since 2000.) With a stagnant rate of new cases over the past five years or so, it is time the world shift its resources and attention towards a control campaign with elimination, rather than eradication, as its primary goal. The following reasons prove this to be the only sustainable option: 1) the future burden of finances on the international community, 2) the possibility for polio to erupt from just a single case of a VDPV, 3) historical evidence based on the smallpox campaign and other polio country case studies, 4) the declining amount of support and enthusiasm for the current campaign, and 5) the implications this global health fight has on arenas such as trade, bioterrorism/national security, and collective memory.

Some policy recommendations must accompany this transition to a control campaign. First and foremost, investments in surveillance and diagnosis must be undertaken in order to ensure any campaign against a disease—no matter where it exists in the control-eradication spectrum. Without ample and constant communication between labs to confirm polio cases and the field to document them, the disease will never be weakened. Next, each country should evaluate its current strategy in conjunction with the WHO guidelines to ensure that it is functioning properly. Taking India as an example, rural compliance rates more than a dozen percentage points away from complete are simply unacceptable in vaccinating against a rampant disease such as polio. Cultural perceptions of OPVs as something malevolently manufactured by an external state are simply unacceptable and counterproductive. India should seriously consider implementing polio education (as well as information campaigns regarding other pandemic diseases) into its schooling system for the youth and target mass adult audiences to help them better understand the vaccines. Finally, vaccine inventories must be enforced worldwide to ensure the quality and effectiveness of both OPVs and IPVs. That the RoC was shipped a batch of useless vaccines to counter its epidemic last year would be intolerable in other developed countries; this standard must be enforced worldwide in order to ensure that polio finally becomes a thing of the past.

Polio was undoubtedly an extensive disease just a few decades ago. With the help of international efforts and resources dedicated towards its eradication, this status has become a thing of the past. Its position as an infectious disease will unfortunately stay for many years to come; this will be true at least until orphan technology breakthroughs such as manufacturing IPVs with higher economies of scale are possible. Until then, the world must shift its vision from eradicating to controlling polio where it already exists. This will allow the global health community focus on other pressing diseases, such as AIDS and malaria, that kill more per annum than do WPVs (Arita et al., 2006). Hopefully the dream of eradication can be fully implemented in the future once conditions allow for its proper execution.

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Appendix

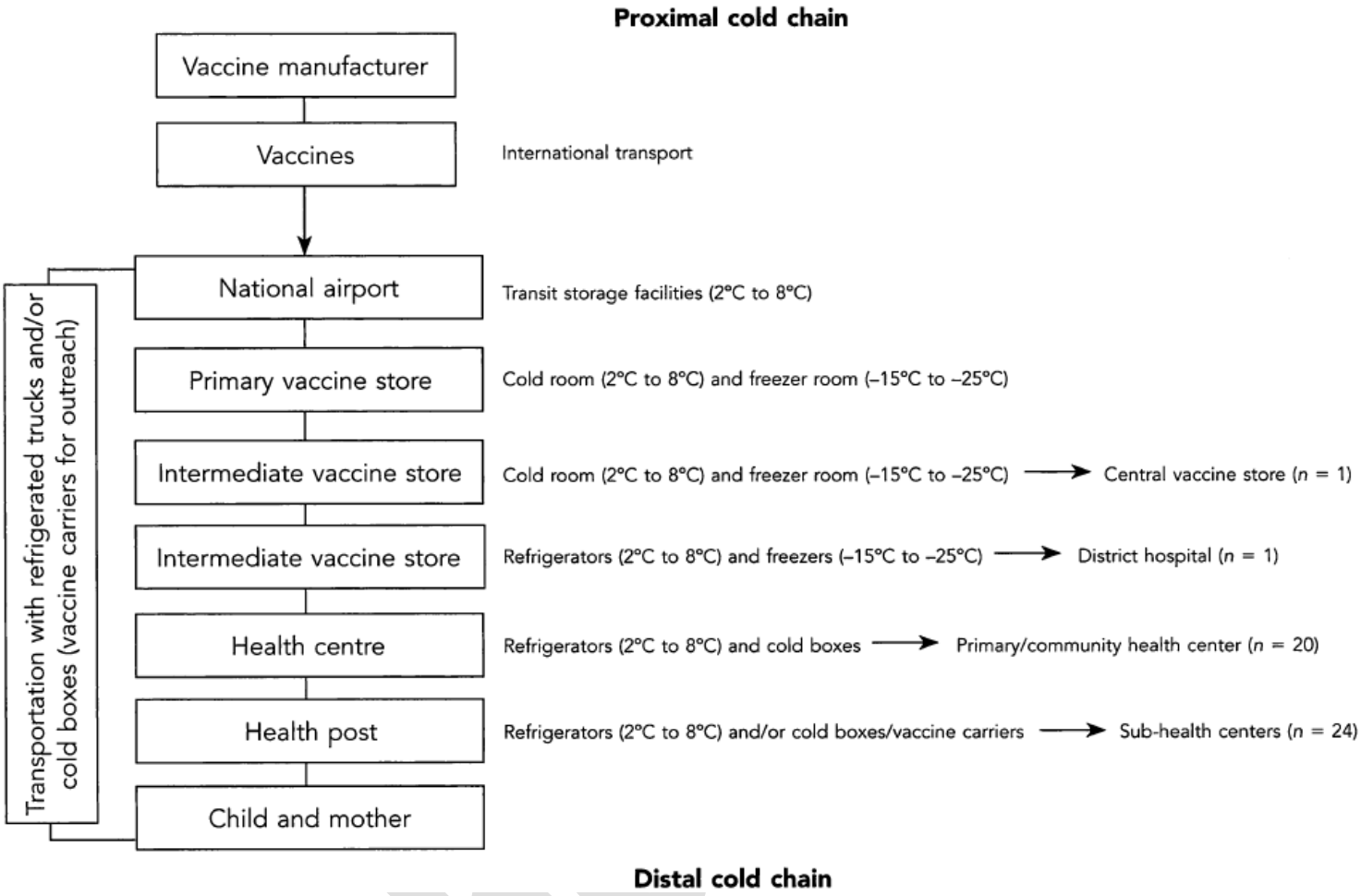
Table 1

Total cases	Year-to-date 2011	Year-to-date 2010	Total in 2010*
Globally	120	84	1292
• in endemic countries:	43	43	232
• in non-endemic countries:	77	41	1060

Countries	Year-to-date 2011			Year-to-date 2010			Total in 2010*	Date of most recent case
	WPV1	WPV3	Total	WPV1	WPV3	Total		
Pakistan	33		33	4	10	14	144	10-Apr-11
Nigeria	6	2	8		2	2	21	18-Mar-11
India	1		1	3	16	19	42	13-Jan-11
Afghanistan	1		1	1	7	8	25	11-Jan-11
DRCongo	43		43				99	02-Apr-11
Chad	23	2	25		7	7	26	16-Mar-11
Angola	2		2	1		1	33	04-Feb-11
Côte d'Ivoire		3	3					27-Feb-11
Mali		1	1	1		1	4	08-Feb-11
Congo	1		1				384	22-Jan-11
Niger		1	1				2	19-Jan-11
Gabon	1		1					15-Jan-11
Uganda							4	15-Nov-10
Russian Federation							14	25-Sep-10
Liberia				1		1	2	08-Sep-10
Nepal				1		1	6	30-Aug-10
Kazakhstan							1	12-Aug-10
Tajikistan				12		12	458	04-Jul-10
Turkmenistan							3	28-Jun-10
Senegal				13		13	18	30-Apr-10
Mauritania				4				28-Apr-10
Sierra Leone				1		1	1	28-Feb-10
Total	111	9	120	42	42	84	1292	
Total in endemic countries	41	2	43	8	35	43	232	
Total outbreak	70	7	77	34	7	41	1060	

Caption: The upper portion of this table demonstrates the 42.9percent increase YTD of new WPV cases since 2010. The lower portion chronicles where exactly polio must be controlled—this is not limited to countries with new cases in 2010 alone, as the YTD data for the RoC do not yet show the outbreak that occurred in the latter part of the year (Last updated: April 27, 2011, from http://www.polioeradication.org/Dataandmonitoring/Poliothisweek.aspx).

Figure 1



Caption: A graphic image of the cold chain as recommended by the WHO. As the Samant et al. (2007) study found, a large percentage of the distal cold chain in rural India is without compliance in administering the OPVs.