



HIV/AIDS
MONITOR
Tracking Aid Effectiveness



Increasing Patient Access to Antiretrovirals

Recommended Actions for a More Efficient Global Supply Chain

A background paper prepared for the HIV/AIDS Monitor
at the Center for Global Development

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Independent Research and Practical Ideas for Global Prosperity

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Summary

Despite sustained efforts by the global HIV/AIDS community and undeniable recent successes in financing antiretroviral treatment for AIDS in low- and middle-income countries, access to such treatment remains limited in many parts of the world. The causes are complex: often they include a lack of health system infrastructure, a shortage of healthcare workers, a lack of affordable treatment, and other social and behavioral factors. A main cause, however, is the lack of an effective and efficient antiretroviral supply chain.

This report identifies some key unmet needs for the antiretroviral supply chain (chapter 1), based on information from interviews with various stakeholders (appendix A). The report then assesses the existing incentives for each stakeholder to do what it takes to meet those needs (chapter 2). The report finds that in some cases no such incentives exist, or the existing incentives are too weak or poorly aligned. Finally, the report recommends a way to meet some of the key needs for a more effective and efficient supply chain—in part through strengthening and better aligning some stakeholder incentives—by creating an online global electronic marketplace for antiretrovirals (chapter 3). The e-marketplace offers an innovative, yet pragmatic tool for increasing access to antiretro-

viral treatment in countries around the world.

Key unmet needs for a more effective, efficient antiretroviral supply chain

Some of the most important key unmet needs identified in chapter 1 are for:

- Accurate forecasting. To avoid stock-outs and emergency shipments, accurate global forecasts are needed for the quantities of antiretrovirals that stakeholders will require. But accurate forecasts depend on coordinated, transparent financing, and procurement plans for HIV/AIDS goods.
- The ability of procurement offices to commit to longer-term orders with suppliers. A key bottleneck in

the supply chain, the inability to place long-term orders, causes procurement delays and antiretroviral stockouts. It also lessens the procurement offices' ability to negotiate better prices with manufacturers. Multiyear framework contracts with high-quality antiretroviral suppliers can help resolve this problem.

- Shorter lead times for antiretroviral production. Shorter production lead times could improve planning, reduce the need for longer-term forecasts, reduce the need for buffer stocks, and speed patient enrollments.
- The ability of manufacturers to predict future demand and market size, to receive prompt payment from procurement organizations, and to compete for antiretroviral orders from low- and middle-income countries on a coordinated basis (rather than country by country).
- More in-country technical capacity for logistics, inventory management, and transportation. Better in-country capacity is needed, especially to make distribution schedules more regular.

Stakeholder incentives to meet key needs for an effective, efficient antiretroviral supply chain are now weak or poorly aligned—creating several obstacles

Each of the key unmet needs identified by antiretroviral supply-chain stakeholders in chapter 1 can be met. But in several cases, the incentives for certain stakeholders to do what it takes to address those needs are weak or poorly aligned. That creates obstacles to building a more effective, efficient antiretroviral supply chain.

- Obstacles to accurate global forecasting include financiers' organizational constraints, strategic differences among financing organizations, and a lack of incentives for countries to contribute to global forecast development. Similarly, access to up-to-date information on antiretroviral consumption is critical to creating national forecasts that could be rolled up into global forecasts. Yet the investment needed to build systems for gathering such information is lacking.
- Obstacles to helping procurement offices commit to longer-term orders include the requirement that many financing organizations national tender boards of some countries place on procurement officers to follow a strict annual tendering process. This requirement is designed chiefly to make procurement more predictable and continuous. It does not necessarily make procurement efficient.
- Obstacles to reducing lead times for antiretroviral production include the financial burden that such an effort would impose on antiretroviral manufacturers—it would require significant increase in working capital and increase risk of holding inventory. Other than technological advances in manufacturing, the most effective strategy for reducing lead times would be for all manufacturers to hold a certain volume of product in inventory. Yet manufacturers will invest in that, and in other simple ways to reduce lead times, only when they can see future demand more clearly.
- Obstacles to helping manufacturers predict demand and market size, re-

ceive prompt payment, and compete globally. NACPs and procurement offices of countries and financing organizations lack strong incentives to ensure higher predictability of demand, to expedite payments to antiretroviral suppliers, and to reduce the transaction costs caused by doing business on a country-by-country basis

- Obstacles to improving in-country technical capacity for logistics, inventory management, and transportation. Financing organizations often have not seen the impact of past investments in transportation assets, so they are reluctant to fund more transportation-related purchases.

Recommendation: to make the antiretroviral supply chain more effective and efficient, stakeholders should create a new global electronic marketplace

This report's single recommendation is to create a global electronic marketplace, or e-marketplace, for antiretrovirals. Similar to the online marketplaces already used in the private sector, such an e-marketplace would help to meet some of the stakeholder needs that most affect antiretroviral availability.

The proposed e-marketplace would help to overcome several obstacles identified in this report's incentive analysis:

- Obstacles to accurate global forecasting. The information gathered automatically through the e-marketplace could be used to make global forecasting more accurate, helping to reduce stockouts and ensure avail-

ability—and ultimately to lower the price of antiretroviral treatment.

- Obstacles to helping procurement offices commit to longer-term orders. The e-marketplace would make procurement more efficient and transparent, without the drawbacks of compelling procurement offices to follow a strict annual tendering process. In addition, the e-marketplace would help the bilateral and multilateral organizations that finance much antiretroviral procurement to improve overall on-target program performance—by expediting their disbursements of funds, and by helping to ensure acceptable performance by grantees.
- Obstacles to reducing lead times for antiretroviral production. The e-marketplace would allow manufacturers to shorten production lead times—at no extra cost—by helping them see future demand more clearly.
- Obstacles to helping manufacturers predict demand and market size, receive prompt payment, and compete globally. The e-marketplace would help manufacturers predict demand better by creating a larger, more aggregated market. It would also give them a simple, effective way to compete globally—increasing transparency and competition, and thus reducing product prices.

The proposed e-marketplace would not, by itself, help to improve in-country technical capacity for logistics, inventory management, or transportation. To meet this need—and especially to strengthen incentives for funding transportation assets—other solutions must be sought.

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Glossary

Access: Affordability, availability, accessibility, and acceptability, leading to the provision of safe and effective products. (For remarks on this definition see appendix A.)

First-line antiretrovirals: Initial regimen prescribed for a naïve patient who meets a country's criteria to start antiretroviral treatment. For first-line antiretroviral treatment, current World Health Organization guidelines recommend two nucleoside reverse transcriptase inhibitors and one nonnucleoside reverse transcriptase inhibitor.

Second-line antiretrovirals: The next regimen used in a treatment sequence after initial therapy has failed (clinically, immunologically, or virologically) or when a patient suffers toxic reaction to a first-line regimen. Current World Health Organization guidelines recommend reserving protease inhibitor class antiretrovirals for second-line treatment. The guidelines also recommend that, for second-line treatment, boosted protease inhibitors supported with two nucleoside reverse transcriptase inhibitors should be used. (At times the distinction between first- and second-line antiretrovirals is blurred. Some second-line drugs, such as Abacavir and Tenofovir Disoproxil Fumarate, are increasingly also used in first-line treatment.)

Pediatric antiretrovirals: First- and second-line antiretrovirals designed for children under 13 years of age—for palatability and other clinical considerations—and dosed accordingly.

Supply chain: A network for delivering drugs from manufacturers to patients—including such processes as product development, manufacturing, procurement, registration, and quality verification, with the associated information and finance flows. This report refers to supply-chain processes for the most part generically, with only the specificity needed to describe their effect on key flows in the antiretroviral supply chain.

Incentive: An explicit or implicit reward for doing an activity, usually designed to encourage that activity.

Explicit incentive: An incentive that leads stakeholders, by doing an activity, to clearly improve their performance on key indicators. This report's incentive analysis focuses only on explicit incentives.

Implicit incentive: An incentive that requires stakeholders to exert effort (often considerable) to engage in behaviors not directly supported by explicit rewards. Implicit incentives can motivate behavior but are more likely to influence the behavior of individuals than systematically to influence that of organizations. Accordingly, implicit incentives are excluded from this report's incentive analysis.

National AIDS control program: The central policy, planning, and implementation arm of the HIV/AIDS program in most countries (the name can vary by country).

Supply-side facilitators: Organizations that coordinate information sharing about market dynamics, catalyze introduction of new drugs (for example, second-generation ACTs) or dosage forms (for example, new types of pediatric formulations), help manufacturers get better rates from active pharmaceutical ingredient suppliers, and connect smaller manufacturers with international regulatory and technical organizations. The Clinton HIV/AIDS Initiative and Médecins sans Frontières are two examples.

Quality regulators: These ensure drug quality by establishing processes for drug registration, approval, postmarketing surveillance, and so on. Examples include the World Health Organization's prequalification program; United States Pharmacopoeia; and stringent regulatory agencies such as the U.S. Food and Drug Administration, the European Medicines Evaluation Agency, and the national regulatory authorities of developing countries.

Global technical agencies: These set treatment norms and guidelines. The World Health Organization is an example.

Financing organizations: These give grants and loans to AIDS control programs. This report chiefly considers four: the Global Fund to Fight AIDS, Tuberculosis and Malaria, the U.S. President's Emergency Plan for AIDS Relief (PEPFAR), UNITAID, and the World Bank's Multi-Country AIDS Program for Africa (the MAP).

Procurement agents: These help countries order and purchase antiretrovirals. Examples include the International Dispensary Association, Mission Pharma, UNICEF, Crown Agents, and the Supply Chain Management System.

Program implementers: Agencies operating antiretroviral treatment clinics. Primarily health ministries and national AIDS control programs, such agencies also include mission and charity organizations with large antiretroviral programs.

About this report

An estimated 33 million people were living with HIV in 2007. An estimated 3 million patients are now on antiretroviral treatment, and at the current enrollment rate, that number will increase to 4.7 million by 2010. These patients need an uninterrupted supply of drugs and health goods, valued at around US\$11 billion, which must move from the country of manufacture to countries where the majority of patients live (mostly sub-Saharan African countries).

A wide array of structural and institutional arrangements exists for organizing antiretroviral supply chains in low- and middle-income countries. Usually, a complex combination of institutions specializing in manufacturing, financing, procurement, drug selection, distribution, care provision, and various other auxiliary functions must join forces to make antiretrovirals available to end-patients. Yet many stakeholders in the antiretroviral supply chain have competing—and often conflicting—objectives. Their incentives are not necessarily aligned to overcome the challenges that stand between patients and access to high-quality antiretrovirals. Manufacturers attempt to maximize sales and profits. Donors want to ensure transparency and speed the disbursement of funds. Countries want to ensure an uninterrupted supply of medicines at a low cost. Patients, final-

ly, are interested in obtaining the best care at the lowest possible cost.

There are more than 100 antiretroviral drug suppliers (though only about 28 have been prequalified by the WHO for one or more antiretrovirals); more than a dozen multilateral and bilateral donors (each with its own rules for procurement and disbursement of funds); and more than 46 low- and middle-income countries providing antiretroviral treatment to at least 31 percent of those in need (some with 400–500 points of antiretroviral treatment and care). With such complexity and so many competing incentives, it is not surprising that donors have set up their own procurement and logistics structures, or they appoint their own procurement agents; that manufacturers have lead times of more than 4–6 months for some of their products, or that they often must destroy their

inventory because of overproduction; that prices for the same product can vary by a factor of 5 or 10; or that patients must switch their antiretroviral drugs because of stockouts at the point of care. This report clarifies workings of, and challenges to, antiretroviral supply chains for developing countries—and it recommends a way to meet unmet needs of supply-chain stakeholders.

Although this report focuses on antiretrovirals, it does not advocate a vertical approach targeting a single commodity group. Such an approach

has limitations and may weaken the supply chain for other essential products. Increasingly, a balanced vertical and horizontal approach—with both a specific disease focus and system-based solutions—is promoted as a way to tackle complex health problems, particularly in resource-limited countries. Consensus is growing about the need for greater global action on health systems, presenting a new objective for global health policy: to restore an appropriate balance between systems-strengthening and disease-specific actions.

The antiretroviral supply chain—its main stakeholders and its key unmet needs

This chapter examines the parts of the antiretroviral supply chain. It explores the roles of stakeholders, gives concrete examples, and highlights key unmet needs for an effective and efficient supply chain.

Complexity in the antiretroviral supply chain: the example of Kenya

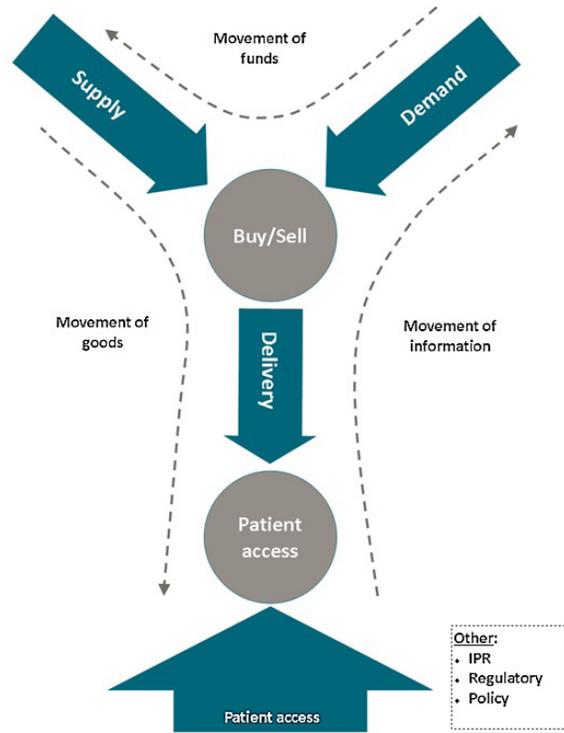
The supply chain map for health goods in Kenya (figure 1.1, next page) shows how complex flows of health goods, funds, and information can be, particularly for antiretrovirals. In 2004 the country's antiretroviral procurement was funded mainly by four donors: the Global Fund, the U.S. Government, Médecins sans Frontières, and the government of Kenya. Each donor used different agents to procure the drugs. Médecins sans Frontières procured its own. Programs supported by the Global Fund used a consortium of procurement agents. U.S. government-funded programs used the Mission for Essential Drugs and Supplies (MEDS) and the Center for Disease Control. And the government of Kenya used Crown Agents, while also procuring some antiretrovirals itself. Several more stakeholders were involved in delivering the antiretrovirals, from the point of first warehousing down to the point of care.

To make all these parts of the supply chain work, stakeholders must decide how and when to move goods along the chain based on information they receive in real time. For example, they need information about patents, in-country registration, donor policies on the drugs and on procurement, and consumption and forecasting data.

A framework for analyzing the antiretroviral supply chain

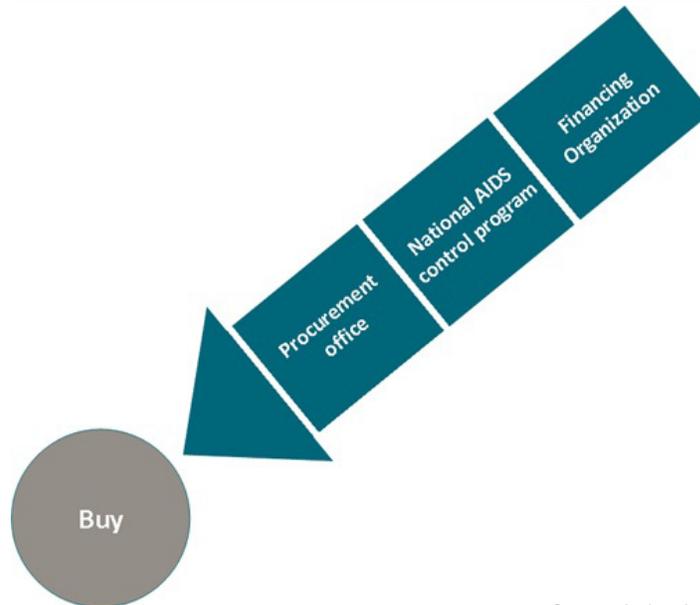
The complex supply chain map for antiretrovirals can be simplified into three subchains—demand, supply and delivery (figure 1.2, page 15). Other models of the supply chain tend to be linear or circular. The trilinear supply chain shown here has two advantages: it segments the flow of funds, goods, and information, and it highlights the importance of two confluence points—the two yellow circles (demand-supply-delivery and delivery-patient access)—that must be actively managed to prevent bottlenecks.

Figure 1.2. Trilinear supply chain diagram showing movement of goods, funds, and information



Source: Authors' depiction of information supplied in text.

Figure 1.3. The demand segment in the antiretroviral supply chain



Source: Authors' depiction of information supplied in text.

Table 1.1. Spending on HIV/AIDS for each person with HIV/AIDS in Rwanda and Zambia

Country	Number of people with HIV/AIDS	Spending by financing source for 2006 (\$ millions)		Total spending for each person with HIV/AIDS (\$)	International spending for each person with HIV/AIDS (\$)
		National funds	International funds		
Rwanda	150,000	6.8	80.8	584	539
Zambia	1,100,000	30.7	173.2	164	157

Sources: Republic of Rwanda 2008 and Republic of Zambia 2008.

some countries are funded much more than others, resulting in uneven support from international donors. For example, an assessment of the HIV/AIDS funds received by Rwanda and Zambia for each person with HIV/AIDS in those countries shows a differential in spending of more than 350 percent (table 1.1).

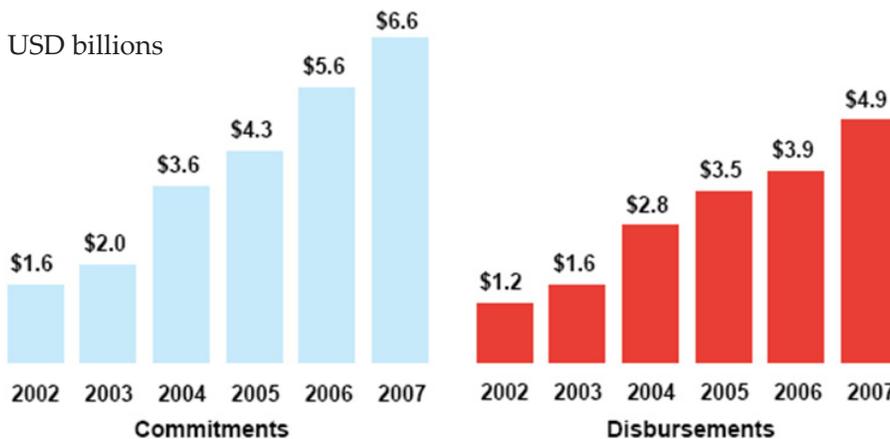
Once donors have raised funds, ensuring quick and effective disbursement is crucial; so is ensuring acceptable performance by countries. Balancing these possibly conflicting objectives is a significant challenge for donors. A lag results between funds committed and funds disbursed (figure 1.4).

Though such a lag is to be expected, the trend over 2003–07 has been toward

an increasing lag between funds committed and funds disbursed—which has increased from 22.5 percent to 27.5 percent lag (figure 1.5, next page).

One major cause of the lag in disbursement might be procurement cycles that can be as long as 16 to 18 months. Compare this with Global Fund grant cycles, which are typically two years for Phase 1 and three years for Phase 2. In addition, in Global Fund grants, the procurement budget for HIV/AIDS programs in many countries is estimated at 40 percent to 50 percent of the total budget. So a delay in procurement often leads to slower disbursement by the donor, which could explain the lag between funds committed and funds disbursed.

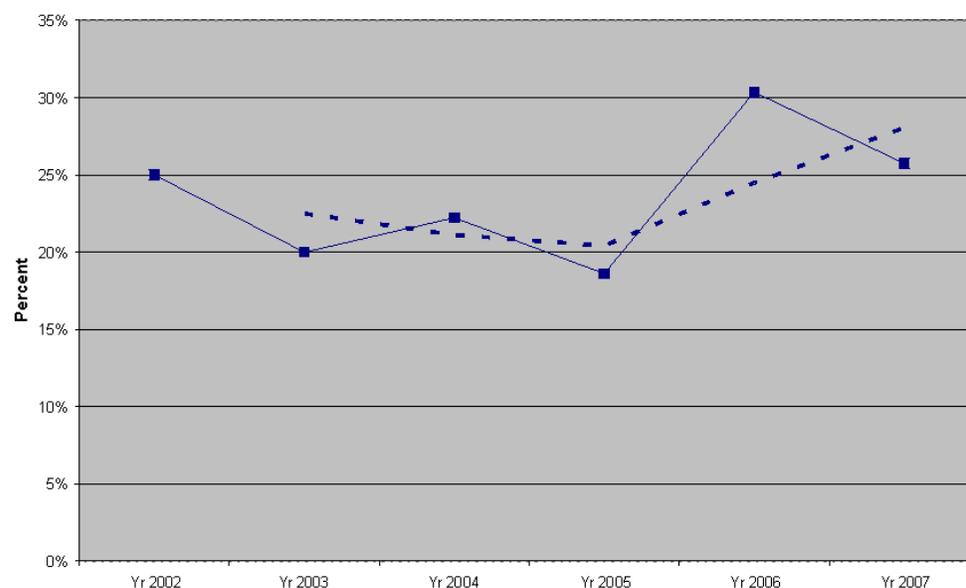
Figure 1.4. Gap between commitments and disbursements in HIV/AIDS funding



Source: Kates et al. 2007.

Note: Data for 2002 and 2003 do not include Global Fund contributions.

Figure 1.5. Lag between commitment and disbursement for HIV/AIDS programs (%)



Source: Authors' analysis.

Note: The dotted line is a two-year moving average.

Interviews with stakeholders (see appendix A) indicated that the key needs for donors are to:

- Develop coordinated forecasts for funding HIV/AIDS programs, and coordinated antiretroviral requirements, with countries and donors
- Expedite disbursement of funds while ensuring acceptable performance by grantees.

National AIDS control program

A country's national AIDS control program is the central policy, planning, and implementation arm of its AIDS response. It coordinates the government's activities with donors, procurement offices, health facilities, and implementation partners. It must manage all aspects of programming, including diagnosis, treatment, care and support, blood safety, laboratory services, bio-medical waste management, infection

control, surveillance and reporting, monitoring and evaluation, research and development, management information systems, finance and auditing, training and capacity building, advocacy, and communication and social mobilization.

The management of procurement and supply-chain functions is vital to supporting many of these activities.

Information being unavailable is one of the biggest supply-chain challenges for national AIDS control programs. Even when information is available, it is not easy for decision-makers to assess and use it. To manage the supply chain effectively, the national AIDS control program must obtain and analyze vast amounts of current information for product selection and quantification. For product selection, it must learn:

- Which drugs are registered in the country
- Which first-line, second-line, and pediatric treatments have been included in the country's standard treatment guidelines and essential drugs list
- Which drugs are acceptable to, and will be financed by, donors
- Which drugs are restricted by patients
- Which drugs have been prequalified (approved for use by a global technical agency such as the World Health Organization)
- What alternative drugs are available in case of resistance or adverse reaction.

For product quantification, the national AIDS control program must learn:

- The current consumption volume and pattern of drug use for first-line, second-line, and pediatric drugs
- AIDS-related morbidity and mortality
- Availability of funds for procurement
- The lead time needed to secure each drug.

Some of this information may be found in-country—but much more is available only internationally, and must be gathered from donors, manufacturers, and policy-setting bodies. After data are gathered, they must be analyzed. Then a choice of drugs must be made. With weak in-country health management information systems and globally scattered data, the national AIDS control program must often make decisions based on incomplete (or inaccurate) information—to respond to immediate antiretroviral needs and to prevent stockouts. The impact of such

decisions is clearly shown in a 2006 report by the DELIVER project (DELIVER 2006):

Data collected from one southern African country demonstrates that a total of 48 different [antiretroviral treatment] regimens are prescribed in public sector sites. Six adult first-line regimens are prescribed and are consistent with [the] recommendation in the [standard treatment guidelines]. However, of the 30 alternate first-line and second-line regimens being prescribed, only one is consistent with [the] recommendation [in] the [standard treatment guidelines]. Similarly, only three of the 12 prescribed pediatric regimens are consistent with [standard treatment guideline] recommendations.

In committing funds, most donors still require annual procurement cycles. Yet without long-term, multiyear orders, securing adequate antiretroviral supplies is likely to become increasingly difficult. Twelve-month supplies and single-delivery shipments are becoming less and less sustainable.

As the cost of first-line drugs rises with the inclusion of newer or second-line drugs in first-line regimens—and as the percentage of patients on second-line drugs increases—the need to sustain funds for antiretrovirals is causing urgent concern at national AIDS control programs. For example, Tenofovir (TDF) is now recommended for use in first-line antiretroviral regimens, yet the cheapest combination that includes TDF costs about five times as much as the cheapest first-line regimen (table 1.2, next page).

And the cheapest second-line regimen costs more than eight times as

Table 1.2. Prices of leading first-line antiretroviral treatments in low- and middle-income countries

<i>Major first-line antiretroviral regimen</i>	<i>Median price in low-income countries (\$ per patient per year)</i>	<i>Median price in middle-income countries (\$ per patient per year)</i>
d4T/3TC/NVP	77	99
AZT/3TC/NVP	207	335
AZT/3TC/EFV	264	416
TDF/3TC/EFV	418	515
TDF/FTC/EFV	478	501

Source: WHO GPRM Report, July 2007.

Table 1.3. Prices of leading second-line antiretroviral treatments in low- and middle-income countries

<i>Major second-line antiretroviral regimen</i>	<i>Median price in low-income countries (\$ per patient per year)</i>	<i>Median price in middle-income countries (\$ per patient per year)</i>
AZT/3TC/LPV _r	621	721
TDF/3TC/LPV _r	775	820
TDF/FTC/LPV _r	835	806
AZT/ddI/LPV _r	900	1178
TDF/ddI/LPV _r	986	1162
ABC/ddI/LPV _r	1140	1503

Source: WHO 2007.

much as the cheapest first-line regimen (table 1.3).

The interviews with stakeholders indicated that the key needs for national AIDS control programs are to:

- Aggregate global and national information related to product selection and quantification
- Obtain longer (multiyear) commitments of funds from donors.

Procurement offices

The procurement office, to meet the purchasing needs of the national AIDS control program, usually gets most of its information about drug requirements, funding, and timelines from

that program. Procurement offices must simultaneously procure antiretrovirals and other related commodities, such as reagents and laboratory equipment. A given office may procure 100–200 products from 25–50 suppliers around the world. Depending on the value of the goods required and the number of manufacturers available to supply them, the office may need to use several procurement methods (for example: sole source, direct negotiation, national or international tenders). The complexity of the procurement cycle means that, in some instances, a single procurement cycle can take 16–18 months to complete. Countries with

weak capacity—a category that usually includes countries in conflict or with a poor historical record of procurement—may outsource procurement, or they may resort to emergency procurement to avoid interruptions in supply.

The steps in antiretroviral procurement are shown in figure 1.6.

The interviews with stakeholders indicated that the key needs for procurement offices are to:

- Access accurate, current information on product selection and quantification
- Have multiyear procurement arrangements (instead of annual tendering)
- Reduce lead time for products—especially single-source products.

Stakeholders in the supply segment

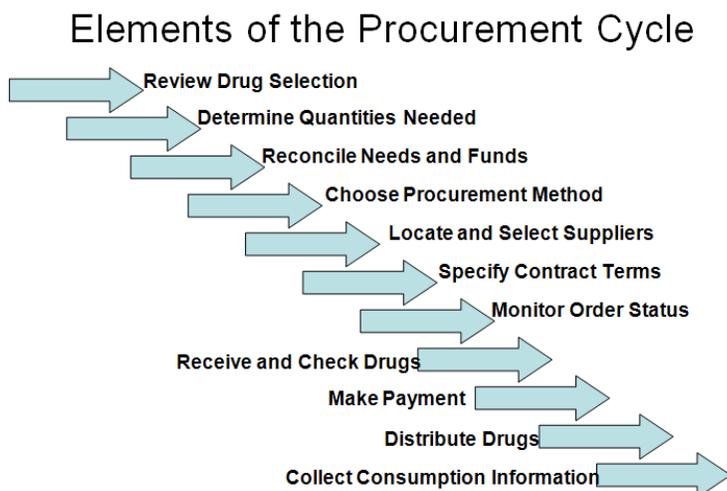
The main stakeholders in the supply segment of the antiretroviral supply

chain are the active pharmaceutical ingredient and finished-goods manufacturers, exporters and international shipping agents, and supply-side facilitators (figure 1.7, next page).

Intermediate and active pharmaceutical ingredient manufacturers produce the intermediates, incipients, and active raw material for antiretroviral drugs. Although antiretroviral production is feasible for most manufacturers, active pharmaceutical ingredients are enormously expensive and difficult to produce, requiring substantial inventories of raw ingredients and costly equipment.

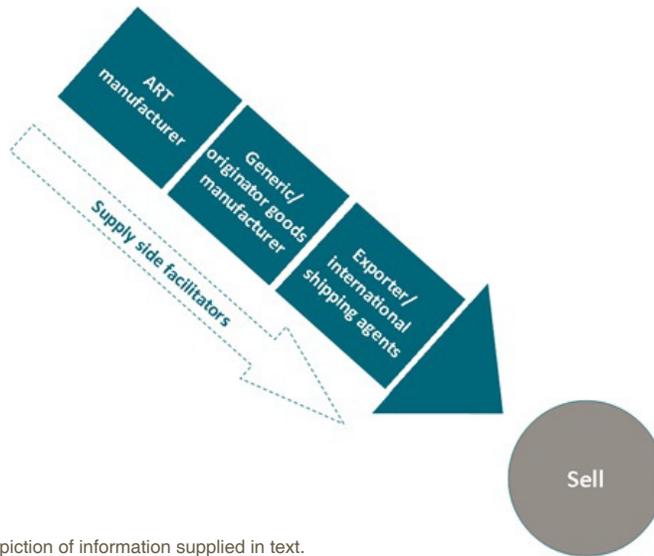
China and India produce the vast majority of bulk active pharmaceutical ingredients, but they do so inconsistently because of the unpredictability in demand. For patent-protected products, originator manufacturers normally produce their own active pharmaceutical ingredients. Without predictable, funded demand, most manufacturers are not willing to in-

Figure 1.6. Steps in antiretroviral procurement



Source: Adapted from MSH 2000.

Figure 1.7. The supply segment in the antiretroviral supply chain



Source: Authors' depiction of information supplied in text.

vest in upgrading or expanding their infrastructure. Nor are they willing to manufacture and then hold inventory, especially since these products have a limited shelf life.

The interviews with stakeholders indicated that the key need for active pharmaceutical ingredient manufacturers is for more predictable demand (orders).

Finished goods manufacturers (generic and originator)

There are two major types of finished-goods manufacturers for antiretrovirals. Originator manufacturers develop new drugs. Generic manufacturers copy existing drugs—or they combine copies of existing drugs into new formulations. Generic antiretroviral drug manufacturers have proliferated in Asia in recent years. An estimated 28 companies now manufacture prequali-

fied antiretroviral drugs, or their components, in nine countries in Asia.

The interviews with supply-chain stakeholders indicated that the key needs for manufacturers are to:

- Have more predictable demand (orders)
- Obtain prompt payment from countries and national AIDS control programs
- Find a simple, effective way to compete for business globally (rather than country by country and client by client).

Supply-side facilitators communicate between stakeholders in the demand and supply segments. On the demand side they work closely with donors, national AIDS control programs, and national procurement offices to streamline requirements for funding, product selection, quantification, and procurement. On the supply side they work with manufacturers to clarify and reduce drug production and marketing

costs in exchange for lower prices and shorter lead times. The best-known facilitators are the Clinton Foundation (CHAI) and Médecins sans Frontières (MSF), though many procurement agents also play this role.

No major unmet needs for supply-side facilitators were highlighted in the interviews with stakeholders.

Global shipping agents offer logistical services, including shipping (by sea, air, and road), storage, preshipment inspections, and customs clearing. The interviews with stakeholders uncovered no clear unmet needs for shipping agents.

Stakeholders in the delivery segment

“In health care, invention is hard, but dissemination is even harder.” This quotation captures the difficulty of delivering public health products (figure 1.8).

Once antiretrovirals reach their target country, they are delivered by public, nonprofit, and private sectors—with increasingly common partnerships between the public and private sectors.

Poor coordination among stakeholders often leads to overlapping roles and duplicated efforts (box 1.1, next page).

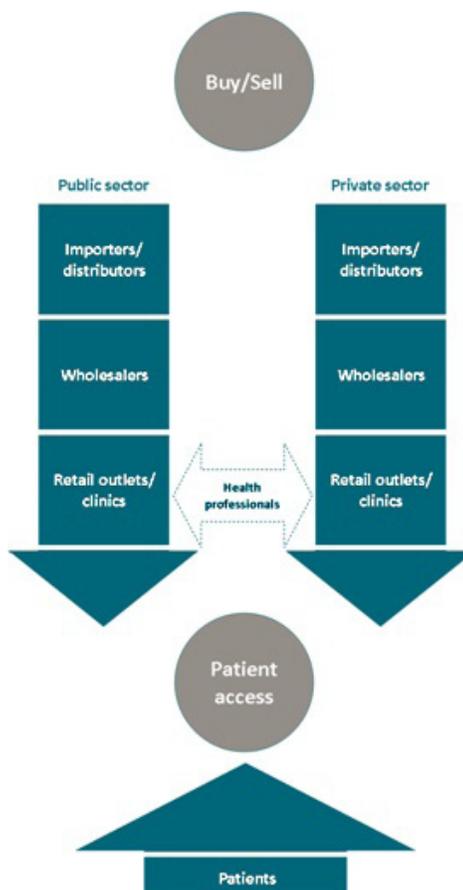
The lack of coordination causes confusion and stockouts at many antiretroviral treatment clinics, often forcing patients to switch to other regimens—not for medical reasons, but because of supply-chain failures. In addition to interrupting treatment, drug stockouts increase the risk that the virus will become resistant to treatment.

The interviews with stakeholders indicated that the key needs for in-country delivery are:

- Better coordination among delivery-related stakeholders in countries
- Access to accurate, current information on consumption (requiring strengthened management systems for order fulfillment and inventory control)
- Better transportation to ensure regular distribution schedules
- More technical capacity for staff to manage inventory and logistics.

The key unmet needs that were highlighted by stakeholders interviewed for this report are summarized in table 1.4, page 24.

Figure 1.8. The delivery segment in the antiretroviral supply chain



Source: Authors' depiction of information supplied in text.

Box 1.1: Antiretroviral delivery stakeholders in Nigeria

In 2005 Nigeria had four funding sources for antiretroviral drugs. One, the U.S. President’s Emergency Plan for AIDS Relief (PEPFAR), had several implementing organizations—each of which partnered with different organizations that were responsible for parts of the supply chain. All four funding sources had different reporting requirements and procurement restrictions, such as the requirement to purchase only from manufacturers approved by the U.S. Food Drug Administration or prequalified by the World Health Organization.

The several delivery channels were not harmonized, with distribution systems operating side by side and different formulas used to calculate orders. Facilities often received goods from several sources; for antiretrovirals, the components of a single regimen came from two supply chains and were available in several brands. Service providers often were required to maintain separate records for each supply chain or implementing agency, and had to collect some drugs and then wait for others to arrive.

Source: DELIVER, 2006.

Table 1.4. Stakeholders and key unmet needs in the antiretroviral supply chain

<i>Segment</i>	<i>Stakeholder</i>	<i>Key unmet needs</i>
Demand	Financing organizations	<ul style="list-style-type: none"> • Develop coordinated forecasts for funding HIV/AIDS programs, and coordinated antiretroviral requirements, with countries and donors • Expedite disbursements of funds while ensuring acceptable performance by grantees
	National HIV/AIDS programs	<ul style="list-style-type: none"> • Access global and national information related to antiretroviral selection and quantification • Obtain multiyear funding commitments from donors for antiretroviral procurement
	Procurement agencies	<ul style="list-style-type: none"> • Access global and national information related to antiretroviral selection and quantification • Have multiyear procurement arrangements (instead of annual tendering) • Reduce lead time for products—especially single-source products
Supply	Active pharmaceutical ingredient manufacturers	<ul style="list-style-type: none"> • Have more predictable demand (orders)
	Generic and originator goods manufacturers	<ul style="list-style-type: none"> • Have more predictable demand (orders) • Obtain prompt payment from countries and national AIDS control programs • Find a simple, effective way to compete for business globally (rather than country by country and client by client)
	Supply-side facilitators	None
	Exporters and international shipping agents	None
Delivery	Public and private sector service providers	<ul style="list-style-type: none"> • Better coordination among delivery-related stakeholders in countries • Access to accurate, current information on antiretroviral consumption (requiring strengthened management systems for order fulfillment and inventory control) • Better transportation to ensure regular distribution schedules • More technical capacity for staff to manage inventory and logistics

How weak and poorly aligned incentives deter stakeholders from building a more effective, efficient supply chain

The supply chain for antiretrovirals in the developing world is a complex network of institutional stakeholders. All, to varying degrees, have direct or indirect functional responsibility for the chain. Efforts to improve access to antiretrovirals must start with a clear understanding of each stakeholder's incentives for doing what it takes to meet key needs and build an effective, efficient supply chain. Based on 21 interviews with different stakeholders, this chapter rates the incentives for each to do what is needed, classifying them as weak, medium, strong, or not applicable (for stakeholders with no influence on a given activity).

This report focuses only on explicit incentives—when a stakeholder clearly achieves better results on key performance indicators by doing what is needed (see glossary). The analysis includes incentives for stakeholders that, though they do not perform an activity, can influence it. A critical question in developing recommendations to improve access to antiretrovirals is whether stakeholders' incentives to support and perform needed activities are well aligned. Activities for which important stakeholders have weak incentives are highlighted and discussed in more detail.

Incentives for stakeholders to help meet key needs identified by financing organizations

Incentives for helping to meet these needs are rated for each stakeholder in table 2.1, next page.

Develop coordinated forecasts for funding HIV/AIDS programs, and coordinated antiretroviral requirements, with countries and donors

Crucial to achieving program success, and to avoiding stockouts or emergency shipments, are accurate global fore-

Table 2.1. Stakeholder incentives for helping to meet the key needs identified by financing organizations

<i>Key unmet need</i>	Financing organizations	National AIDS control programs	Procurement offices	Active pharmaceutical ingredient producers	Manufacturers	Supply-side facilitators	Shipping agents	Delivery-related stakeholders
Develop coordinated forecasts for funding HIV/AIDS programs, and coordinated antiretroviral requirements, with countries and donors	Medium	Weak	Weak	Strong	Strong	Strong	N/A	N/A
Expedite disbursements of funds while ensuring acceptable performance by grantees	Strong	Strong	Strong	N/A	Strong	Strong	N/A	N/A

Source: Authors' analysis of data described in text.
 Note: N/A is not applicable.

casts for the quantities of antiretrovirals that will be required. Accurate forecasts depend on coordinated, transparent financing and procurement plans for HIV/AIDS goods. Financing organizations view forecasting as critical—although they express interest in more accurate global demand forecasts—yet they do not always provide information on future financing and planned procurement to help generate forecasts extending beyond their own grantees and focus countries. That is largely because of organizational constraints and strategic differences among financing organizations.

National AIDS control programs and procurement offices have weak incentives to contribute to the development of coordinated, accurate global forecasts. The benefits of such forecasts are not explicit for them and are perhaps regarded as mere externalities in their decision-making processes.

In contrast, manufacturers and active pharmaceutical ingredient produc-

ers have strong incentives to generate and obtain more accurate global demand forecasts. Such forecasts would allow them to plan marketing and production more efficiently.

For supply-side facilitators, matching supply with demand is part of their essential mission, so they have a strong incentive to develop more accurate global demand forecasts.

Most stakeholders have incentives to do part of what is needed to forecast antiretroviral demand. Few, however, have incentives to ensure that information from disparate sources is aggregated to make global forecasts more accurate. Financing organizations have an interest in good forecasts, but tend to focus on demand among their particular grantees. National AIDS control programs and procurement offices are keen to develop good country-level demand forecasts, but have limited capacity—they cannot complete forecasts without information from other sources, especially large AIDS donors.

Expedite disbursements of funds while ensuring acceptable performance by grantees

Expedited disbursements of funds would allow better planning throughout the antiretroviral supply chain. By reducing uncertainty, it would make the chain better coordinated. Manufacturers and active pharmaceutical ingredient producers would gain from more predictable revenue streams. National AIDS control programs and procurement offices would gain tremendously, becoming better able to manage program budgets and procurement cycles. Financing organizations have the most influence over this activity and strong incentives to expedite grant approval and disbursement—as the organizations’ performance is often measured based on the number and amount of grants disbursed in a given period. Yet financing organizations are sometimes hampered in expediting disbursements because of bureaucratic requirements, or because a country lacks absorptive capacity.

Incentives for stakeholders to help meet key needs identified by national AIDS control programs and procurement offices

Incentives for helping to meet these needs are rated for each stakeholder in table 2.2.

Access global and national information related to antiretroviral selection and quantification

To select and quantify first- and second-line antiretroviral regimens, national AIDS programs, national AIDS control programs, and procurement offices need information on many factors, including:

- The intellectual property status of drugs for the country
- The WHO prequalification status of drugs
- Donor quality policies
- The registration status of drugs in the country
- Alternative drug regimens available

Table 2.2. Stakeholder incentives for helping to meet the key needs identified by national AIDS control programs and procurement offices

<i>Key unmet need</i>	Financing organizations	National AIDS control programs	Procurement offices	Active pharmaceutical ingredient producers	Manufacturers	Supply-side facilitators	Shipping agents	Delivery-related stakeholders
Access global and national information related to antiretroviral selection and quantification	Medium	Strong	Strong	Strong	Strong	Strong	N/A	N/A
Obtain multiyear funding commitments from donors for antiretroviral procurement	Weak	Strong	Strong	Strong	Strong	Strong	N/A	N/A
Have multiyear procurement arrangements (instead of annual tendering)	Weak	Strong	Strong	Strong	Strong	Strong	N/A	N/A
Reduce lead time for products—especially single-source products	Medium	Strong	Strong	Weak	Weak	Strong	N/A	Strong

Source: Authors’ analysis of data described in text.
Note: N/A is not applicable.

- Pricing and the budget available for procurement from different financing streams.

Considering all these factors is an overwhelming task for the already strained national AIDS control programs and procurement offices, especially since the information is not available at a single source—extensive searching and comparing is necessary and, because this information keeps changing, this multivariate process must be repeated each time antiretrovirals are purchased. National AIDS control programs and procurement offices have strong incentives to access the information, but struggle with capacity constraints.

Manufacturers and active pharmaceutical ingredient producers would also benefit from having global information on antiretroviral regimens and quantities selected in each country. Such information would help them plan. However, financing organizations now appear to have only a medium incentive to create an integrated source for this information and so enable efficient and timely access to all stakeholders.

Obtain multiyear funding commitments from donors for antiretroviral procurement

To encourage longer-term planning by national AIDS control programs and procurement offices, financing organizations not only must provide large amounts of funds, but must also commit—or at least credibly signal—future funding amounts. More predictable funding would help the national AIDS control programs and procurement offices plan future antiretroviral purchases more accurately and allocate

treatment dollars more effectively. For example, a national AIDS control program’s decision to offer free second-line treatment will depend partly on its confidence in the future availability of funds. Unpredictable funding leads to higher purchase prices and more emergency shipments. When donor funds become available only late in a financial year, the pressure to spend allocated budgets in the remaining time leads to inefficient purchasing.

Making funds more predictable can be problematic for many financing organizations because they lack full control over their future resources. For bilateral donors, national governments often make intermittent determinations about funding allocations to donor agencies. For multilateral donors, the challenge is even greater, as many depend on diverse groups of donor countries and private foundations for their resources.

Since these external constraints are likely to persist, financing organizations must avoid setting unrealistic funding expectations that cannot be met later. Pledge-guaranteed financing arrangements are one way to ensure greater short-term predictability in financing, and to reduce the uncertainty arising from gaps between committed and disbursed funds.

Have multiyear procurement arrangements (instead of annual tendering)

Annual tendering for antiretroviral purchases is an extremely cumbersome and time-consuming process, often leading to delays and stockouts. The inability to make and commit to longer-term orders can thus contribute to a need for emergency shipments. Annual tendering also compromises the

ability of purchasers to negotiate better prices with manufacturers.

National AIDS control programs and procurement offices could benefit immensely from the flexibility to negotiate multiyear framework contracts with high-quality antiretroviral suppliers. The countries could then purchase the quantities required for each planning cycle under the terms—including pricing terms—set in the framework contract. They could operate their HIV/AIDS programs with a truly demand-driven antiretroviral supply chain, rather than with the present supply-driven system. Framework contracts could also enable some suppliers to offer some countries better prices because of guaranteed business.

Many financing organizations—and the national tender boards of some countries—now require procurement offices to follow a strict annual tendering process, to make procurements as transparent and controlled as possible. This measure causes significant losses to overall efficiency, with cascading harmful effects on the antiretroviral supply chain as a whole.

Reduce lead time for products—especially single-source products

Shorter lead times would improve planning for drug requirements, reduce needs for buffer stocks, and accelerate patient enrollments. Financing organizations, shipping agents, and supply side facilitators all have strong incentives to reduce production and delivery lead times for antiretrovirals. PEPFAR, through its Supply Chain Management System, has established three regional distribution hubs in Africa to reduce lead times by holding

antiretrovirals (and other goods) closer to recipient countries.

Manufacturers do not have strong incentives for reducing lead times, since doing so is likely to require significant capital investment or working capital. Aside from technological advances, a manufacturer's most effective strategy for reducing lead times would be to hold set volumes of a product in inventory. But that is expensive for manufacturers, who would need to increase their working capital and their cash flow flexibility. An alternative would be for manufacturers to switch production lines over to the required products as soon as new orders are confirmed. But that would increase production and operation costs—most manufacturers do not switch production lines until they have enough orders to produce the most cost-effective batch sizes.

Better demand forecasts can help manufacturers avoid these misalignments, allowing them to plan ahead and avoid the inefficiencies arising from small-batch production. Supply-side facilitators have helped some manufacturers reduce antiretroviral prices with better demand forecasts—but it is not clear whether these efforts have also significantly reduced lead times. To shorten lead times without undue financial burdens on manufacturers, innovative strategies are needed.

Finally, lead times from the planning of requirements to order placement are also too long, making better procurement processes a critical unmet need.

Incentives for stakeholders to help meet key needs identified by manufacturers and active pharmaceutical ingredient producers

Incentives for helping to meet these needs are rated for each stakeholder in table 2.3.

Have more predictable demand (orders)

As demand for antiretrovirals remains very uncertain, manufacturers and active pharmaceutical ingredient suppliers must develop supply-planning mechanisms to avoid overstocking or understocking. More predictable demand would benefit manufacturers and active pharmaceutical ingredient suppliers, who would benefit from longer-term production batch planning, better pricing arrangements for raw materials and, thus, lowered production costs through overall economies of scale.

Similarly, shipping agents could do better capacity planning if they knew future demand with more certainty.

But national AIDS control programs and procurement offices do not stand to benefit directly from making their orders more predictable. The possible indirect benefits to them—lowered prices, better lead times from manufacturers—are not now considered in their decisions about activities or resource priorities. Financing organizations, too, lack strong incentives to make demand more predictable for suppliers. Maintaining a healthy supply market is not viewed by many financing organizations as one of their core activities.

Obtain prompt payment from countries and national AIDS control programs

Procurement offices often inflict lengthy payment terms on antiretroviral manufacturers and suppliers. That leads to larger requirements for upfront payments before firm orders can be placed—further delaying the already slow and cumbersome procurement process.

Manufacturers and active pharmaceutical ingredient suppliers have strong incentives to ensure that they

Table 2.3. Stakeholder incentives for helping to meet the key needs identified by manufacturers and active pharmaceutical ingredient producers

<i>Key unmet need</i>	Financing organizations	National AIDS control programs	Procurement offices	Active pharmaceutical ingredient producers	Manufacturers	Supply-side facilitators	Shipping agents	Delivery-related stakeholders
Have more predictable demand (orders)	Weak	Weak	Weak	Strong	Strong	Strong	Strong	N/A
Obtain prompt payment from countries and national AIDS control programs	Medium	Weak	Weak	Strong	Strong	Strong	Strong	N/A
Find a simple, effective way to compete for business globally (rather than country by country and client by client)	Weak	Weak	Weak	Strong	Strong	Strong	N/A	N/A

Source: Authors' analysis of data described in text.
Note: N/A is not applicable.

are paid on time. To compensate themselves for uncertainty about payment, manufacturers sometimes build added costs into their product pricing. Smaller antiretroviral suppliers suffer the most from late payments, as they must fund the resulting shortfalls with expensive overdrafts and high-interest working-capital loans.

Procurement offices and national AIDS control programs have only weak incentives to expedite their own payments.

Find a simple, effective way to compete for business globally (rather than country by country and client by client)

The transaction costs for manufacturers of doing business country by country are high, especially in low-income countries with small markets. Many manufacturers have only a small in-country presence.

To reduce these transactional costs, manufacturers appoint distribution agents in low-income countries, to bid on their behalf on government tenders. That creates another intermediary in an already complex supply chain, further reducing both its efficiency and its transparency. And as new and smaller suppliers enter the antiretroviral market—with new second-line or enhanced first-line treatments—they generally lack the experience and resources to do business with country governments one by one.

Manufacturers, active pharmaceutical ingredient suppliers, and supply-side facilitators thus have strong incentives to simplify the business by creating a larger antiretroviral market. Procurement offices and national AIDS control programs have no clear incen-

tives to simplify the business for manufacturers with a global antiretroviral market. They do not see eliminating differences between national markets as an important aim. Nor do financing organizations have strong incentives to simplify the business—they do not see it as part of their core mandate.

Incentives for stakeholders to meet key needs identified by delivery-related stakeholders

Incentives for helping to meet these needs are rated for each stakeholder in table 2.4, next page.

Better coordination among delivery-related stakeholders in countries

Antiretroviral delivery involves many stakeholders, including central medical stores, government-run antiretroviral treatment sites, faith-based organizations, private hospitals and clinics, nongovernmental organizations, and national technical and policy institutions. Roles commonly cross-cut among them, making it difficult to define each player with a clear direct or indirect involvement in delivery. However, most countries with high HIV/AIDS prevalence have now established suprasectoral national AIDS coordination programs to coordinate multisectoral treatment and prevention strategies. Although that measure has solved many coordination problems, some challenges remain.

The national AIDS control programs' mandate for setting overall national AIDS strategies is clear. But there still remain conflicting roles in the coordination of the delivery of antiretrovirals through different channels. Policy and technical assistance to national AIDS

control programs and Ministries of Health is often lacking in this context.

Access to accurate, current information on antiretroviral consumption (requiring strengthened management systems for order fulfillment and inventory control)

The flow of antiretrovirals into and through the supply chain depends on the flow of consumption data back up the system, informing national operational and management decisions. Data on the quantities of drugs dispensed to patients, and the number of people on each regimen, can be collected at antiretroviral treatment sites. But archaic communications infrastructures and the lack of reporting budgets lead to poor data collection.

To ensure that the supply chain for antiretrovirals is demand-driven, some countries (Zambia, Kenya, Uganda, Tanzania, Zimbabwe) have implemented “no report, no product” policies for their public sector antiretroviral supply chains. Such policies create incen-

tives for antiretroviral treatment clinics to record data and to report those data to the national level: in principle, if they do not report data on consumption and stock on hand, they will not receive supplies from the central medical stores. However, the incentives to record and report consumption data to the national level are far from robust—especially where human resources to record the data are scarce. If the data were more systematically collected and shared, they could be used to forecast national antiretroviral demand better, and hence to forecast global demand.

In a few instances, national AIDS control programs have invested significantly to gather data and information. Such investments have made forecasts for antiretrovirals more accurate, and have helped to make some antiretroviral treatment programs very successful. Brazil’s national AIDS control program, for example, ensures that each AIDS drug-dispensing unit in the country has a computer system to track drug consumption and drug stocks. The unit sends these data to the

Table 2.4. Stakeholder incentives for helping to meet the key needs identified by delivery-related stakeholders

<i>Key unmet need</i>	Financing organizations	National AIDS control programs	Procurement offices	Active pharmaceutical ingredient producers	Manufacturers	Supply-side facilitators	Shipping agents	Delivery-related stakeholders
Better coordination among delivery-related stakeholders in countries	Strong	Strong	Strong	N/A	N/A	Strong	N/A	Strong
Access to accurate, current information on antiretroviral consumption (requiring strengthened management systems for order fulfillment and inventory control)	Medium	Strong	Strong	N/A	N/A	Strong	N/A	Strong
Better transportation to ensure regular distribution schedules	Medium	Strong	Strong	N/A	N/A	N/A	N/A	Strong
More technical capacity for staff to manage inventory and logistics	Medium	Strong	Strong	N/A	N/A	Strong	N/A	Strong

Source: Authors’ analysis of data described in text.
Note: N/A is not applicable.

program's headquarters in Brasilia at the end of each day. This measure has done much to help Brazil's antiretroviral program succeed.

Financing organizations and program implementers have begun to realize the importance of collecting and sharing consumption data—but they have not yet been very successful at creating an adequate system of rewards, incentives, and investments to collect and report the data systematically. Financing organizations do not always work in a coordinated manner; often they help to collect consumption data only from their own programs or clinics. In countries where antiretroviral treatment clinics are fragmented among many public, private, and mission donors, even though all the clinics are under the national AIDS control program, their consumption data reporting varies significantly. Data collection is not based on a structure that promotes the linkage of comparable data or the sharing of information within and across local, national, and global levels. National health management information systems need strengthening; particularly, they need a standardized, cost-efficient way to collect data on order fulfillment, product availability, and inventory control.

Better transportation to ensure regular distribution schedules. The distribution of antiretrovirals to treatment sites depends on predictable, reliable transport.

Although national AIDS control programs—and all other delivery-related stakeholders—acknowledge this, transport remains a fairly neglected link in the antiretroviral supply chain.

Financing organizations have funded many grants to buy new vehicles, but they have often done so without improving transport management for the antiretroviral supply chain. That has often led to inefficient use of already scarce transport resources.

Without proper systems for vehicle allocation, asset-tracking and maintenance management, and the like, financing organizations are reluctant to fund more transportation assets for the supply chain—often they cannot see the impact of such investments. Low in-country capacity for transportation management makes it difficult to keep regular distribution schedules, leading in turn to stockouts (or to a need for larger buffer stocks).

More technical capacity for staff to manage inventory and logistics

As the flow of antiretrovirals and HIV/AIDS commodities increases, the goods that delivery-related personnel must manage at every stage of the antiretroviral supply chain become more diverse and more complex. Those handling logistics and distribution often lack the training or the experience needed to serve a large patient base with a consistent, reliable flow of complex goods. The lack of staff capacity is most severe at health centers where healthcare workers with various other responsibilities must also help with logistics and inventory management.

Delivery-segment stakeholders, national AIDS control programs, procurement offices, and supply-side facilitators all recognize human resources as a key need and all have strong incentives to add staff capacity. But human resources receive little attention from large financing organizations. Supply-

chain management systems, and a few grants for health-systems strengthening from the Global Fund and the World Bank, are now only beginning to address this need.

Recommendation for building a more effective, efficient supply chain—create a global electronic marketplace for antiretrovirals

To meet the key needs for an effective, efficient antiretroviral supply chain identified in chapter 1—and to strengthen some of the weaker stakeholder incentives discussed in chapter 2—the authors’ recommendation is to create an electronic marketplace for global antiretroviral procurement.

This chapter presents analysis to indicate that a global electronic marketplace, or e-marketplace, is an innovative and pragmatic solution with a possible positive effect in many countries and with the potential to help stakeholders meet their key needs while better aligning their incentives.

This chapter describes the proposed global e-marketplace, explaining how it would address unmet needs in the antiretroviral supply chains while improving stakeholder incentives. In addition, the chapter considers the costs and benefits of the e-marketplace, discusses its technical feasibility, and presents a possible rollout strategy and timetable. It is suggested that the e-marketplace could be established within a few years.

What is a global electronic marketplace—and how would it work for antiretrovirals?

A marketplace is a location, physical, or virtual market where buyers, sellers, financiers, promoters, regula-

tors, and other stakeholders can meet to transact, monitor, view, or provide information. An electronic marketplace is a virtual marketplace that:

- Provides decision-makers with pre-screened, reliable information (such as prices, product availability, lead times, and payment terms) at a single online location
- Enables instant purchasing
- Enables the instant transfer of money from buyers to sellers
- Enforces commitments from both buyers and sellers, making all transactions binding
- Screens possible participants before letting them join the marketplace (in some cases, this function may extend to participant selection)
- Makes all transactions transparent, putting all buyers and sellers on an equal footing (all receive the same offers and know what is being offered)
- Enables voluntary participation by stakeholders while enforcing its

terms (none can participate in the e-marketplace without adhering to its policies and guidelines)

- Uses a common, robust technology platform.

The proposed e-marketplace for antiretrovirals would help businesses sell products and services to other businesses and governments. For example, an antiretroviral manufacturer would offer its products on the marketplace for sale to national AIDS control program procurement officers, nongovernmental organizations, and faith-based organizations.

The idea of an electronic marketplace where independent organizations buy and sell products is not new. An example of an existing e-marketplace for the health sector is the World Health Organization's WebBuy catalogue, which was developed with support from the United Nations Office for Project Services and has been operating for several years. World Health Organization country offices use the catalogue to buy health goods and other products. WHO's headquarters does the preliminary work of identifying high-quality suppliers and negotiating sale terms and conditions. After technical and financial screenings, WHO posts a list of products and approved suppliers with their prices, terms, and conditions. Country offices order directly from the catalogue. After each order is placed and confirmed at headquarters, the sale amount is deducted from the country's budget.

How the proposed e-marketplace would meet key needs for a more effective, efficient antiretroviral supply chain

Building a global e-marketplace for antiretrovirals would meet—in whole or in part—many of the key needs identified by stakeholders interviewed for this report (see chapter 1 and annex A); it would not, however, address the need for in-country data capture and logistical capacity. To address these needs, separate strategies would need to be developed and implemented country by country.

The ability of the e-marketplace to meet each of the key needs identified by stakeholders is assessed in table 3.2, next page

Costs and benefits of the proposed e-marketplace for antiretrovirals

Once stakeholders have agreed in principle to create the proposed electronic marketplace, and after an agreed-on rollout strategy is formulated, a thorough analysis of the system's costs and benefits—using both quantitative and qualitative variables—would be required. The proper way to do such a cost-benefit modeling analysis would depend on the scale and scope of the marketplace. However, the analysis would have to include both financial and nonfinancial components. A summary of cost and benefit types for each stakeholder group appears in table 3.3, page 38.

More generally, an e-marketplace for antiretrovirals would produce two

Table 2.4. Stakeholder incentives for helping to meet the key needs identified by delivery-related stakeholders

<i>Stakeholder</i>	<i>Key unmet need</i>	<i>Probable effect of creating a global electronic marketplace for antiretrovirals</i>
Financing organizations	Develop coordinated forecasts for funding HIV/AIDS programs, and coordinated antiretroviral requirements, with countries and donors	If some of the major donors join the e-marketplace or promote its use, the e-marketplace could help to develop coordinated forecasts by consolidating data from transactions.
	Expedite disbursements of funds while ensuring acceptable performance by grantees	The e-marketplace could significantly expedite disbursement of funds related to procurement, reducing intervals from months to a few days. In addition, more efficient procurement through the e-marketplace could speed up expenditures—and hence disbursements—related to program implementation.
National HIV/AIDS programs	Access global and national information related to antiretroviral selection and quantification	The e-marketplace would help to meet this need by aggregating and making available much more information in this category.
	Obtain longer multiyear funding commitments from donors for antiretroviral procurement	The e-marketplace would not necessarily lead to longer multiyear commitments from donors; however, donors might find a mechanism to support longer multiyear commitments if the e-marketplace tool were made available to them.
Procurement agencies	Access global and national information related to antiretroviral selection and quantification	The e-marketplace would help to meet this need by aggregating and making available much more information in this category.
	Have multiyear procurement arrangements (instead of annual tendering)	Multiyear procurement arrangements would be easy to implement and supervise and would result in lower costs and increased efficiency. These benefits may result in stakeholders supporting multiyear procurement.
	Reduce lead time for products, especially for single-source products	The e-marketplace, with its capacity for order aggregation, would make orders significantly more predictable for manufacturers; it would therefore meet this need by reducing lead times. A requirement that manufacturers hold minimum amounts of buffer stocks would further reduce production lead times.
Active pharmaceutical ingredient manufacturers	Have more predictable demand (orders)	The e-marketplace, with its capacity for order aggregation, would help to address this need by making orders significantly more predictable for manufacturers.
Generic and originator goods manufacturers	Have more predictable demand (orders)	The e-marketplace, with its capacity for order aggregation, would help to address this need by making orders significantly more predictable for manufacturers.
	Obtain prompt payment from countries and national AIDS control programs	The e-marketplace would address this need by automatically transferring funds from donors' accounts to manufacturers' accounts on an agreed-on date.
	Find a simple, effective way to compete for business globally (rather than country by country and client by client)	Whether the e-marketplace would meet this need would depend on how many countries and organizations agreed to purchase through the e-marketplace. The more buyers join the e-marketplace, the better able it will be to meet this need.
Supply-side facilitators	None	N/A
Exporters and international shipping agents	None	N/A
Delivery-related stakeholders	Better coordination among delivery-related stakeholders in countries	The e-marketplace would not meet this need.
	Access to accurate, current information on antiretroviral consumption (requiring strengthened management systems for order fulfillment and	The e-marketplace would not meet this need.
Delivery-related stakeholders	Better coordination among delivery-related stakeholders in countries	The e-marketplace would not meet this need.
	Access to accurate, current information on antiretroviral consumption (requiring strengthened management systems for order fulfillment and inventory control)	The e-marketplace would not meet this need.
	Better transportation to ensure regular distribution schedules	The e-marketplace would not meet this need.
	More technical capacity for staff to manage inventory and logistics	The e-marketplace would not meet this need.

Source: Authors' analysis of data described in text.

Note: N/A is not applicable.

Table 3.3. Types of costs and benefits from an e-marketplace for each stakeholder group

<i>Stakeholder</i>	<i>Cost types</i>	<i>Benefit types</i>
Donors and financing organizations	<ul style="list-style-type: none"> • Initial cost of establishing new structures to participate in this process • Ongoing cost of collecting, gathering, and assessing information 	<ul style="list-style-type: none"> • More efficient use of funds • Faster implementation of donor-funded health programs • More transparent use of funds • Reduced product costs
National HIV/AIDS control programs and procurement offices	<ul style="list-style-type: none"> • Ongoing cost of collecting, gathering, and assessing information 	<ul style="list-style-type: none"> • More efficient procurement • Reduced transaction costs for drug selection, ordering, and payment • Reduced product prices • Reduced lead times for orders • Fewer stockouts and treatment interruptions, yielding better health outcomes
Suppliers	<ul style="list-style-type: none"> • Initial cost of establishing new structures to participate in the e-marketplace—including the cost of negotiating and establishing new terms and conditions with the system • Ongoing cost of reformulating existing relationships with distributors 	<ul style="list-style-type: none"> • Increased market access, ensuring a level playing field for all competitors • Increased market size • Reduced marketing and sales costs • More predictable future demand (orders) • Prompt payment for orders filled
E-marketplace operator	<ul style="list-style-type: none"> • Initial cost of setting up the e-marketplace • Ongoing cost of operations, including human-resource costs; technology costs; and (most significant) costs for collecting, aggregating, updating, and assessing all required information 	N/A

Source: Authors' analysis of data described in text.
 Note: N/A is not applicable.

types of gains: process efficiency gains and competitive efficiency gains.

- Process efficiency gains would result from streamlined, automatic purchasing through the e-marketplace, which would reduce administrative and transaction costs. In addition, some parts of procurement would take less time. Some parts would work better. And monitoring the quality of suppliers would be easier.
- Competitive efficiency gains would result from the large overall volume of purchases through the e-marketplace, which would increase the purchasing power of all buyers and reduce their purchasing costs. The e-marketplace would also increase competition by helping buyers identify high-quality sources and by stimulating the creation of new, high-quality sources.

Even for products with few suppliers or a single supplier, where there is limited possibility of reducing price through competition, the e-marketplace would help in aggregating demand—making orders more predictable and products more available by shortening lead times.

Benefits and drawbacks of the e-marketplace for critical stakeholder groups

The stakeholders that will be most critical to the success of the proposed e-marketplace—by supporting its creation and using it—are financing organizations, national AIDS control program, procurement offices, and manufacturers of high-quality antiretrovirals. (Other stakeholders in the antiretroviral supply chain, though generally important for the operation of

the e-marketplace, are less critical for creating the required policies and for getting the system started.)

All of these critical stakeholder groups would realize benefits from the e-marketplace. Some, but not all, might also find that the proposed system has disadvantages for them.

Financing organizations.

The e-marketplace would bring three benefits to financing organizations:

- It would speed the use, and therefore the disbursement, of funds.
- It would make procurement more transparent.
- It would automatically capture procurement data.

A possible difficulty facing the e-marketplace for financing organizations is that it would require their coordination and joint participation—whereas, until now, they have relied on their own systems to perform some of their functions. This has built inertia into the systems that may be difficult to change.

Just as financing organizations now have only weak incentives to help manufacturers predict demand more accurately—for example, by developing coordinated antiretroviral requirements, and funding forecasts for HIV/AIDS programs, with countries and other donors (see chapter 2)—so they have only weak incentives to invest in a global database for information related to antiretroviral selection and quantification. Creating the proposed e-marketplace would require only a small, bundled investment that need not conflict with the financing organizations' institutional constraints or strategic mandates.

Certainly, not all financing organizations have the same incentives to invest in creating the e-marketplace. Some have their own vertical systems in place. PEPFAR might prove most readily inclined to support the e-marketplace. If the Global Fund gears up to implement its voluntary pooled procurement, it could use the e-marketplace for its grantees.

The e-marketplace would require financing organizations to submit lists of grantees with open grants. It would also require them to submit lists of antiretrovirals and manufacturers eligible for procurement with their financing. Finally, it would require them to create incentives for grantees to buy antiretrovirals through the e-marketplace, rather than directly from manufacturers.

National AIDS control programs.

The e-marketplace would bring three benefits to national AIDS control programs:

- It would make goods procurement more efficient.
- It would make delivery more predictable.
- It would shorten lead times for orders.

These benefits would, in turn, improve downstream supply chain performance and program outcomes.

No disadvantages of the e-marketplace for national AIDS control programs were identified.

National AIDS control programs now have only weak incentives to make demand more predictable and to expedite payments to suppliers. The e-marketplace will, sooner or later, create large incentives to participate in the system that meets these needs—such

as reduced prices and better delivery terms.

In countries in conflict, and in other places where capacity is low, national AIDS control programs would be most likely to join the e-marketplace quickly. Also, subcontractors to national AIDS control programs that do their own procurement—nongovernmental and church-based organizations, for example—would be able to join quickly, being less hampered by bureaucracy.

The e-marketplace would require national AIDS control programs to provide it with information on the first- and second-line antiretroviral regimens that are recommended in the country, the registration status of each drug in the country, and so forth.

Procurement offices

The e-marketplace would bring four benefits to procurement offices:

- It would make procurement simpler and faster, reducing the lead time for orders.
- It would collect, in one location, all information about procurement (though it would not collect information about consumption).
- It would help procurement offices identify and select suppliers that meet the quality standards imposed by financing organizations—now a cumbersome task.
- It would help procurement offices negotiate better prices, yielding overall savings for procurement budgets.

A disadvantage of the e-marketplace for procurement offices is that it would shrink their role—possibly so much that the national AIDS control program could absorb it. In addition, it would limit opportunities for procurement of-

fices to charge hidden fees. Such transparency is not always welcome.

Like the national AIDS control programs, procurement offices now have only weak incentives to help suppliers more accurately predict demand—and they have only weak incentives to expedite payments to suppliers. The e-marketplace would do these things without imposing new burdens on procurement offices. And over time, as the e-marketplace proves that it can help procurement offices obtain lower prices and better delivery terms, procurement agents would come to see how contributing to coordinated global planning for antiretrovirals through the e-marketplace benefits them. That would create stronger incentives for procurement offices to support the system.

As buyers on the e-marketplace, procurement offices would provide the system with information about their orders (for details see box 3.1, next page)—both in advance, based on annual procurement plans, and also when placing orders. The procurement offices would also need to submit the results of preshipment quality inspections and similar information.

Manufacturers of high-quality antiretrovirals.

The e-marketplace would bring four benefits to high-quality antiretroviral manufacturers:

- It would give them access to a much larger market.
- It would save costs by guaranteeing that purchasers pay them promptly.
- It would save costs by reducing their marketing expenses.
- It would save costs by making demand more predictable.

One disadvantage of the e-marketplace for manufacturers is that it could lower product prices by increasing competition, giving purchasers more bargaining power. Another is that the e-marketplace would limit manufacturers' ability to price products differently for different countries.

About 28 manufacturers produce high-quality antiretrovirals. Despite the disadvantages of the e-marketplace for these manufacturers, some would willingly participate in the hope of increasing their market shares. Manufacturers of single-source regimens would also be likely to join.

The companies that would be least likely to join the e-marketplace at the outset are those with large market shares, existing marketing infrastructures, and highly differential pricing. Such companies would wait to see how the e-marketplace could benefit them before deciding to participate in it.

Manufacturers have only a weak incentive to reduce production lead times. They are hesitant to increase their inventory, and so take on additional risk, before they have received firm orders. The e-marketplace will create risk-pooling effects that allow each manufacturer to build its stock. In addition, the e-marketplace will reduce manufacturers' excess-inventory risks by making more and better information about demand available. That will create stronger incentives for manufacturers to reduce production lead times by holding stocks of intermediate or finished goods on hand.

The e-marketplace would require manufacturers to provide it with information about their product pricing, their delivery and shipment terms, their credit and payment terms, the

Box 3.1. How the global electronic marketplace for antiretrovirals would work

How would the proposed e-marketplace for antiretrovirals work? Here is a hypothetical example.

The national AIDS control program of country Q has obtained Global Fund Round 6 funds for the treatment and care of HIV/AIDS patients. Two key parts of the grant are to expand the treatment of patients on first- and second-line regimens and to put more pediatric patients on treatment. The national AIDS control program estimates the total procurement budget at US\$12 million for the first year to treat X first-line, Y second-line, and Z pediatric patients. The national AIDS control program's procurement officer logs onto www.antiretroviral-marketplace.org to start procurement. The e-marketplace guides the officer through a series of prompts, including:

- *Country name, user name, and password.* The national AIDS control program procurement officer enters the requested information. The e-marketplace, after identifying the user, pulls up information on the donors that have agreed to fund the national AIDS control program and the purpose of such funds.
- *What funding source do you plan to use for this procurement?* The procurement officer is given a choice of several dropdown menu options. The officer selects the Global Fund to fight AIDS, Tuberculosis and Malaria. The e-marketplace shows information on the budget provided from the Global Fund for antiretroviral procurement.
- *Which round of funding do you plan to use?* The procurement officer selects Round 6. The e-marketplace provides information on the budget available for Round 6 and the purpose of such funds.
- *What antiretroviral combinations do you plan to buy?* The procurement officer selects products for first-line, second-line, and pediatric patients. The e-marketplace shows antiretrovirals registered in the country and included on the Global Fund's compliance list, along with other information (prices, lead times, terms and conditions, and the like).
- *Possible suppliers, desired quantities, procurement dates?* The procurement officer enters the requested information, selecting suppliers from a list provided. The e-marketplace shows information on the total cost of procurement, the availability of funds, the authorization to spend those funds, and the lead time for receiving the products ordered.
- *Choose antiretroviral combinations and click to purchase.* The procurement officer enters the requested information and places the order. The e-marketplace transmits the order to manufacturer. Funds are deducted from the budget of the national AIDS control program and from the budget that the Global Fund has allocated to it. This money will move from the Global Fund's account to the manufacturer's account according to agreed-on trade terms.

- *Your order has been placed. You can track this order online using order number AB12. Your budget balance for Global Fund Round 6 antiretroviral procurement is \$100.00. If you are done, please exit the website.* The procurement officer exits the e-marketplace, which will track the status of the order with the manufacturer until the products purchased are received by the national AIDS control program.

quality status of their products, the locations of their warehouses and manufacturing plants, and the intellectual-property status of their products in each country.

Technical feasibility

The success of existing electronic marketplaces for health and other goods suggests that, in principle, an e-marketplace for antiretrovirals should be technically feasible. But what features of the proposed system are specific to antiretrovirals? And how feasible is the creation of an e-marketplace with all of those features? Although the proposed system may seem to create special challenges, the functions that it will need to perform and the conditions for its success—described below—are all well within the reach of donors.

- Accessing detailed information and making it available. By far the greatest challenge for the e-marketplace, this function must accomplish two sorts of tasks: data gathering (for cases where data is not already collected), and data aggregation (for cases where data is collected but is not effectively shared or is not shared at all). Although in most cases only data aggregation is required, the main stakeholders now have little or no incentive to share information. To succeed, the e-mar-

ketplace will need to increase such incentives. That will be difficult, but it is not impossible.

- Making transactions binding. The e-marketplace must automatically ensure that orders are binding. Donors' and buyers' budgets must be debited. Suppliers' accounts must be credited. (Without the ability to make transactions binding, the e-marketplace would become merely an information portal—less valuable, although still useful.)
- Acquiring a robust technology platform. For the design of the e-marketplace, the technology platforms of several existing electronic marketplaces and exchanges could be licensed—possibly at little or no cost. (Preliminary discussions with senior management at eBay France suggest that some exchanges might consider supporting the e-marketplace as a way to show corporate social responsibility.)
- Having a trusted host organization to manage the e-marketplace. One possibility is an industry-owned consortium—a common model today (for example, Covisint is a marketplace owned by automotive companies). Alternatively, financing organizations could jointly support the e-marketplace, and would form a consortium for its governance. Another possibility, also common

today, is third-party ownership with a user fee for procurement. For example, supply-side facilitators could create the e-marketplace; each donor would then pay a small fee to access it. If stakeholders agreed on this approach in principle, they would then have to explore acceptable governance structures.

- **Maintaining financial sustainability.** The most common financial model for a marketplace is to charge a certain percentage on every transaction. Most procurement agents and buying organizations now operate in a similar way: the World Health Organization, UNICEF, IDA, and Crown Agents all typically charge from 2–8 percent of the value of goods (depending on volume and product category). It might be possible for a marketplace, because it operates more efficiently, to charge less than 1 percent on each purchase—especially if the total value of transactions on the marketplace is very large.
- **Attracting a critical mass of stakeholder participants.** Without participation by at least a few of the main stakeholders, the e-marketplace would not survive. At least one major donor must participate; several companies manufacturing first- and second-line drugs must participate; and at least a few buyers (national AIDS control programs, nongovernmental organizations, and faith-based organizations) must be on board at the outset.
- **Transacting a certain volume of purchases.** Only by transacting a certain volume of purchases can the e-marketplace demonstrate its marketing advantages for manufacturers,

suggest its purchasing advantages to countries and other buyers, and encourage donors—who are keen to improve on disbursement rates and other indicators of program success—to participate.

Recommended rollout strategy and timetable

The functions of the proposed e-marketplace for antiretrovirals fall into three categories (excluding its basic technology platform): information functions, transaction functions, and financial functions.

A first step in designing and rolling out the e-marketplace would be to identify existing activities for antiretrovirals in each of these three categories, and to strengthen one or more of them.

The licensed technology platform could then be deployed to link the selected activities, joining them in a single comprehensive approach. After an initial beta test with a limited number of stakeholders—allowing an assessment of how well the new system performs against specific criteria (speed, cost, availability, simplicity, and the like)—the e-marketplace would then be refined and expanded to include more countries, manufacturers, and donors.

Over time, the stakeholders that own and manage the e-marketplace might consider expanding its scope from that of a marketplace for antiretrovirals and related goods to that of a larger marketplace for health goods.

Depending on what approach is adopted—whether existing efforts are strengthened or new ones are created, whether an existing technology platform is licensed or a new one is built,

and whether the system begins with a small group of early adopters or with a larger group of stakeholders—the e-marketplace could have its beta test

(with a limited set of functions and products) within 12 months. An impact analysis would take another 3–6 months.

Concluding remarks



First, regardless of the significant efficiencies offered by the e-marketplace, it should not be considered as a substitute for strengthening countries' procurement capacity, but as a mechanism to assist countries during the interim period, as countries build their capacity for efficient and transparent procurement. This mechanism would also be most useful for newly launched products and where there is asymmetry between supply and demand for products.

Second, the e-marketplace's most attractive feature is the possibility of expanding it to many other products and types of products. For example, it might grow to encompass diagnostics, laboratory equipment, reagents, and maintenance services.

Third, as stated earlier, although this report focuses on antiretrovirals, it does not advocate a vertical approach targeting a single commodity group. Such an approach may appear to help the supply for a single product category,

but in the long-term may weaken the supply chain for other essential products. It is therefore of paramount importance to balance and build capacity for a vertical and horizontal approach—with both a specific disease focus and system-based solutions.

If the global electronic marketplace for antiretrovirals can achieve even a fraction of the benefits it promises, it will significantly increase access to antiretrovirals and, sooner or later, to other health goods as well.

Appendix A. Study aims, methodology, limitations, and definitions

This report was commissioned because it has been recognized that scaling up antiretroviral treatment programs would require a systematic analysis of the supply chains for antiretrovirals and other goods related to HIV/AIDS.

The report's key objectives were:

- To identify points in the antiretroviral supply chain where the main stakeholders can behave more efficiently and thereby increase access to antiretrovirals in developing countries. To identify stakeholders' incentives for actions that increase access to antiretrovirals
- To recommend policies that can mitigate supply-chain risk and better align stakeholder incentives, creating a more efficient supply chain and improving access to antiretrovirals in developing countries.

There were two key reasons the report looked specifically at the supply chain for antiretrovirals. First, extremely large sums of money were being devoted to antiretroviral procurement: for example, over the last five years, the U.S. government alone committed roughly US\$6 billion for antiretroviral drugs through the PEPFAR program. In many countries, the amounts of money are larger than any previously used to procure particular

health goods. Second, although reports suggest that the provision of HIV/AIDS services is becoming more integrated at facilities, the provision and supply of HIV/AIDS goods are not—they are becoming more vertical. In some cases, antiretroviral drugs are financed, ordered, collected, distributed, received, stored, and used separately from other essential medicines. In Mozambique, for example, AIDS drugs are airlifted monthly to provincial warehouses, whereas other health commodities are distributed quarterly in trucks. The effects of the antiretroviral supply chain on other health goods can only be analyzed once the antiretroviral supply chain itself is well understood.

Methodology

This report identifies key unmet needs in the antiretroviral supply chain and places them in three main groups depending on where they appear in the supply chain: in the supply segment, in the demand segment, or in the delivery

segment. The key unmet needs were identified through interviews with experts and through secondary research.

Next, the authors conducted interviews with decision-makers at stakeholder organizations. The objective was to assess existing incentives for each stakeholder to do what it takes to meet each key need for an effective, efficient antiretroviral supply chain. The authors used quasi-structured phone and in-person interviews, rather than formal surveys, because the flexibility offered by phone and in-person interviews allowed respondents to bring up new issues at will. Twenty-one interviews were conducted between July 2007 and December 2007. Respondents were asked to identify activities they considered key to improving access to antiretrovirals and to describe the roles of their organizations in providing antiretroviral treatment. All interviews were conducted by the authors. A similar methodology has been used in previous studies of healthcare value chains.

Based on the interviews, the authors rated the incentives for stakeholders in each category to do what it takes to meet key needs (ratings were strong, medium, weak, and N/A). The major incentive misalignments were highlighted. Finally, a policy recommendation was developed—the global electronic marketplace—for strengthening incentives to make the antiretroviral supply chain more effective and efficient, and ultimately to increase access to antiretrovirals.

Limitations

No large increase in access to antiretrovirals will be possible as long as over-

all health systems remain fragile. This report does not address behavioral, social, or medical issues. It addresses only particular weakness in the antiretroviral supply chain. Moreover, it focuses solely on the supply chain for antiretrovirals and not on those for other goods, such as HIV/AIDS test kits, laboratory supplies, or drugs for opportunistic infections—even though, without those health goods, no antiretroviral treatment center could be effectively run.

Also, access to antiretrovirals cannot be increased until the constraints on expanding voluntary counseling and testing—and other auxiliary services—have been addressed. The supply-chain and related systems for such services at antiretroviral treatment clinics should mesh smoothly with the antiretroviral supply chain. To put just one patient on antiretroviral treatment, from 3–20 individuals must be tested (depending on prevalence rates). Thus, the capacity for antiretroviral treatment in some countries is severely limited by the supply chain for testing equipment, chemicals, and laboratory reagents—a chain that is far more complex than that for antiretrovirals. Improvements in supply chains for other goods are thus critical for increasing access to antiretrovirals.

Defining access

To understand and categorize actions for improving access to antiretrovirals, a precise definition of access is needed. This report accepts a definition of access proposed by Penchansky and Thomas (1981) and later adapted to a public health setting by a World Health Organization-SEAM working group.

The definition distinguishes among four key parts of access to antiretrovirals: affordability, availability, accessibility, and acceptability leading to the provision of safe and effective products. Each part can be further defined and segmented, as shown in figure A1.

Many of the concepts central to this report have not always been defined or employed precisely elsewhere, and are understood differently by different readers. The glossary defines other key terms used in this report.

Figure A1. Access—its four dimensions and their definitions



Source: Management Sciences for Health 2001.

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