
REVIEW

Lessons learned in shaping vaccine markets in low-income countries: a review of the vaccine market segment supported by the GAVI Alliance

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Objectives	The Global Alliance for Vaccines and Immunization (GAVI) anticipated that growing demand for new vaccines could sufficiently impact the vaccines market to allow low-income countries (LICs) to self-finance new vaccines. But the time required to lower vaccine prices was underestimated and the amount that prices would decline overestimated. To better understand how prices in the LIC vaccine market can be impacted, the vaccine market was retrospectively examined.
Design	GAVI archives and the published literature on the vaccine markets in LICs were reviewed for the purpose of identifying GAVI's early assumptions for the evolution of vaccine prices, and contrasting these retrospectively with actual outcomes.
Results	The prices in Phases I and II of GAVI-supported vaccines failed to decline to a desirable level within a projected 5-year timeframe. GAVI-eligible countries were unable to sustain newly introduced vaccines without prolonged donor support. Two key lessons can be applied to future vaccine market-shaping strategies: (1) accurate demand forecasting together with committed donor funding can increase supply to the LIC vaccines market, but even greater strides can be made to increase the certainty of purchase; and (2) the expected time to lower prices took much longer than 5 years; market competition is inherently linked to the development time for new vaccines—a minimum of 5–10 or more years. Other factors that can lower vaccine prices include: large-scale production or alternate financing mechanisms that can hasten vaccine price maturation.
Conclusions	The impacts of competition on vaccine prices in the LIC new-vaccines market occurred after almost 10 years. The time for research and development, acquisition of technological know-how and to scale production must be accounted for to more accurately predict significant declines on vaccine prices. Alternate financing mechanisms and the use of purchase agreements should also be considered for lowering prices when planning new vaccine introductions.
Keywords	Developing country vaccine market, economics of vaccines, global immunization policy, donor assistance policies, new vaccine introduction strategies

KEY MESSAGES

- A number of lessons can be learned from the experiences of the Global Alliance for Vaccines and Immunization for the development of effective vaccine price-lowering strategies in low-income countries (LICs).
- Our analysis shows that the impacts of competition on vaccine prices in the public markets of LICs occur after almost 10 years.
- Donors and policy makers need to allow sufficient time for the impacts of competition on vaccine prices to occur when planning new vaccine introductions.

Introduction

The Global Alliance for Vaccines and Immunization (GAVI) ranks near the top of multilateral organizations in aid effectiveness (United Kingdom Department for International Development 2011). It is therefore not surprising that GAVI was recently able to raise an additional \$4.3 billion dollars for immunization in the world's poorest countries bringing total funding for 2011–15 to \$7.6 billion (GAVI Alliance 2011a). And yet, paradoxically, GAVI's critics have argued that GAVI's aid is not effective enough, and that GAVI should be adopting different strategies to lower prices of vaccines (Arie 2011). Indeed, GAVI has always believed it could lower prices in the vaccine market through a number of market-shaping strategies. But to date, GAVI's success in reducing prices in the market, low enough for the poorest countries to assume full financial responsibility for immunization, has been limited. By 2015, it is projected that a majority of GAVI-eligible low-income countries (LICs) will be able to co-finance only US\$0.20/dose for new vaccines, with GAVI assuming the balance (Cornejo *et al.* 2011).

This article examines the characteristics of the global vaccines market before and after GAVI to better understand why GAVI's specific strategies to reduce vaccine prices did not have the desired outcomes.

Design

To contrast GAVI's assumptions for the vaccine market with actual outcomes, GAVI strategies, policies and analyses on vaccine demand forecasting, on vaccine manufacturer competition, including from manufacturers in emerging market economies (emerging manufacturers), and on vaccine prices in the GAVI market were reviewed. Sources for the review were GAVI archives, such as committee and board meeting minutes, and GAVI policy papers. The review was limited to the written record and may not fully reflect rationale behind the development of each strategy.

To assess the evidence base for policies and strategies, the published literature on vaccine markets in LICs was reviewed. A search using MeSH terms 'vaccines', 'pricing' and 'developing countries' was conducted on PubMed Central. All articles reporting on strategies to impact vaccine pricing were reviewed.

The global vaccines market prior to GAVI

At the time of the launch of the Expanded Programme for Immunization (EPI) in the 1970s, only ~5% of children in LICs had access to immunization (Kim-Farley 1992). In 1977, the

World Health Organization (WHO) established global policies for immunization and the goal to immunize more than 80% of the global birth cohort by 1990 (World Health Organization 2011). A consequence of expanding immunization to all children was the globalization of the vaccine market.

Early EPI donor-sponsored vaccines covered diphtheria-tetanus-pertussis (DTP), polio [oral polio vaccine (OPV)], measles (M) and tuberculosis (Bacillus Calmette Guérin – BCG), all of which could be purchased for <\$1.00 in LICs (World Health Organization and UNICEF 1996; UNICEF 2010). These same four vaccines (against six diseases), in addition to others, were also used in high-income countries (HICs). In 1990, ~60% of DPT vaccines were being produced and sourced locally (Institute of Medicine 1993). However, the supply of EPI vaccines to UNICEF was exclusively from European, Canadian and Japanese vaccine manufacturers. Suppliers to the global vaccine market were relatively numerous but the market was dominated by two multinational European vaccine manufacturers who together accounted for 50% of the market (Figure 1) (DeRoeck 2002).

While in LICs the demand for vaccines remained mostly restricted to the four EPI vaccines until the advent of GAVI in 2000, in HICs these vaccines had been largely replaced by newer or alternate vaccines and the market had expanded to include several additional vaccines.

Innovation in the 1980s and 1990s: differentiation of the global vaccine market into LIC and HIC segments

The 1980s and 1990s was a period of intense innovation in the vaccine industry. Four trends had a profound impact on the global vaccine market: (1) many HICs switched from the use of traditional EPI vaccines to new or alternate vaccines, for example, from OPV to inactivated polio vaccine (IPV) (Marwick 1996), and from whole-cell pertussis vaccine (wP) to acellular pertussis vaccine (aP) (United States Centers for Disease Control and Prevention 1997); (2) HICs increasingly switched from the use of multi-dose vaccine presentations (containing thiomersal or other preservatives) to single-dose vials and pre-filled syringes without preservatives (Milstien *et al.* 2005); (3) several HICs introduced vaccines against diseases, such as Hepatitis B (HepB) and *Haemophilus influenzae* type b (Hib) into routine paediatric immunization schedules (Chandran *et al.* 2008; Mast and Ward 2008) and prepared for the introduction of several more vaccines in late stage development, for example, pneumococcal conjugate, rotavirus, Human Papilloma Virus; and (4) in HICs, the valence of paediatric vaccines increased from either monovalent or trivalent combinations to tetravalent, pentavalent and then

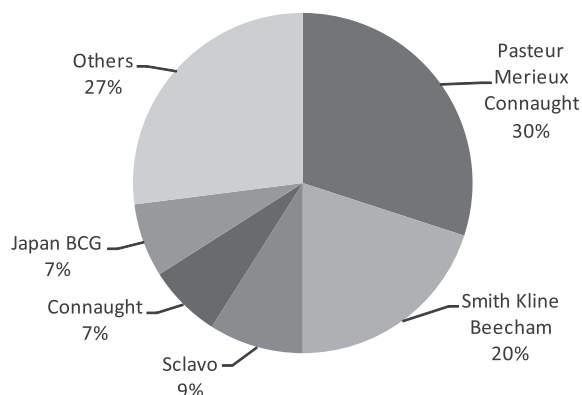


Figure 1 Vaccine market share in 1990 (DeRoeck 2002).

hexavalent combinations, such as DTaP-HepB, DTaP-HepB-IPV and DTaP-HepB-IPV-Hib (Ellis 1999).

The impact of these trends on the global market was a split into low- and high-value LICs and HICs market segments, respectively. By the late 1990s, LIC markets represented 88% of the volume of the global vaccine market but only 18% of the value (Whitehead and Pasternak 2002).

Impact of innovation in the 1980s and 1990s: consolidation and privatization in the vaccine market

The number of vaccine manufacturers declined from 26 to 4 in the USA between 1967 and 2002 (Institute of Medicine 2004). By 2000, 10 of the 14 manufacturers producing traditional EPI vaccines for the UNICEF Supply Division had partially curtailed or completely terminated production (Institute of Medicine 2004) and 4 manufacturers occupied more than 75% of the global vaccine market (Figure 2) (Batson 2001). The consolidation in the market place is explained by the relatively poor returns on investments for vaccines, and the considerably higher risks in research and development (R&D) than for pharmaceuticals, associated with the innovations occurring in the industry (Institute of Medicine 2004; Bloom *et al.* 2005).

GAVI market-shaping strategies and their impact on the LIC vaccines market segment

GAVI was launched in 2000 to redress the inequity that was occurring in vaccine access by accelerating the uptake of new and under-utilized vaccines in the world's 74 poorest countries. It has since undergone three strategic planning phases (Table 1) (GAVI Alliance 2012a–c). In Phases I and II, GAVI expected that it could influence prices in the LIC vaccine market but subsequent evaluations have found that GAVI's impact on vaccine prices was negligible and weak, respectively (Chee *et al.* 2008; CEPA LLP and Applied Strategies 2010). Therefore, in Phase III, GAVI set a specific goal to 'shape' the market with the aim of reducing prices of new vaccine (GAVI Alliance 2012c).

GAVI employed at least four distinct strategies to reduce new vaccine prices during GAVI Phases I and II: (1) improving demand forecasting for new vaccine products in LICs, (2) increasing the number of vaccine manufacturers supplying the GAVI market, (3) relying on emerging manufacturers to be 'low-cost producers' for new vaccines and (4) obtaining the

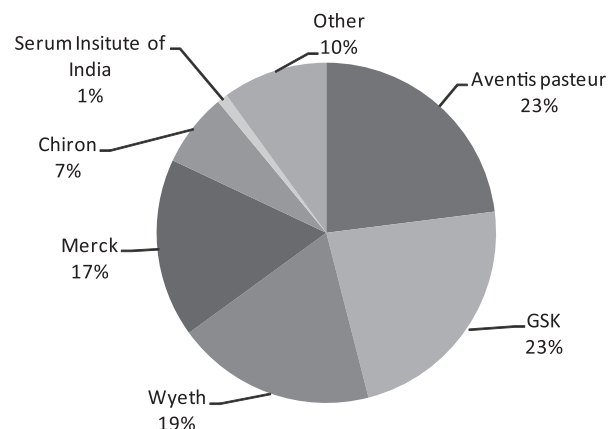


Figure 2 Vaccine market share in 2000 (Batson 2001).

lowest possible prices from all suppliers. These four strategies are reviewed, and their impacts on prices and supply in the LIC vaccine market are discussed.

Improving demand forecasting for new vaccines to increase manufacturers' investments in industrial capacity and supply for vaccines in LICs

Prior to the launch of GAVI, the high uncertainty of new vaccine demand was touted by manufacturers as being the single largest deterrent for serving the LIC vaccine markets. Historically, variances of up to 80% between demand forecasted and vaccines purchased for LIC markets were possible, causing manufacturers to suffer write-offs of unused inventory (Whitehead and Pasternak 2002). Manufacturers were, therefore, hesitant to scale up vaccine production for the GAVI market in the event that demand for new vaccines in LICs did not materialize at the forecasted scale. Limited vaccine supply, in turn, kept vaccine prices relatively inflated.

GAVI understood that improvements in demand forecasting would reduce risks to inventory and potentially increase capacity and supply to meet or exceed vaccine demand, and this, in turn, could optimize vaccine prices. Improvements to demand forecasting for new vaccines included: extending UNICEF Supply Division's annual contracts to 3-year agreements; funding product-specific demand forecasts, such as with the GAVI Pneumococcal Accelerated Demand and Introduction Plan (PneumoADIP), which developed strategic demand forecasts for pneumococcal vaccine 5–20 years into the future; and generating a long-term demand forecasting model, through the Accelerated Vaccine Introduction initiative in 2009, to consistently generate strategic demand forecasts for all GAVI-eligible countries (Wrobel 2007; GAVI Alliance 2012d).

A first GAVI evaluation (Phase I) found that improvements in forecasting and procurement mechanisms, and long-term funding did attract additional vaccine suppliers (Chee *et al.* 2008). By 2004, accuracy of forecasting had reached 80%, which undoubtedly reduced the risk of write-offs for manufacturers (Sekhri 2006). But it is impossible to separate the impact of improved forecasting from the impact of secured financing for vaccine purchases. It is likely that both are needed to affect vaccine manufacturers' investment in capacity and supply. In a 2003 demand forecasting roundtable with public

Table 1 GAVI strategic goals Phases I–III

GAVI Phase I 2000–6 (GAVI Alliance 2012a)	GAVI Phase II 2007–10 (GAVI Alliance 2012b)	GAVI Phase III 2011–15 (GAVI Alliance 2012c)
(1) Supply of new and under used vaccines (2) Strengthening vaccine delivery systems	(1) Contribute to strengthening the capacity of the health system to deliver immunization and other health services in a sustainable manner (2) Accelerate the uptake and use of underused and new vaccines and associated technologies and improve vaccine supply security (3) Increase the predictability and sustainability of long-term financing for national immunization programmes (4) Increase and assess the added value of GAVI as a public–private global health partnership through improved efficiency, increased advocacy and continued innovation	(1) The vaccine goal: accelerate the uptake and use of underused and new vaccines (2) The health systems goal: contribute to strengthening the capacity of integrated health systems to deliver immunization (3) The financing goal: increase the predictability of global financing and improve the sustainability of national financing for immunization (4) The market-shaping goal: shape vaccine markets (a) Ensure adequate supply to meet demand (b) Minimize costs of vaccines to GAVI and countries

sector organizations, vaccine manufacturer industry representatives stressed that without assurances that the vaccine would be purchased, manufacturers still viewed the forecasted demand, no matter how accurate, as hypothetical (Pneumo ADIP and Applied Strategies 2009).

In spite of the improvements in accuracy of forecasting, no vaccine supplied to GAVI is forecasted to exceed demand in 2012, and UNICEF Supply Division considers all of its vaccine supply to be ‘critical’ or ‘requiring planning’ (UNICEF 2011a).

Increasing manufacturer competition in the GAVI market to reduce vaccine prices

In Phase I of GAVI, the higher levels of vaccine demand, secured by donor commitments for 5 years of vaccine procurement, were expected to draw new manufacturers into the market. The expectation was that an increase in market competition would lead to reductions in prices of new vaccines (Godal 2000). GAVI anticipated that prices of Hib-containing vaccines would decline to ~\$1.00/dose, considered an affordable level for LICs, as all six EPI antigens could be purchased for <\$1.00. Countries were then expected to achieve financial sustainability of new vaccine introductions, defined as the ability of a country to raise sufficient resources to cover the costs of its immunization programs from sources other than GAVI (GAVI Alliance 2001).

GAVI’s early support of monovalent HepB increased competition in the market. From 2001 to 2005 UNICEF HepB monovalent, single-dose vaccine price declined from \$0.75 to \$0.41/dose (Chee *et al.* 2008). By then, GAVI stopped supporting monovalent HepB in favour of the multivalent pentavalent vaccine (DTP-HepB-Hib). But unlike HepB while demand for pentavalent vaccine (DTP-HepB-Hib) in LICs increased, manufacturer competition did not materialize as expected within 5 years. Pentavalent vaccine initially sold to GAVI at \$3.65/dose and averaged \$3.00 or more per dose for 10 years (Figure 3)

(UNICEF 2011b). It took 7 years for a competing manufacturer to develop, produce and license a second prequalified pentavalent vaccine for the GAVI market. With five competitors in the market by 2010, prices had declined to \$2.25. It is uncertain what impact additional entrants to the market might have on prices, but it seems unlikely that prices would reach the \$1.00/dose threshold of ‘affordability’.

Since product development timelines dictate the pace of new market entrants, and in the case of pentavalent for GAVI, this took a minimum of 7 years, the expectation for increased competition and impact on vaccine pricing should be framed within a more realistic time period. Realistic projections for market competition and levels of vaccine pricing are critical for both strategic planning and securing donor confidence.

Relying on emerging manufacturers as low-cost producers

Emerging manufacturers now supply 86% of the traditional EPI vaccines to UNICEF (World Health Organization *et al.* 2009). They also offered HepB and Yellow Fever vaccines, considered ‘mature vaccines’, to GAVI, at sometimes up to half the price of a multinational vaccine manufacturer, although differences in presentation sizes make price comparisons imperfect (UNICEF 2011c,d). For these reasons, emerging manufacturers were considered to be potential suppliers of lower-priced new vaccines (Whitehead and Pasternak 2002).

Historically, multinational manufacturers have been innovators of new vaccines, making substantial investments in R&D technologies. Emerging manufacturers, on the other hand, although more diverse as a group, have traditionally invested in large-scale production facilities, and exploit cost advantages but make limited investments in R&D (Wilson 2010). Emerging manufacturers typically lag 5–15 years behind multinational manufacturers in the production and licensing of similar new vaccines from a local source (Table 2) (Milstien *et al.* 2007; Decker *et al.* 2008; Plotkin and Plotkin 2008; Serum Institute of

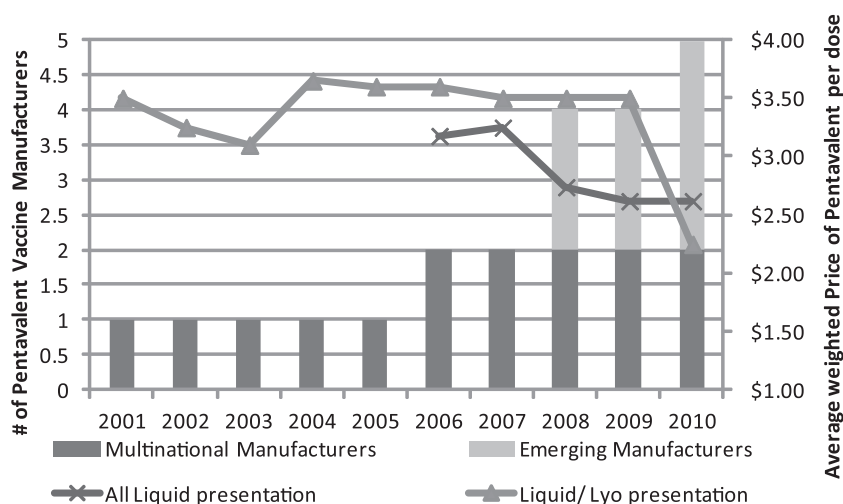


Figure 3 GAVI vaccine pentavalent manufacturers and price 2001–10 (UNICEF 2011b).

India Ltd 2011; GAVI Alliance 2011b; World Health Organization 2012). For pentavalent vaccine, 12 years elapsed between the first licensed vaccine from a multinational and the first licensed vaccine from an emerging manufacturer.

Nevertheless, GAVI has steadily increased the number of vaccine suppliers from an initial 5 in 2001 to 13 in 2010 (Figure 4) (GAVI Alliance 2010). Multinational manufacturers initially dominated GAVI's vaccine supply but since 2006 have made up about half of the number of suppliers. Therefore, the reliance on emerging manufacturers as low-cost producers would seem a feasible strategy, but total reliance would delay new vaccine introductions by several years. In addition, other mechanisms may accelerate price maturation in the LIC market. In the case of the Advance Market Commitment for pneumococcal conjugate vaccine, a price reduction from \$120/dose in the US market to \$3.50/dose in the LIC market (GAVI Alliance 2009) was achieved, but it should be noted that this took more than 5 years of negotiating with industry, multilateral partners and global donors.

Obtaining lowest prices from vaccine suppliers

The practice of 'tiered pricing', based on the buyer's ability to pay, has been practised by multinational suppliers to UNICEF since the inception of the EPI. This pricing mechanism was promoted by both WHO and UNICEF in the 1990s and was recommended to GAVI (Batson *et al.* 1994; Whitehead and Pasternak 2002). The practice allowed donors to purchase vaccines for LICs at significantly lower prices than in HICs. GAVI, therefore, expected that multinational manufacturers would also set prices of new vaccines at or near the marginal cost of production.

But the cost of R&D and manufacture of new vaccines is higher than for the original six EPI antigens. New vaccines were developed using more innovative technology, more complex manufacturing processes and under far greater regulatory stringency, requiring up to 500 quality testing steps (GlaxoSmithKline Biologicals 2009). Clinical development for certain vaccines required testing in tens of thousands of subjects: development of Merck's rotavirus vaccine enrolled more than 70 000 participants from 11 countries, and similarly

development of GSK's rotavirus vaccine enrolled 90 000 participants in Europe, Latin America, Asia, Africa and the USA (CenterWatch; GlaxoSmithKline 2010). Unlike for EPI vaccines, in which R&D costs have long been recovered, a return on investment for R&D of new vaccines must be recovered from vaccine sales (Greco 2004; Institute of Medicine 2004). Therefore, prices paid by GAVI for new vaccines have been considerably higher than for EPI vaccines.

Furthermore, the practice of tiered pricing is undermined by the differentiation between LIC and HIC market segments. Prior to GAVI, manufacturers could recover a greater return from sales in HICs while offering sharply discounted prices in LICs (Greco 2004). However, recovery of investments for products produced exclusively for the GAVI and/or LIC markets, such as pentavalent vaccines, now needs to come from vaccine sale revenues in these markets. So even though new vaccines continue to be offered to GAVI at the manufacturer's lowest price, due to the costs of production and exclusivity of sales in the LIC market segment, prices for new vaccines far exceed the prices paid for traditional EPI vaccines.

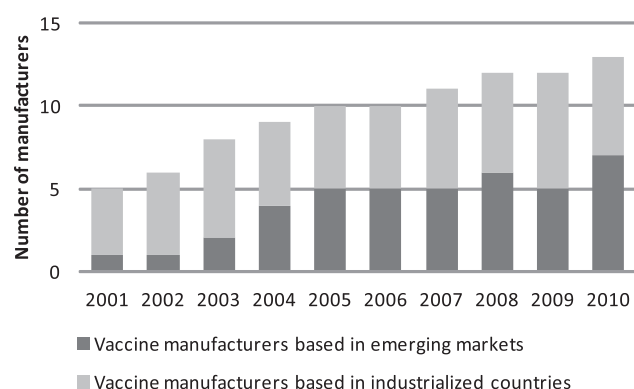
Discussion

By the time GAVI was launched, the global vaccines market bore little resemblance to the EPI vaccines market of 30 years ago. GAVI's partners and funding further created a whole new market for new vaccines where none existed before. But there exists little evidence in the immunization literature on market-shaping policies and the potential impacts on vaccine pricing. A search of PubMed Central, using the MeSH terms 'vaccines', 'pricing' and 'developing countries' yielded 262 hits, but many of these focused on the cost-effectiveness, or other health technology assessment, of a specific vaccine. Only four articles discussed strategies for impacting the vaccine market in LICs and only one article assessed the impact of tiered pricing.

While GAVI has been immensely successful in accelerating introduction of new life-saving vaccines in LICs, critics have faulted GAVI for not reducing vaccine prices to affordable levels in LICs (Arie 2011). Our review of the vaccine market in LICs

Table 2 First year of new vaccine introduction by source of production

Vaccine	Industrialized manufactures (Decker <i>et al.</i> 2008; Plotkin and Plotkin 2008)	Emerging manufacturers
Recombinant monovalent HepB	1986	1997 (World Health Organization 2012)
Monovalent conjugate Hib	1987	1998 (Milstien <i>et al.</i> 2007)
Bivalent combination HepB-Hib	1996	—
Tetravalent combination DTP-HepB	1993	1998
Pentavalent combination DTP-HepB-Hib	1996	2008 (Serum Institute of India Ltd 2011)
Pneumococcal	2000	Est. 2015 (GAVI Alliance 2011b)
Rotavirus	2006	Est. 2013 next 5 years (GAVI Alliance 2011b)

**Figure 4** Manufacturers of GAVI supported vaccines 2001–10 (GAVI Alliance 2010).

and of GAVI's strategies to lower vaccine prices yielded two fundamental lessons that can be applied to future vaccine market-shaping strategies.

Lesson 1: Accurate demand forecasting of new vaccines can reduce the risk to manufacturers and positively impact supply thereby reducing the negative impacts of demand uncertainty on price. However, forecasts must be backed by financing to draw new entrants into the LIC market and the certainty of purchase agreements has the potential to further increase capacity and promote lower vaccine prices.

Improving demand forecasting, securing financing and negotiating purchase agreements can obtain supplier investments in future markets and reduce the risk of supply crises as seen for traditional EPI vaccines (Figure 5) (UNICEF 2011e). Five manufacturers now compete in the pentavalent market compared with one in 2001 (UNICEF 2011b). But given that most GAVI-eligible countries make only modest contributions to financing the purchase of new vaccines, ~39% in 2008, accurate forecasting alone is unlikely to be sufficient to increase the capacity of supply to this market (Lydon *et al.* 2008). Sufficient secured funding from donors will be critical to maintain and attract new competition in the LIC vaccine market segment, but it is the certainty of sales that will likely have a greater impact on vaccine capacity and prices.

Donors have raised funds for GAVI in innovative ways. In 2006, the International Financial Facility for Immunization

raised \$2.3 billion in the form of government bonds to finance the wide spread introduction of pentavalent vaccines (International Financial Facility for Immunization 2011). A separate dedicated fundraising initiative, the Advanced Market Commitment, has committed funding for the purchase of conjugate pneumococcal vaccine for more than 10 years, securing the commitments of two multinational manufacturers and two emerging manufacturers to invest in product development and/or supply of pneumococcal conjugate vaccines for LICs, at a low price (GAVI Alliance 2009). Securing investment in supply of other available new vaccines, such as rotavirus and HPV, and future vaccines, including malaria and dengue, will be equally important.

Lesson 2: The time needed to influence the market to reduce new vaccine prices takes longer than the 5-year GAVI planning phases and prices most likely will never reach traditional EPI vaccine price levels.

Generating greater competition on the market was a prime strategy for reducing vaccine prices. But several factors account for the longer than expected time to achieve greater competition in the market, such as suboptimal demand forecasting on the part of countries, a lack of predictable and/or sustained financing for new vaccines, the time needed to increase industrial capacity for vaccines, either through investment in a new plant or the expansion of an existing facility and the time needed for new entries in the vaccine market (5–7 years or more). Furthermore, the complexity of developing and manufacturing new or combination vaccines is far greater than for traditional EPI vaccines. New vaccines, such as pneumococcal conjugate vaccine, are significantly more complicated to manufacture than traditional EPI antigens; *de novo* development can take, on average, 10–15 years (Wilson 2010). Building new dedicated production facilities alone can take on average 3–5 years and cost in the order of \$200–\$450 million dollars. All these factors have the potential to limit the historical cost advantages that emerging manufacturers have enjoyed for traditional EPI vaccines.

In addition, low value of an LIC market may limit or deter competition. Incentives to compete may be lacking especially in the absence of a large HIC market in which to recover extensive R&D costs. Currently, competition from emerging manufacturers would be expected to occur only after an innovative vaccine that had already been on the market for several years,

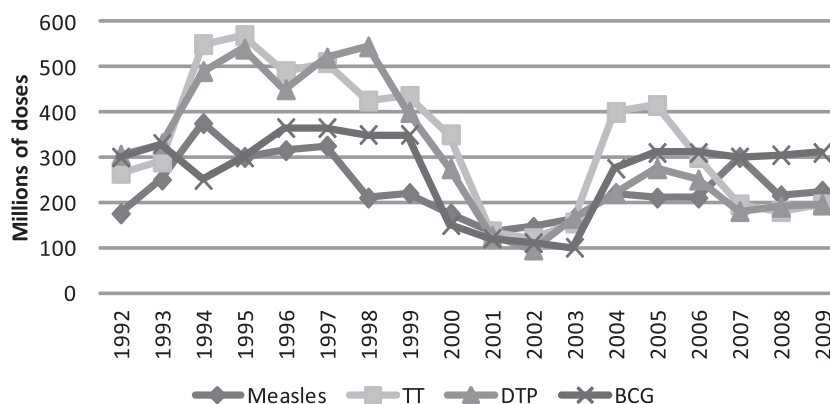


Figure 5 Historical vaccine supply crisis in the absence of adequate long-term forecasting (UNICEF 2011e).

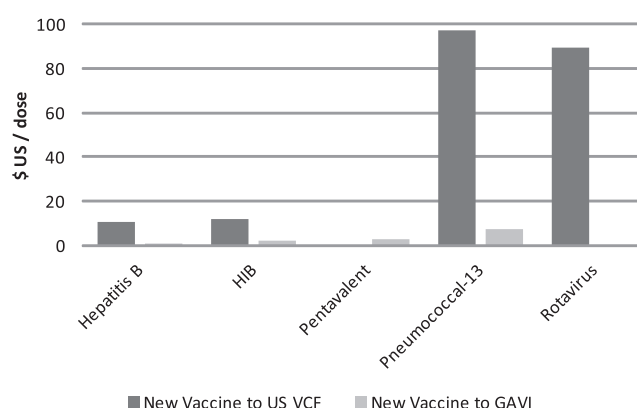


Figure 6 2011 Vaccine price comparison between GAVI and US public market (United States Centers for Disease Control and Prevention 2011; UNICEF 2011f).

by then the value of the market would have significantly declined.

Other factors such as the economics of vaccine production also have an impact on price. As the economics of vaccines are highly scale-sensitive, in certain cases, less competition could actually lower vaccine prices providing larger-scale manufacturers are in the market (Wilson 2010).

While competition in the market can help to reduce prices, given the R&D investments, the manufacturing complexities of new vaccines and the relatively small number of vaccine suppliers, it is unlikely that prices of new vaccines will ever reach prices of traditional EPI vaccines. But GAVI nevertheless benefits from the lowest prices of new vaccines in the market (Figure 6) (United States Centers for Disease Control and Prevention 2011; UNICEF 2011f).

Conclusions

While immunization ranks at the top of aid effectiveness, donors have nevertheless come to expect further reduction in vaccine prices. Reducing new vaccine prices would allow global immunization initiatives like the GAVI Alliance to access more children. To design effective market-shaping strategies a number of lessons can be learned from the experiences of the GAVI Alliance. The first is that planning over a longer horizon

may improve the accuracy of market predictions and build greater confidence amongst the financiers of immunization in the LIC market. Increasing certainty around financing vaccine purchases could impact vaccine prices. The second is that the amount of time required to realize lower vaccine prices has been greater than expected. This review finds that competition and the observed impacts on prices occurred after almost 10 years. In addition to increased competition, scale of production and alternate financing mechanisms can also contribute to price reductions for vaccines. Five-year strategic planning cycles should therefore be re-evaluated for their effectiveness in favour of longer cycles. Donors also need to be made aware that, given the changes in the vaccine market, prices of new vaccines are unlikely to ever return to the historic levels of the EPI. Nevertheless, even at current price levels, by continuing to invest in immunization, donors and beneficiary countries will accelerate developments in health more than with any with other interventions.

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