IMMUNIZATION FINANCING AND SUSTAINABILITY: A REVIEW OF THE LITERATURE*

INTRODUCTION. Until recently, the principal focus of the published literature on immunization services has been on programmatic issues such as how to improve coverage, how to decrease wastage, and how to reach hitherto unreached populations or populations groups. While there was considerable interest in cost and cost-effectiveness issues—especially in the 1980s, when a large number of cost and cost-effectiveness studies were conducted—the issue of immunization financing was not dealt with as an independent subject until the mid-1990s. The timing of this shift was related to several changes: the emergence, in the development community as a whole, of concerns for the sustainability of development projects and for issues such as "donor dependence"; the realization by donors and academics that immunization programs, funded largely using donor resources, were a prime example of *un*sustainable development for many low and middle income countries; and the concomitant realization that with an ever-increasing arsenal of potential vaccines—and their ever-increasing price—the continuation of substantial donor support would not be sustainable for *donor* countries and agencies, either.

Thus, the literature on immunization financing is relatively young. Early references date back to the cost and cost-effectiveness studies of the 1980s, but most of the literature is less than five years old. Even now, the majority of articles are in the form of reports, unpublished documents and other "grey" sources, with far fewer articles published in the academic press. This review focuses on published articles, since these are accessible to a wider audience and have had the benefit of peer review, but it also refers to key sources in the *grey* literature—with suggestions, wherever possible, on how to obtain these resources, including references to their location on the Internet. It considers the subject under three headings: the cost of immunization programs; the financing of immunization programs; and the impact of health sector reforms. Each section is followed by a summary of key gaps in the literature.

COSTS, COSTING AND ECONOMIC EVALUATION. The first articles on the cost and economic evaluation of immunization programs date back to the early 1980s, when a large number of cost analyses and cost-effectiveness studies were carried out using costing guidelines published by the World Health Organization in 1979 [**1**,**2**]. Most of these early studies were interested in the total economic cost of immunization programs—that is, the cost of all program components (such as vaccines, syringes and staff time, etc.), *plus* allocations for capital costs and for the cost of shared resources such as health centers and vehicles. Studies were carried out in Thailand [**3**,**4**], Indonesia [**5**,**6**], The Gambia [**7**,**8**], Kenya [**9**], Sri Lanka [**10**], Côte d'Ivoire [**11**,**12**], Colombia [**13**], Ecuador [**14**] and Brazil [**15**,**16**]. These studies generally expressed their results in terms of a cost-effectiveness ratio that used coverage data—obtained using a standardized cluster sampling technique [**17**]—as its denominator, resulting in a measure of the

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average cost per fully immunized child. The average costs per FIC for these early studies are noted in Table 1, along with values obtained in a later series of cost-effectiveness studies carried out in Burkina Faso, Cameroon, The Gambia, Haiti, Mauritania, Senegal, Sudan, Turkey, the Philippines, and India [**18**,**19**,**20**,**21**].

In addition to estimating total program costs and calculating costs per FIC, many of these early studies attempted to answer managerial concerns and compare the cost of delivery strategies such as fixed facilities, mobile teams and periodic campaigns. They found that fixed facilities were generally less costly per FIC than mobile teams or periodic campaigns, that salaries and capital costs accounted for the largest share of total costs, and that the higher the service volume overall, the lower the cost per FIC [**3**,**4**,**7**,**8**,**13-16**,**18-21,88**]. A number of studies, including several recent ones, have focused specifically on the cost implications of mass campaigns and door-to-door strategies [**22-25**], while others have looked at the impact of factors such as input prices, the service volume at individual facilities, the sociodemographic features of the target population, and the composition of service teams, among others [**2**,**26**,**27**]. Many of these studies were summarized in several reviews in the early 1990s [**18**,**21**,**28**].

A shift to "new" vaccines. A key outcome of the cost and cost-effectiveness studies of the 1980s was the recognition that immunization—or, more specifically, that vaccination with the six "traditional" EPI antigens—was one of the most cost-effective health interventions available. This became canonized in the World Bank's "*World Development Report 1993: Investing in Health*" [**29**] and similar publications in the early 1990s [**30**,**31**], and led to inclusion of the EPI in numerous "essential package" approaches to priority-setting in the early to mid-1990s [**32**,**33**,**34**]. At the same time, the World Health Organization recommended the inclusion of hepatitis B in all national immunization programs, the "Universal Child Immunization" initiative of UNICEF came to an end, and interest rapidly shifted away from studies of the EPI and towards newer vaccines such as hepatitis B, *Haemophilus influenzae* type B and yellow fever [**35**–**59**]. Many studies of these "new" antigens used model-based cost-effectiveness estimates to assess, in a prospective way, the value of introducing them into national immunization programs, and to compare alternative strategies for doing so [**35**,**36**,**41**,**44-50,54,56,57**]. Others looked at issues such as vaccine and materials costs, including the impact of combination vaccines and bulk procurement [**36**,**52**,**53,54**]; the *total additional cost* of introducing these vaccines into existing immunization programs, often expressed as the increase in cost per FIC [**19,29**,**35,60-62**]; and their cost-effectiveness in national programs into which they had already been incorporated [**35**,**39**,**40**,**43**,**47**,**54,63**]. While the cost-effectiveness of these new vaccines was repeatedly confirmed in a variety of settings, many studies concluded with concerns about the affordability of these vaccines and the need for financing strategies that would ensure their uptake in low-income countries—a precursor to the subsequent emergence of sustainable financing as a topic of its own.

Theoretical and methodological pieces. Numerous articles and book chapters have discussed the theoretical dimensions of applying economic analysis to immunization programs. Early pieces focused on the applications of cost-effectiveness and cost-benefit analysis to existing immunization programs [**2**,**64-68**]. More recent articles have explored the *prospective* use of these techniques as a way of choosing between different vaccine combinations and delivery strategies [**55,69,71**], and have examined the

limitations of model-based cost-effectiveness studies—perhaps the most common form of economic evaluation in the published literature at present [**47**,**70**-**73**]. A small number of articles has also applied economic analysis to hypothetical interventions such as putative vaccines against diarrheal disease, schistosomiasis and HIV/AIDS [**74**-**77**].

Perhaps surprisingly, the number of publications on costing methodologies is relatively small. Several articles have provided criticisms [**78**,**88**] and suggested refinements to the 1979 "EPI costing guidelines" of WHO, and have addressed issues such as the allocation of joint costs [**79**] and methodologies for estimating vaccine costs [**80**]. In 1989, the WHO released the "EPICost" software package, a computerized costing tool based on its 1979 guidelines [**81**]. This was not used widely, partly because of its substantial data requirements and partly because of waning interest in cost and cost-effectiveness studies of the EPI in the early 1990s [**82**].

Information gaps:

- Most cost studies were conducted in the 1980s, and few have been conducted since. Updated information on immunization program costs is therefore lacking.
- Very few studies have attempted to estimate the current global cost of immunization programs—a particularly important issues from a donor perspective, especially if innovative financing strategies and tools such as global or regional trust funds are to be considered.
- Costing methodologies and the definition of endpoints such as the "fully-immunized child" remain inconsistent between studies.
- Little is known about the additional cost of incorporating new vaccines—including long-recommended ones such as hepatitis B, *Haemophilus* influenzae type B, and yellow fever vaccines—into national immunization programs, nor on the components of these additional costs.

FINANCING AND FINANCIAL SUSTAINABILITY. As explained earlier, the literature on immunization financing is relatively young. While some of the cost studies conducted in the 1980s included details of how these programs were financed [**18**,**21**], financing *per sé* was not dealt with as an independent subject until the mid-1990s. The literature on financing, though small, can be considered under five headings: **1.** How much are countries and donors paying, both for the EPI and for newer vaccines such as hepatitis B, and what exactly are they paying for? **2.** What *should* donors and countries be paying for, and why? **3.** What has been the impact of alternative financing strategies such as user fees and community financing? **4.** What has been the impact of procurement-assistance schemes on the reliability of immunization financing? And **5.** What lessons can be learned from *other* health programs, family planning and primary care in particular, and from financing models adopted by immunization programs in industrialized countries.

Several general caveats are worth noting. First, the interpretation of "financial sustainability" is highly variable. Some sources refer to it as the ability of a country to mobilize sufficient *domestic* resources to meet the full capital and recurrent costs of its immunization program (i.e. self-sufficiency), while others interpret it as the ability of a country to mobilize sufficient resources—*whether from domestic or external sources*—to reliably meet its immunization program costs. Second, some articles fail to distinguish

between financial and programmatic sustainability, and deal with both subjects—which, although closely related and equally important, are quite distinct—as though they were the same thing. Some articles also fail to distinguish between financing for *immunization programs* and financing for *vaccine development*, the two of which are also quite distinct.

1—*How much are countries and donors paying, and what exactly are they paying for?* Very little published information exists on the financing of national immunization programs, with the exception of data from a few cost-effectiveness studies of the EPI in the 1980s [**11**,**12**,**18**,**21**], a recent series of immunization financing case studies in Morocco [**83**], Côte d'Ivoire [**84**], Bangladesh [**85**], Colombia [**86**], and Cambodia, Lao PDR and Vietnam [**87**], and an e-mail survey of UNICEF and PAHO staff conducted in 1998 [**88**]. Data from some of these studies are summarized in Table 2. The earlier studies looked only at the *total economic cost* of these programs—that is, program-specific costs (such as vaccines, syringes and staff time, etc.) *plus* capital and other shared costs, in keeping with the WHO costing method. More recent studies have separated program-specific and total economic costs and have analyzed the distribution of financing sources for each [**89**,**90**]. Given the small number of countries for which such analyses have been carried out—and the fact that many of these countries were chosen because of their unique financing arrangements, such as Morocco's use of a World Bank loan—it is difficult to draw any reliable conclusions from the data. This may be remedied in the near future as more case studies become available [**91**] and as a financing database, currently being prepared by WHO, is completed [**92**]. The impact of the global Polio Eradication Initiative on EPI financing has also been a subject of interest [**93-95**].

Information on *vaccine* financing is easier to obtain. Estimates for most countries are published on a yearly basis by UNICEF in its annual *State of the World's Children* report [**96**]. Financing data for vaccines in Latin American the Caribbean countries is also available from PAHO, particularly for countries using its revolving fund [**97**]. In addition, a recent survey looked at differences in the pattern of financing between EPI vaccines and newer vaccines such as hepatitis B, HiB and yellow fever [**88**].

2—*What should donors and countries be paying for, and why?* The literature on this subject falls into two categories. The first category includes articles that describe existing or potential protocols for rationalizing the allocation of donor funds to immunization-related purchases and activities, of which UNICEF's "targeting strategy"—which placed countries in "bands" according to their population and national income, and used these bands to determine the extent of support each should receive—was perhaps the first example [**98**]. Other proposals have included a fund to stimulate research and development and help poor countries meet the cost of their national immunization programs [**99**]; the use of global or regional trust-funds to fund new vaccine purchases in developing countries [**100**]; and the suggestion that countries should pay a fixed percentage of GDP towards immunization activities, with rich-country surpluses being used to subsidize poor-country shortfalls in the interest of equity and in recognition of the global externalities associated with immunization [**101**]. Recent articles have examined the use of GAVI funds for eligible countries [**102**,**103**], the proposal to establish an "Asian Vaccine Initiative" to help finance immunization activities in developing countries in Asia [**104**]; and the use of proceeds from debt relief

to increase domestic allocations to immunization activities in highly-indebted poor countries [**105**].

The second category includes a small number of descriptive pieces which examine the political and institutional features of governments, donors and lending agencies vis-à-vis their support for immunization. Examples include descriptions of the "war against hepatitis B" [**106**,**107**] and of the evolution (and decline) of alliances such as the Children's Vaccine Initiative [**108**,**109**] and the Global Alliance on Vaccines and Immunization [**110**]; UNICEF's evaluation of its "Universal Child Immunization" initiative [**111**]; a report by the General Accounting Office of the United States government [**112**]; and a recent self-evaluation of lending activities carried out by the World Bank [**113**], among others [**114**,**115**]. While these references do not address questions of "how" and "why" directly, they nevertheless provide useful insights into the inner workings of governments, lenders and donor organizations, especially with regard to their involvement in immunization issues.

3—*Alternative financing strategies: user fees and community financing*. The use of user fees and community financing to pay for immunization services has been addressed in several sources. A recent WHO report summarizes arguments against the use of user fees for immunizations [**116**,**117**]. Two world-wide surveys have looked at the prevalence of formal and informal cost recovery for immunization services, one in 1991 (for 79 countries) and the other in 1998 (for 78 countries) [**118**,**88**]. Both found substantial variations in the method of cost recovery (which ranged from direct fees for shots and registration cards to indirect methods such as fundraising and in-kind donations of labor for national immunization days) as well as the extent of costs recovered. At the country level, several articles summarize China's experience with user fees and community financing for immunizations [**119**,**120**,**121**].

Impact on service quality and utilization. Several articles have looked at the impact of cost recovery on the quality and utilization of preventive services in general. In Niger and Guinea, a recent evaluation of the Bamako Initiative concluded that user fees for curative services were being used to cross-subsidize the recurrent cost of immunization activities at the health center level [**122**], and that some health centers were using proceeds from these fees to finance immunization-related *capital* costs (such as motorcycles and refrigerators) as well [**123**]. Studies of the impact of cost recovery for *curative* care have concluded that utilization of preventive services can, in fact, increase with such practices, provided funds are retained at the health center and are used in a way that improves the perceived quality of their services [**124**,**125**]. Cost recovery for *preventive* services, however, has been found to reduce the utilization of these services in both developing and developed countries, especially among poor and marginalized groups [**126**-**129**], as have other price-related variables such as distance to the nearest health facility [**130**]. Comments in the WHO paper also deal with questions of quality and utilization, mostly from a critical perspective [**116**].

4—*The impact of procurement-assistance schemes.* Many countries rely on one of three *procurement assistance schemes*—PAHO's revolving fund, UNICEF's Vaccine Independence Initiative, and the European Union's ARIVAS scheme—for technical support in purchasing vaccines and related supplies. The theoretical benefits of such schemes are well-described in an early commentary on the PAHO fund [**131**]. More recently, review articles [**88**,**90**,**104**,**114**,**132**] and several specific evaluations [**133**,**134**]

have shed light on the present status of these funds, complementing agency reports on their functioning.

5—*Lessons from other programs, family planning and primary care in particular, and from immunization financing in industrialized countries.* Sustainable financing has also been a concern of family planning and primary health care programs, and certain transferable insights—limited by the unique features of immunization programs such as their organizational structure, their need for outreach activities and the presence of constraints on cost recovery, among others—can be derived from the literature on these subjects [**135-139**]. Family planning also provides an example of what can happen when donor support for an essential program declines, as happened in Turkey in the late 1990s [**140**]. For primary care, the "model" approach to sustainable financing has been the so-called Bamako Initiative, where local revolving funds—capitalized by donors, replenished with user fees, held at local health centers and administered by local community members—have promoted local financing, community ownership and improved quality of primary health facilities, sometimes to very good effect [**135,141**]. Experiences with the Bamako initiative in Benin and Guinea have recently been summarized in a series of in-depth analyses, several of which have commented specifically on their impact on immunizations [**122**,**123,136,138**].

Immunization financing in the United States has also been the subject of recent interest. With its complicated (and often poorly coordinated) use of federal and state-level entitlements and discretionary grants to pay for immunization services and the significant variation in immunization coverage between different sub-populations and between rich and poor states [**142-145**], the USA provides an interesting parallel with the *global* situation. Key features of this system—and recommendations for how to improve it—were reviewed in a recent report from the US Institute of Medicine [**146**] and summarized in a journal supplement dedicated to this subject [**147**].

Information gaps:

- Up-to-date, accurate data on financing patterns only exists for a small handful of countries—too few for any generalizations to be made or for cross-country trends to be identified.
- Little is known about the specific socio-political and institutional determinants of national/governmental support for immunization—issues that are frequently described with the generic term "political commitment," but are seldom examined any further than this—and of other barriers, perhaps *outside* the immunization system, that may hinder countries' progress towards financial and programmatic sustainability.
- Very few studies have looked at changes in financing patterns over time. This makes it difficult to track the impact of issues such as changes in donor support, countries' enrolment in procurement-assistance schemes, and countries' introduction of new vaccines and adoption of health sector reforms, among others.
- There are no analyses—but considerable debate—on the use of loan financing for immunization. Questions of "if", "how" and "for what" remain largely unanswered.
- Several articles have proposed the establishment of trust funds and other regional or global redistributive mechanisms, but almost none of these have

attempted a comparative analysis. This makes it difficult to compare the costs, benefits and impacts on key actors, especially given differences in the assumptions used by each study.

- Relatively little is known about the long-term impact of participation in procurement-assistance schemes, and whether these schemes improve the sustainability of countries' financing efforts.
- With regard to user fees, most analyses are either speculative, theoretical, or infer conclusions from other areas rather than examining their impact on immunization specifically. Thus, there is little in the way of concrete evidence regarding the impact of cost recovery on the equity, quality, utilization and coverage of immunization services nor on the proportion of program costs likely to be recovered by such activities. The impact of demand-generating activities on these outcomes is also unclear.
- Very few articles have looked at the impact of risk pooling schemes (such as community financing and health insurance) on the utilization and performance of immunization services, nor at how these services can best be protected under such schemes.

HEALTH REFORM AND IMMUNIZATIONS. The impact of health sector reform on immunization programs has received increasing attention over the past few years, far more so in agency reports and discussion papers [**148**-**152**] than in the academic literature [**103**,**132**]. Many reports have focused on decentralization [**86**,**88**,**90**], the impact of which on primary care and family planning has also been a subject of interest [**153**-**159**]. Others have looked at issues such as sector-wide approaches [**160**] and the use of private-sector contracts for ancillary services, more often for PHC as a whole than specifically for immunization-related services [**150**,**161**,**162**-**167**]. Private *provision* of immunization has been less well-studied, largely due to limitations on data [**88**,**90**,**168**]. One series of case studies looked at the uptake of new vaccines in the private medical sectors of Zimbabwe [**52**], Thailand [**53**] and Morocco [**169**], and the impact of these on national decisions to introduce new vaccines. Estimates of private sector participation were also obtained in an e-mail survey of PAHO and UNICEF staff in 1998 [**88**] as was some data on the participation of NGOs—a subject on which the literature is otherwise very limited [**88**,**90**]. A few articles have also explored the impact of incentives for both providers [**119**,**120**,**170**] and users [**171**] on their provision and utilization of immunization services.

Information gaps:

- It is not clear whether funding flows in decentralized health systems are covering immunization program costs that were previously funded by a central ministry or EPI department, nor whether decentralization leads to an increase in resource mobilization at sub-national levels in support of immunization services and programs.
- There is relatively little information on the extent of private sector involvement in the delivery of immunization services, and on the equity, efficiency, quality and coverage implications of maintaining or increasing this involvement. This is true of both NGOs and for-profit providers.

Table 1. Cost per fully immunized child, various studies*

Country	Year	Reference	Strategy	Cost per FIC US $	Range
Bangladesh	1997-98	[**85**,**90**]	Routine plus campaigns	$21.47†	
Burkina Faso	1987	[**18**, **21**]	Mobile teams	$12.71	
Cameroon	1982	[**25**]	Routine services	$2.19	
			Mass campaign	$18.93	
	1986	[**18**, **21**]	Mass campaign	$14.50	
Colombia	1985	[**13**,**25**]	Routine services	$26.59	
			Mass campaign	$59.90	
Cote d'Ivoire	1981	[**11,12**]	Not specified	$16.40‡	
	1998	[**84**,**90**]	Routine plus campaigns	$24.29	
Ecuador	1989	[**14,25**]	Routine services	$4.39	
			Mass campaign	$8.60	
The Gambia	1980	[**7**,**8**]	Not specified	$14.30§	$6.00 to $26.00
Indonesia	1979	[**2**]	Fixed facilities	$2.30	
	1981	[**6**]	Fixed facilities	$2.04**	
	1980-85	[**5**]	Not specified	$3.53	$3.37 to $3.65
Kenya	1981	[**9**]	Fixed facilities	$14.33	$7.45 to $41.80
	1990	[**88**]	*Paper pending*	$12.39	
	1992	[**88**]	*Paper pending*	$14.20	$13.05 to $15.35
Mauritania	1985	[**18**, **21**]	Fixed facilities	$6.83	
			Mobile teams	$17.37	
			Mass campaign	$8.97	
Morocco	1997-98	[**83**]	Routine plus campaigns	$20.89	
Philippines	1988	[**18**, **21**]	Fixed facilities	$13.29	
	1978	[**2**]	Fixed facilities	$2.80	$2.50 to $7.02
Senegal	1987	[**18**, **21**]	Mass campaign	$20.03‡	
Sri Lanka	1984	[**10**]	Municipal clinic	$6.05††	$4.94 to $7.15
			MOH clinic	$3.76‡‡	$2.68 to $4.84
			Plantation clinic	$5.25‡‡	$4.50 to $6.00
Tanzania	1987	[**18**, **21**]	Fixed facilities	$6.53	
Thailand	1979	[**3**]	Fixed facilities	$7.76	
	1980	[**2**]	Fixed facilities	$6.20	$4.96 to $35.69
	1985	[**4**]	Fixed facilities—hospital	$13.50	
			Fixed facilities—health center	$11.40	
			Mobile teams—hospital	$19.30	
			Mobile teams—health center	$13.50	
Turkey	1988	[**18**, **21**]	Fixed facilities	$19.00	

* Different methods were used to calculate the costs in each study, so comparisons should be made with care.
† Used IPV instead of OPV.
‡ Of this $16.40, $12.00 was attributed to the cost of measles vaccine alone.
§ For EPI plus yellow fever vaccine, the average cost became $18.00, range $7.00-$36.00
** Excludes measles vaccine.
†† Average calculated as mid-point of range.

Table 2. Financing patterns, various studies*

Country	Year	Reference	Strategy	Domestic	Donors
Bangladesh	1997-98	[**85**]	Not specified†	81.0%	19.0%
Burkina Faso	1987	[**18**,**21**]	Fixed facilities	27.0%	73.0%
Cambodia	1993	[**87**]	Not specified	0.0%	100.0%
	1994	[**87**]	Not specified	3.0%	97.0%
	1995	[**87**]	Not specified	5.0%	95.0%
	1996	[**87**]	Not specified	0.3%	99.7%
	1997	[**87**]	Not specified	6.4%	93.6%
Cameroon	1986	[**18**,**21**]	Mass campaign	87.0%	13.0%
Cote d'Ivoire	1978	[**11**,**12**]	Not specified‡	28.7%	71.3%
	1979	[**11**,**12**]	Not specified†††	44.7%	55.3%
	1980	[**11**,**12**]	Not specified†††	45.0%	55.0%
	1981	[**11**,**12**]	Not specified†††	65.7%	34.3%
	1998	[**84**]	Not specified	66.0%	34.0%
Lao PDR	1988	[**87**]	Not specified	3.0%	97.0%
Mauritania	1985	[**18**,**21**]	Fixed facilities	41.0%	59.0%
		[**18**,**21**]	Mobile teams	31.0%	69.0%
		[**18**,**21**]	Mass campaign	41.0%	59.0%
Morocco	1997-98	[**83**]	Not specified***	96.0%	4.0%
Philippines	1988	[**18**,**21**]	Fixed facilities	84.0%	16.0%
Senegal	1987	[**18**,**21**]	Mass campaign	29.0%	71.0%
Tanzania	1987	[**18**,**21**]	Fixed facilities	35.0%	65.0%
Turkey	1988	[**18**,**21**]	Fixed facilities	96.5%	3.5%
Vietnam	1998	[**87**]	Not specified	60.0%	40.0%

* Unless otherwise stated, figures represent percentage of total immunization program costs financed by each source.
† For both Bangladesh and Morocco, “domestic” resources include funds from World Bank loans that met 23% of total program costs in both countries.
‡ Percentage of EPI materials costs only: equipment, fuel, supplies (including vaccines) and travel.

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