

PEOPLE  
that  
DELIVER

# Healthcare Supply Chains in Developing Countries

## SITUATIONAL ANALYSIS



**Acknowledgments**

The main author of this report is Paul Dowling of the USAID | DELIVER PROJECT. The author would like to acknowledge the contributions of the following people who provided input and reviewed the draft report: Kimberly Bardy and Kevin Pilz of the U.S Agency for International Development, Maeve Magner of RTT, Andrew Brown of the University of Canberra, and Carmit Keddem and Naomi Printz of John Snow, Inc.

**People That Deliver**

The conference, “People That Deliver,” is a global conference intended to improve health outcomes through promotion of workforce excellence in supply chain management. Hosted by the World Health Organization, the conference is mainly funded by the U.S Agency for International Development and the Reproductive Health Supplies Coalition through specific grants to Bioforce.

**Citation**

Dowling, Paul. 2011. *Healthcare Supply Chains in Developing Countries: Situational Analysis*. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 4.

**Abstract**

This paper examines the current situation for healthcare supply chains in low- and/or middle-income countries, how the public and private healthcare supply chains in these countries are organized, and how they perform using some key availability and affordability indicators. This paper is not intended to be a comprehensive analysis of how supply chain performance or medicine access can be improved; rather, it is a broad situational analysis of how these supply chains are currently organized and performing.

**Cover photo:** Pharmacy stores in Rwanda. Credit: Gary Steele, John Snow, Inc.

# Contents

- Introduction..... 1
  - Purpose..... 1
  - Medicine Access ..... 1
  - Scope ..... 2
- Healthcare Supply Chains in Low- and/or Middle-Income Countries—How Are They Organized? ..... 5
  - Public Sector ..... 5
  - Private—Not-for-Profit ..... 7
  - Private—Commercial..... 8
- Supply Chains in Low- and/or Middle-Income Countries—Comparative Analysis ..... 9
- How Well are Supply Chains Performing ..... 13
  - Supply Chain Performance in Developed Countries ..... 13
  - Supply Chain Performance in Low- and/or Middle-Income Countries ..... 13
  - Human Resources Issues..... 16
- Innovation in Low- and/or Middle-Income Country Supply Chains ..... 17
- Conclusion..... 18
- References..... 19
  
- Appendix A. Developing Country Supply  
Chain.....23



# Acronyms

3PL	third party logistics provider
ARV	antiretroviral
CHW	community health worker
CMS	central medical stores
EPI	Expanded Programme on Immunization
FBO	faith-based organization
HAI	Health Action International
LMIC	low- and/or middle- income country
LMIS	logistics management information system
MOH	Ministry of Health
MSF	Médecins sans Frontières
NGO	nongovernmental organization
RMS	regional medical stores
SME	social marketing entity
TB	tuberculosis
UNICEF	U.N. Children's Fund
USAID	U.S. Agency for International Development
WHO	World Health Organization



# Introduction

The World Health Organization (WHO) estimates that about one-third of the world's population lack access to essential medicines and diagnostics (WHO 2004i). In the poorest parts of Africa and Asia, this proportion increases to 50 percent. While the proportion of people lacking access declined from 1977 to 1997, the absolute number increased from 2.1 to 3.8 billion (WHO 2004i). By improving access to existing medicines and vaccines, an estimated 10 million lives per year could be saved (WHO 2004i). Medicine access remains one of the leading causes of poor health outcomes and affects the ability of countries to attain their Millennium Development Goals (MDGs). While many factors influence medicine access, the capacity of in-country supply chains to forecast, procure, and deliver essential medicines and other health supplies is a major constraint. Donors are expected to provide nearly \$10 billion worth of medicines to developing countries by 2011 (Ballou-Aares 2008; Global Health 2008). The impact of this investment will to a large extent be determined by the ability to efficiently forecast, procure, and deliver these supplies to where they are needed.

## Purpose

This paper examines the current situation for healthcare supply chains in low- and/or middle-income countries (LMICs), how the public and private healthcare supply chains in these countries are organized, and how they perform using some key availability and affordability indicators. This paper is not intended to be a comprehensive analysis of how supply chain performance or medicine access can be improved; rather, it is a broad situational analysis of how these supply chains are currently organized and performing.

## Medicine Access

The causes of poor access to medicines are complex and not just related to supply chain performance. The WHO framework for access (Figure 1) cites four medicine-specific factors that have to be in place to ensure availability and access.

**Figure 1. WHO Framework for Medicine Access**



There needs to be:

- Rational selection and use of medicines
- Affordable price for all actors including patients
- Sustainable financing mechanisms
- Reliable health and supply systems to deliver medicines to users.

While all of these factors are important independently, they are also interlinked and cross-cutting. For example, rational selection will ensure the most appropriate commodities are selected in relation to efficacy, quality, and cost-effectiveness, enabling more sustainable financing and increased affordability.

### Box 1. Essential Medicines

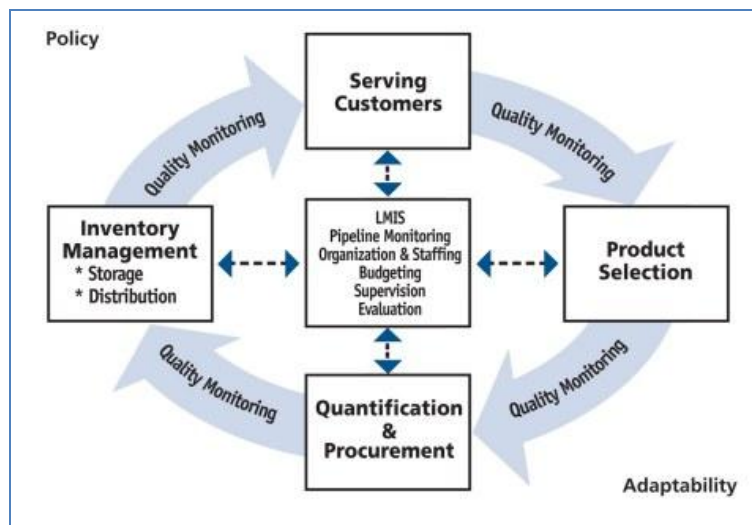
Essential medicines are those that satisfy the priority healthcare needs of the population. They are selected with due regard to public health relevance, evidence on efficacy and safety, and comparative cost-effectiveness. Essential medicines are intended to be available within the context of functioning health systems at all times in adequate amounts, in the appropriate dosage forms, with assured quality and adequate information, and at a price the individual and the community can afford.

## Scope

The paper defines *supply chain management* as “the set of activities involved in moving a product (in this case medicines, diagnostics and other health supplies) and its associated services from the ultimate supplier to the ultimate customer” (Jacoby 2009). For the sake of simplicity, this paper will use the term *medicines* to refer to essential medicines (Box 1) and other vital health supplies needed to provide services including consumables, diagnostics, condoms, vaccines, etc.

The main supply chain functions included are shown in Figure 2.

**Figure 2. The Logistics Cycle**



These include selection, quantification (or forecasting), procurement, inventory management, storage, and distribution. A well-defined logistics management information system (LMIS) provides linkages between these components. All of these functions must work together to ensure supply can meet demand. These functions operate at different levels within a country: central, regional/district,



and service delivery points. Additionally, there may be several distinct supply chains operating vertically within a country with many points of intersection and overlap and a diverse set of stakeholders. Finance is a key component of the supply chain, as the availability of funding determines what supplies can be procured and where and when supplies can be distributed. For this paper, financing is considered insofar as 1) sustainable financing is needed to build and maintain adequate supply chains, and 2) supply chain systems need to be coordinated with financing flows to ensure optimal performance.



# Healthcare Supply Chains in Low- and/or Middle-Income Countries—How Are They Organized?

We look first at the structure of medicine supply chains in LMICs followed by a brief examination for comparative purposes of those in developed countries.

In most LMICs, medicines are distributed through three systems:

- Public or government-run system
- Private not-for-profit
- Private commercial.

Appendix 1 shows a simplified schematic of a developing country medicine supply chain.

## Public Sector

The share of medicines distributed through the public sector for sub-Saharan Africa was estimated at 33.2 percent in 1990 (Bennett, Quick, and Velásquez 1997). These figures will vary greatly from country to country, from 16 percent in Senegal to 50 percent in Zimbabwe (Foster 1991). More recent estimates vary from 70 to 90 percent in Malawi, to 15 percent in Mali and 10 percent in Ghana (McCabe 2009). However, estimates based on value may be misleading, because a higher proportion of medicines distributed through the private sector are likely to be branded and innovator medicines, which are more expensive, thus inflating the private share.

The main public sector supply model in LMICs includes a public or parastatal entity responsible for procurement and distribution of health supplies to public sector outlets. This entity is often called a central medical stores (CMS) in Anglophone countries or Pharmacie D'Approvisionnement (or similar) in francophone countries; for simplicity, they will be referred to here as CMS. In some Pacific countries, pharmacy departments of ministries may play this role. CMS vary in the level of autonomy they have (Govindraj and Herbst 2010). Some CMS (e.g., Ghana, Malawi) are almost completely public sector entities run as a division of the Ministry of Health (MOH) while others have a large degree of operational and financial autonomy, for example the Centrale d'Achats des Médicaments Essentiels Génériques et des Consommables Médicaux in Burkina Faso has independent management structures, although the government has representatives that sit on its board. Regardless of any commercial goals, CMS are expected to play a role in increasing access to medicines.

The role and responsibilities of CMS also vary. Traditionally, the function of the CMS is to store and distribute medicines from a central store location to the next level of distribution, usually at regional or district level, though some CMS' also operate regional medical stores (RMS), which store and distribute products to the health facility level. Malawi has three RMS, while Senegal operates eight such RMS. In some countries, RMS carry out procurement, in others there is a separate procurement entity often under the auspices of the MOH, while in others procurement is partly or wholly decentralized to lower levels (e.g., in Ghana it is partly decentralized; in the Philippines it is almost completely decentralized).

The distribution process is generally driven by an order process, which occurs on a regular basis, either monthly or quarterly as determined by the individual MOH. There tends to be limited visibility into actual patient demand, stock on hand, and how products are managed in facilities. That is often the responsibility of a separate “pharmacy” department within the MOH or in devolved settings, local authorities. These structures are supposed to monitor facility performance in managing their medicines; however, they suffer from lack of resources, tools, and capacity to fulfill this function.

Although data are limited, there is a view among many commentators that CMS benefit from a degree of autonomy from the MOH (Ballou-Aares 2008; Govindraj and Herbst 2010). CMS with less autonomy from the public sector face problems in the following:

- Attracting and retaining professional staff due to poor wages and incentives
- Absence of shareholders, meaning less accountability.

A counterargument to this is that more autonomous CMS may lose sight of their public service function and may have incentives to focus on profitable business rather than access to essential medicines. CMS are responsible for supplying medicines to public sector health facilities. Facilities place orders either directly with the CMS or orders are placed on their behalf through an intermediate level (e.g., in Malawi, health facility orders are submitted to districts that verify them and submit them to one of three RMS). Public sector supply chains often follow administrative or bureaucratic structures (e.g., orders are often placed at provincial and/or district levels rather than at locations that optimize cost-effectiveness or performance). Distribution models tend to be either push or pull depending on whether the CMS or MOH determines how much ships where and when, and where the pull model is triggered by order requests received from the facilities.

Kitting, the process where individual, separate items are packed and shipped together usually in predetermined quantities, is still a feature of some supply chains in LMICs. While it may be appropriate for emergency settings where speed is critical, demand can only be estimated and waste tolerated; for routine supply chains, it is generally not used or appropriate.

As countries move toward decentralization, the role of CMS may change or even disappear. In the Philippines, there is no CMS; local governments procure medicines directly from local suppliers except for a limited quantity of “priority” medicines including for programs like Expanded Programme on Immunization (EPI) and tuberculosis (TB), which are supplied by the Federal Department of Health. The Philippines has a well-developed network of commercial distributors; while local procurement has advantages in reduced lead times, and consequently lower inventory levels, this fragmentation of procurement often leads to high procurement costs. A strong national medicines registration and quality assurance system is also required to ensure quality of available medicines.

Many programs are expanding the range and reach of services. For example, many countries are promoting community-based health services with cadres of community health workers (CHWs) providing services in their local communities. In Pakistan, Lady Health Workers provide services in the local communities, while in Ethiopia, health extension workers operate out of community-based health posts. In most cases, CHWs are supplied by a parent health facility adding another level to the supply chain. In Kenya, the number of sites offering voluntary counseling and testing for HIV increased from 200 in 2003 to 4,000 in 2009, posing new challenges for already fragile supply chains.

### ***Vaccines/Expanded Program on Immunization***

Vaccines in LMICs typically flow through a predominantly vertical supply chain, managed by national EPI programs, often with technical support from the U.N. Children’s Fund (UNICEF) and

WHO. This is mainly due to their unique product characteristics—in this case, cold chain requirements—although the campaign nature of much of vaccine distribution is also a factor. Vaccine supply chains are coming under new pressures (Optimize 2009):

- New, significantly more expensive vaccines are being introduced
- New product design features introduced to decrease wastage like single-use vials and prefilled syringes require significantly more space on trucks and in refrigerators.

There is less tolerance now for wastage (WHO cites wastage rates for some vaccines as high as 50 percent), driving the need to make vaccine supply chains more agile with increased automation. On the positive side, some newer vaccines do not require cold chain and utilize single-dose vials as opposed to the previous multipacks with consequential reductions in waste. The need for greater efficiencies and improved performance has led many of those involved in EPI supply chains to propose merging these supply chains with those of essential medicines; a recent pilot in Senegal by Optimize is distributing vaccines with other program supplies (Dicko 2011).

### ***Other Vertical Programs***

While in most countries there is a CMS responsible for distribution of essential medicines and other supplies, there may also be a number of vertical supply chains, particularly for certain programs that may or may not be managed by CMS. For example, in many countries, antiretrovirals (ARVs) and other HIV supplies may be distributed through a vertical supply chain. In many cases, the motivations for establishing these “vertical” supply chains are driven by concerns about the weaknesses of the existing supply chain and a desire for improved performance and accountability for program priorities, which are often prioritized and funded by direct donor support. The additional attention and resources these supply chains receive often means better performance than that for essential medicines. Examples of “verticality’s” include:

- In Malawi, ARVs are distributed to public sector sites by a third party commercial distribution company contracted by UNICEF.
- In Nigeria, contraceptives are distributed through a mainly vertical supply chain operated by the reproductive health program at federal, state, district, and local levels.
- In many countries, certain key supply chain functions (e.g., forecasting) may be carried out separately by programs (i.e., some functions are vertical while others are more “integrated”).

### **Private—Not-for-Profit**

There are often a number of autonomous private not-for-profit medicine supply chains operating in LMICs. These include systems operated by faith-based organizations (FBOs) and international or local development and humanitarian nongovernmental organizations (NGOs) such as Médecins sans Frontières (MSF), International Planned Parenthood affiliates, Save the Children, etc. In addition, social marketing entities (SMEs)<sup>1</sup> may operate supply chains or utilize commercial supply

---

<sup>1</sup> Social marketing is the application of commercial marketing techniques to promote behaviors that improve public health. SMEs distribute subsidized medicines (e.g., condoms, bed nets, oral rehydration salts) either through their own supply chains or through existing commercial distributors.

chains to distribute a limited range of medicines. In many countries, FBOs have come together to operate cooperative supply chains, for example the Churches Health Associations of Malawi, Ghana, and Zambia. In Ghana, the Churches Health Association provides about 30 percent of healthcare in Ghana through a network of 152 institutions (Ballou-Aares 2008) and operates a central warehouse sourcing products locally from private distributors or from the CMS.

These not-for-profit organizations often purchase medicines overseas through procurement agencies like the IDA Foundation or Mission Pharma. They often rely on donor funds for medicine purchases or for in-kind donations (e.g., UNICEF, the U.N. Population Fund, and the U.S. Agency for International Development [USAID]). As donors move toward direct budget support to governments (e.g., sector wide approaches and basket funds), they are becoming increasingly more reliant on government funds or access to public sector medicines. They are usually dependent on cost recovery for at least some of their funding and strive to keep prices affordable. Access to finance for procurement can be a challenge, as beneficiaries' purchasing power limits the sustainability of cost recovery. FBO facilities may be affiliated to the public sector (e.g., Malawi), NGOs may manage public sector facilities (e.g., Liberia), or SMEs may supply public facilities (e.g., the Philippines), further clouding the distinction between public and private channels. There are little data available as to how well these supply chains perform. International NGOs like MSF are known for their capacity in logistics, while national organizations like the Church Health Associations may suffer from resource limitations.

## Private—Commercial

The structure and importance of commercial supply chains for medicines varies from country to country. However, purchasing power of the public limits their significance in all LMICs. The following examples illustrate some of the variety of commercial models found.

In Mali, the commercial market for pharmaceuticals is highly consolidated with two wholesalers controlling about 80 percent of the market (McCabe 2009). These two wholesalers supply about 400 independent pharmacies throughout the country, with daily direct delivery to pharmacies in the capital Bamako and independent distributors to the rest of the country. By contrast, the commercial market in Ghana is much more fragmented with about 60 importers and 166 wholesalers supplying around 700 pharmacies and over 11,000 chemical shops.<sup>2</sup> In Malawi, there are 22 importers/wholesalers. UNICEF distributes ARVs to public sector facilities using a commercial network; this system is operated by a freight company with UNICEF supplying pharmaceutical oversight.

In many countries, public sector facilities procure supplies from the commercial sector. In many instances, for example Malawi and Ghana, this is officially allowed only in the event that the CMS is stocked out of the item in question; however, enforcement of this regulation is questionable. Also, public sector supply chains may also supply commercial or other private outlets.

---

<sup>2</sup> Chemical shops are retail outlets that are not operated by a licensed pharmacist and are only authorized to sell a limited number of medicines.

# Supply Chains in Low- and/or Middle-Income Countries—Comparative Analysis

There are different ways to dissect supply chains to assess their performance. This paper will use two organizing frameworks to analyze the characteristics of medicine supply chains: the first through an analysis of the supply chain functions, and the second by looking at ideal characteristics of well-performing supply chains. Comparisons between LMICs and developed country supply chains are included for illustrative purposes. It is worth noting that the organization and financing of LMICs and developed countries supply chains are completely different. The U.S. supply chain can be characterized by a high degree of automation and use of technology, high performance in terms of availability, lean inventory levels (stock levels measured in days), high levels of efficiency, daily or even more frequent deliveries, an increasing emphasis on security and quality assurance, and a high degree of private sector (commercial) participation. There is a high degree of visibility in terms of stock levels, etc. The U.S. medicine supply chain is well resourced, supplies are generally available to meet all demand, much of the supply chain is outsourced or directly operated by the commercial sector, and supply chain management is seen as a core business function.

## Comparison of Supply Chain Functions

Table 1 gives a brief comparative synopsis of the situation for supply chains in developed and developing countries, organized by supply chain functions.

**Table 1. Comparison of Developed and LMIC Medicine Supply Chains**

Function	Developed	LMIC
Selection	<ul style="list-style-type: none"> <li>• Regulatory body regulates what medicines can be distributed/marketed</li> <li>• Medical practitioners can prescribe although third party payers through reimbursement policies have role</li> </ul>	<ul style="list-style-type: none"> <li>• Limited ability to enforce national policies and regulations</li> <li>• Primarily driven by national essential medicine list (for public sector) although there are often exceptions</li> <li>• Standard treatment guidelines also significant determinants</li> </ul>
Forecasting	<ul style="list-style-type: none"> <li>• Carried out by manufacturers to plan production</li> </ul>	<ul style="list-style-type: none"> <li>• Carried out by in-country procurers (CMS) or programs to plan procurement—often constrained by poor data on demand or real demand hard to estimate due to limited supply</li> </ul>
Procurement	<ul style="list-style-type: none"> <li>• Framework contracts with multiple distributors, allows variable volume uptake based on real-time demand</li> </ul>	<ul style="list-style-type: none"> <li>• Fixed volume procurements based on forecasted demand and/or available financing, typically annual</li> <li>• Limited ability to do emergency procurements</li> <li>• Public procurement using third party funds often subject to World Bank regulation</li> <li>• Procurement often fragmented among government and (multiple) donors</li> <li>• May use procurement agents</li> </ul>

Function	Developed	LMIC
Medicine quality	<ul style="list-style-type: none"> <li>• Regulatory approvals needed.</li> <li>• High degree of quality assurance</li> <li>• New technology being deployed to counter risk of counterfeiting</li> </ul>	<ul style="list-style-type: none"> <li>• Third parties may impose stringent regulatory authority requirements; otherwise national regulatory approval</li> <li>• Batch testing to supplement</li> <li>• In-country testing capacity limited and may not be accredited</li> <li>• Limited pharmacovigilance</li> <li>• Significant counterfeiting, product diversion, and quality concerns</li> </ul>
Storage	<ul style="list-style-type: none"> <li>• High capacity</li> </ul>	<ul style="list-style-type: none"> <li>• Limited capacity, often poor storage conditions</li> </ul>
Distribution	<ul style="list-style-type: none"> <li>• Daily (or more frequent) delivery</li> <li>• Collection not a normal practice</li> </ul>	<ul style="list-style-type: none"> <li>• Delivery frequency may be monthly or quarterly</li> <li>• Limited transport capacity</li> <li>• In public sector, lower levels must often collect</li> </ul>
Inventory management	<ul style="list-style-type: none"> <li>• Minimum, maximum stock levels are measured in days; result is highly efficient systems, high turnover rates</li> <li>• Automated systems</li> </ul>	<ul style="list-style-type: none"> <li>• Minimum, maximum stock levels measured in months; result is inefficient systems with significant funds tied up in inventory; low turnover rates</li> <li>• Predominantly manual systems, may be some automation at central level</li> </ul>
LMIS	<ul style="list-style-type: none"> <li>• High degree of automation; result is real-time or close to real-time visibility of supply and demand data</li> </ul>	<ul style="list-style-type: none"> <li>• Very limited degree of automation; result is limited data visibility, data poor quality and old</li> </ul>
Coordination	<ul style="list-style-type: none"> <li>• High degree of coordination facilitated by visible data and close relationships</li> </ul>	<ul style="list-style-type: none"> <li>• Limited coordination, high levels of duplication and waste</li> <li>• Multiple partners often supplying same item to same supply chain with limited data sharing or visibility leads to problems</li> </ul>

## Comparison of Supply Chain Characteristics

Another view of supply chains is to consider to what degree they exhibit desirable supply chain characteristics (USAID | DELIVER PROJECT 2011). An integrated or seamless supply chain where the links or seams between supply chain functions, levels, and partners are minimized with the ultimate objective of bringing supply and demand closer together is considered ideal. The desirable supply chain characteristics defined here are:

- Clarity of roles and responsibilities in the supply chain—are roles, responsibilities, and procedures clearly documented and understood?
- Streamlined processes: Are systems optimal and are non-productive levels and processes eliminated?
- Trust and collaboration: Do partners trust each other, collaborate, coordinate, and share data?
- Agility or flexibility: Can the supply chain respond quickly to changes in supply and demand?
- Visibility: Are supply chain data (demand, supply, finance) visible up and down the supply chain to all?
- Alignment of objectives and incentives: Do partners share the same objectives and are there incentives in place to do the right thing to improve performance?



Table 2 summarizes these characteristics for developed country and LMIC supply chains.

**Table 2. Supply Chain Characteristics for Developed and Developing Countries**

Characteristic	Developed	LMIC
Visibility	<ul style="list-style-type: none"> <li>• Good internal and external visibility<sup>3</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Internal visibility varies but generally low; poor external visibility</li> <li>• Data often poor quality, incomplete, and untimely</li> <li>• High reliance on periodic surveys</li> </ul>
Alignment of incentives/objectives	<ul style="list-style-type: none"> <li>• High</li> <li>• Competition acts as incentive</li> <li>• Routine monitoring also incentivizes</li> </ul>	<ul style="list-style-type: none"> <li>• Number of partners and organizations involved means difficult to align</li> <li>• Absence of performance data acts against incentivization</li> </ul>
Trust and collaboration	<ul style="list-style-type: none"> <li>• High degrees of trust between supply chain partners</li> <li>• Sharing of data in real time</li> </ul>	<ul style="list-style-type: none"> <li>• May be low levels of trust</li> <li>• Reluctance to share data</li> <li>• Shortages and stockouts lead to loss of trust and confidence</li> </ul>
Clarity of roles and responsibilities	<ul style="list-style-type: none"> <li>• Systems and roles documented and clearly understood</li> <li>• Well-trained personnel</li> </ul>	<ul style="list-style-type: none"> <li>• Systems are weak, roles unclear, procedures often ad hoc</li> <li>• Personnel may lack skills needed</li> <li>• High staff turnover compounds difficulties</li> <li>• Responsibilities devolved across many entities and individuals leads to loss of focus</li> </ul>
Agility/flexibility	<ul style="list-style-type: none"> <li>• Highly flexible systems capable of quickly responding to real demand</li> </ul>	<ul style="list-style-type: none"> <li>• Highly inflexible systems with long lead times, infrequent deliveries, poor data</li> </ul>
Streamlining	<ul style="list-style-type: none"> <li>• Highly streamlined systems; design based on optimizing efficiencies and performance</li> </ul>	<ul style="list-style-type: none"> <li>• Often highly inefficient systems, multiple levels, many bureaucratic steps</li> <li>• Supply chain networks often based on bureaucratic structures leading to inefficiencies</li> </ul>

<sup>3</sup> In a survey of U.S. pharmaceutical stakeholders, the vast majority of respondents said they could obtain information from their supply chain within three business days—19 percent said they had real-time data and 66 percent said they had real-time data but had to manually aggregate the data (Axendia 2010).



# How Well are Supply Chains Performing

This section evaluates supply chain performance in LMICs based on outputs—mainly availability and affordability.

## Supply Chain Performance in Developed Countries

To provide some perspective on supply chain performance, it is useful to look at metrics for developed countries. A common metric of supply chain performance in developed countries is order fill rate—the proportion of orders filled within a determined period of time. In the United States, the typical order fill rate from distributor to a pharmacy within 24 hours of an order being placed is 95 percent. Order fill rates from retailer to customer are greater than 99 percent (higher because retailer also has stock) (Healthcare Distribution Management Association 2004). A survey of European Union countries found that 96 percent of orders were filled within 45 minutes of being placed (Clement, Tuma, and Walter 2005). Due to the large number of items being carried—45,000 stockkeeping units in a typical outlet—and their cost, outlets in the United States tend to carry low inventory levels and so orders are placed frequently—often several times a day. Stock levels are measured in days, by contrast with developing countries where stock levels are measured in months due to infrequent order cycles and long lead times. For developed country medicine supply chains, availability is almost a given; performance focuses on efficiencies and quality. In the United States, the wholesale distributors report that overall their net cost accounts for less than 2 percent of the total value delivered (Healthcare Distribution Management Association 2004).

## Supply Chain Performance in Low- and/or Middle-Income Countries

An assessment of the performance of LMIC supply chains is constrained by a number of factors including 1) lack of data as to performance, and 2) the presence of many confounding factors that impact medicine availability, in particular financing.

**Performance data:** Many in-country supply chains do not routinely monitor and report on their performance. In and of itself, this is a significant indicator of suboptimal performance. If monitoring does occur, it is often based on periodic survey data for a limited set of indicators.

**Confounding factors:** It is often difficult to say whether or not performance (medicine availability) is due to supply chain factors or due to other factors, in particular inadequate financing for supplies.

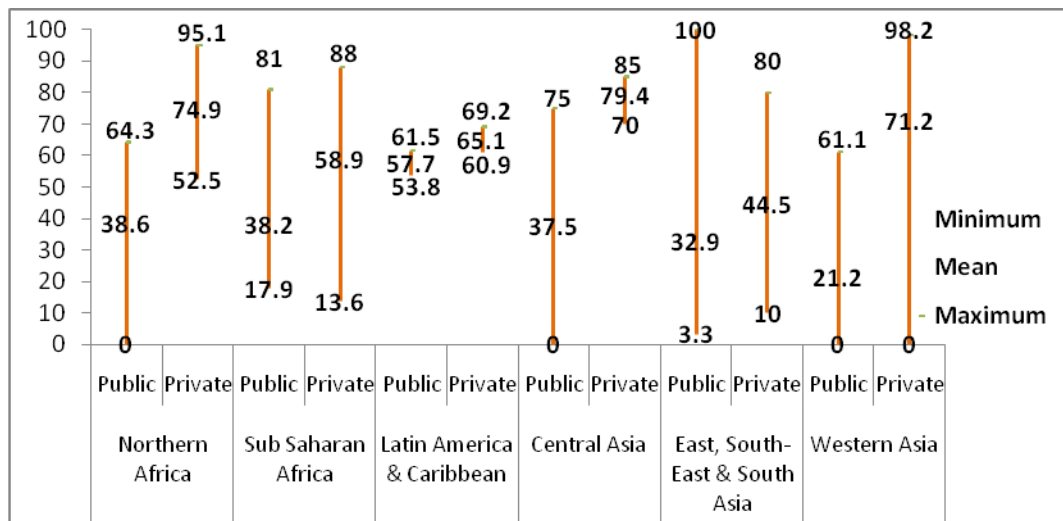
Data on order fill rates for LMICs are rarely available. In Cameroon, order fill rates for the CMS over a six-month period were 69.5 percent, while in Senegal they were 65 percent in 2005 and 49 percent in 1995 for the CMS (Govindraj and Herbst 2010). The most common metric of supply chain performance in developing countries is stockout rate: the proportion of locations stocked out of a particular item on the day it is surveyed. As facilities are normally resupplied infrequently (often months between deliveries) and options for patients are limited, a stockout can have significant negative health consequences. Stockouts are usually assessed using a limited number of items (so called tracers) chosen because of their health importance.

The WHO and Health Action International (HAI) have developed a standardized methodology to assess medicine access based on surveys of price, availability, and affordability. Survey medicines include a standard list of core medicines chosen to reflect treatments for common acute and chronic conditions in a country that significantly contribute to morbidity and mortality. Surveys are carried out in a

representative sample of public and private facilities. A secondary analysis of 45 surveys using this methodology (A Cameron, M Ewen, D Ross-Degnan, D Ball, R Laing 2008) revealed (Figure 3):

- For a basket of core medicines, mean availability in the public sector ranged from 38.2 percent in sub-Saharan Africa to 57.7 percent in Latin America and the Caribbean.
- In the private sector, the mean availability ranged from 44.5 percent in East, Southeast, and South Asia to 79.4 percent in Central Asia.
- Overall mean availability was higher in the private sector at 63.2 percent than for the public sector at 34.9 percent.

**Figure 3. Availability for Basket of Medicines, Public and Private Sectors**



### **Expanded Program for Immunization/Vaccines**

There are limited data as to how vaccine supply chains are performing. However, it is clear that many of the weaknesses that characterize essential medicine supply chains are also seen in those for vaccines. A study in The Gambia of missed opportunities for vaccinations found vaccine shortages to be the number one reason for non-immunization (Gambia 2004). An intervention in Mozambique by VillageReach reported baseline (2002) stockouts of vaccines in one province of 80 percent (VillageReach 2011). In 2011, districts in Uganda reported vaccine stockouts for up to three months including vaccines for diseases such as polio, TB, diphtheria, tetanus, measles, and whooping cough (Vision Reporters 2011). At the same time, the MOH reported that the stockouts were not due to shortages but to distribution problems. A recent analysis of 42 assessments of vaccine stores managements carried out between 2003 and 2007 (Optimize 2008) revealed a number of shortcomings in critical areas including poor management of arriving vaccines, poor planning for equipment maintenance, transport failure, and poor stock control. The analysis revealed that most of the deficiencies were in management areas.

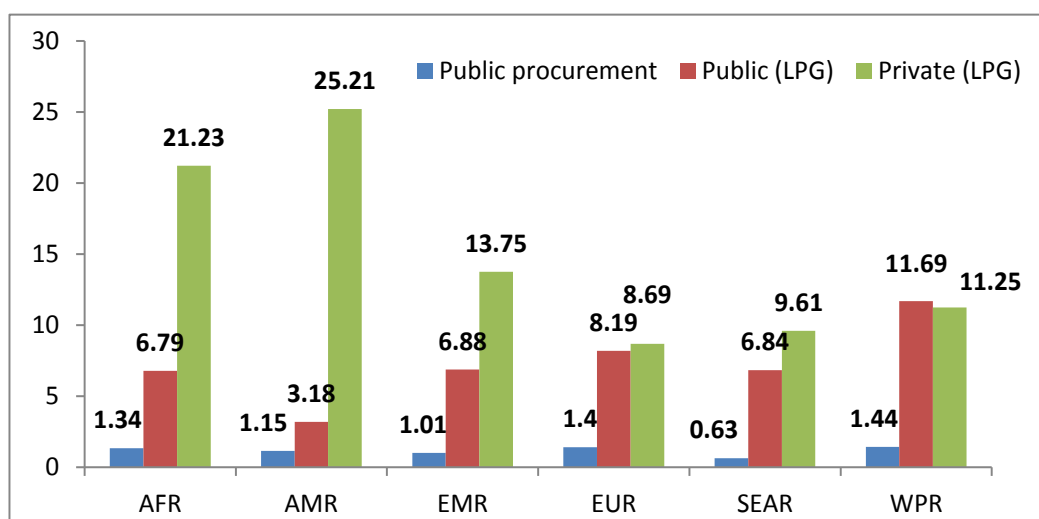
## Availability for Program Supplies

As already noted, for the public sector there may be special programs with partially vertical supply chains. These supplies may get special attention, and more resources, and the number of items being managed is usually limited, resulting in improved performance than for other essential medicines. For instance, many HIV programs have excellent availability (at least within the confines of the financing envelope available [i.e., the number of patients on treatment]). For this reason, WHO/HAI surveys do not look at these “program” items because performance may not be indicative of overall system performance.

## Affordability

The other commonly available indicator for medicine access is affordability. Price results for WHO/HAI surveys are presented as median price ratios or the ratio of a medicine’s median price across outlets to the Management Sciences for Health median international reference price for the year preceding the survey. While in many public sector systems, medicines are free of charge, in systems that do charge, median price ratios for a basket of 15 medicines varied from 3.18 in the Americas to 11.95 in western Pacific countries; in the private sector, median price ratios (for the lowest priced generic available) were higher, ranging from 8.69 in the European region to 25.21 in the Americas (WHO 2004ii) (Figure 4).

**Figure 4. Median Price Ratios of Public Sector Procurement Prices, and Lowest Priced Generic Prices in Public and Private Sectors by WHO region**



Ratio of median price to MSH international reference price. LPG, lowest priced generic.

Markups are high, medicines are often unaffordable, and while availability in the private sector is higher than the public sector, this is offset by higher prices, reducing access.

An assessment of affordability in developed countries is beyond the scope of this paper. While medicines are expensive, there are numerous payment schemes, and out-of-pocket expenditures are usually only a fraction of the price.

## Human Resources Issues

There is an increasing awareness of the need to focus on human resource requirements for healthcare supply chains. Issues of insufficient staff numbers, appropriate training, geographical and professional isolation in rural and remote environments, a lack of supervision/contact with supervisors, inadequate professional and personal facilities, pay and conditions, and workload are all significant issues that affect staff satisfaction, turnover, and the ability of staff to complete their job satisfactorily (Hawthorne and Anderson 2009; WHO 2010). For staff with supply chain responsibilities, issues may be more pronounced due to an overall lack of attention to the importance of supply chain skills, resulting in a lack of capacity in healthcare personnel. In addition, supply chain professionals are rarely considered a cadre in MOHs. With an increasing understanding that the health workforce is the rate-limiting step to the improvement of health systems in many countries, the first Global Forum on Human Resources for Health in Kampala, Uganda, in 2008 endorsed the Kampala Declaration and Agenda for Global Action. The second Global Forum on Human Resources for Health was held in 2010 in Bangkok and continued to emphasize the importance of human resource development. The People that Deliver<sup>4</sup> initiative is focusing the interest, ideas, and resources of development partners to the specific human resource issues for healthcare supply chain management.

---

<sup>4</sup> See [www.peopletthatdeliver.org/](http://www.peopletthatdeliver.org/).

# Innovation in Low- and/or Middle-Income Country Supply Chains

While innovation is limited, there are a number of important developments in medicine supply chains in developing countries:

**Mobile health:** A number of countries are strengthening the reporting of logistics data using mobile technologies, and in particular mobile phones (USAID | DELIVER PROJECT 2010). Use of widely available cellphones can improve both the quality and timeliness of data reporting.

**Vendor-managed inventory models:** Widely used in commercial settings in developed countries, systems where the distributor of the goods assumes responsibility for more logistics functions from the recipient are being implemented in Zimbabwe for family planning and some HIV supplies (USAID | DELIVER PROJECT 2008) and in Senegal by Optimize for EPI and program supplies. This “task shifting” reduces the burden on health personnel but may only be viable for a limited number of medicines.

**Computerized information systems:** Web-based LMISs with online reporting of logistics data (e.g., in Bangladesh for contraceptives) offer the possibility of improving data visibility, a key characteristic of well-functioning supply chains. The Supply Chain Management Systems project is computerizing warehouse systems in many CMS.

**Product integration:** The success of vertical program efforts at increasing performance (e.g., for many HIV programs) has also served to highlight weaknesses in the broader supply chain for essential medicines. There is renewed focus now on strengthening overall health system supply chains for all medicines and merging many program systems to achieve efficiencies.

**Private sector partnership/outsourcing:** Partnerships and outsourcing to third party logistics providers (3PLs) are considered best practice in commercial and developed country settings. However, application of this in developing countries for medicines is limited. Limited private sector capacity to provide services and public sector capacity to manage contracts is a major constraint. In addition, both parties may be reluctant to contract. Nevertheless, a number of examples exist: UNICEF outsources ARV distribution in Malawi to a 3PL, and in Bangladesh and Nigeria the family planning units both outsource commodity distribution to 3PLs.

**Flexible procurement:** Supply chains need agile, flexible procurement mechanisms capable of delivering quality products at low costs. A number of initiatives to strengthen national procurement, including pooled procurement (e.g., the Global Fund’s Voluntary Pooled Procurement Mechanism, the Global Drug Facility for TB medicines), use of framework contracts, and outsourcing, are receiving increased attention.

# Conclusion

Non-availability of medicines is a major factor in poor health outcomes in LMICs. While the causes are complex—they include inadequate human resources, weak health systems, poor access to services, and lack of finance—the performance of supply chains is clearly suboptimal. Increased donor and government investment in medicine procurement must be accompanied by investments in LMIC supply chains and personnel in order to build more flexible and seamless supply chains. This means strengthening existing supply chains, investing in infrastructure, introducing new technologies and new financing systems, new innovations, expanding the role of the private sector, and smart integration of current vertical systems. All of these efforts will be founded on increased human resource capacity. Medicine supply chains are people supply chains and depend not just on financial and technical inputs but also capacity building.



# References

- Arive (undated). *Missed Opportunity Study for Vaccination in Health Facilities in The Gambia*. Available at [www.ariva.bf/etude/Gambie/STUDY%20ON%20Missed%20opportunity%20study%20report.pdf](http://www.ariva.bf/etude/Gambie/STUDY%20ON%20Missed%20opportunity%20study%20report.pdf) (accessed May 23, 2011)
- Axendia. 2010. *Global Supply Chain Visibility, Control and Collaboration, Business Imperative, Regulatory Necessity*.
- Bennett, S., J. D. Quick, and G. Velásquez. 1997. *Public-Private Roles in the Pharmaceutical Sector: Implications for Equitable Access and Rational Drug Use*. Health Economics and Drugs Series, No. 005. Available at <http://apps.who.int/medicinedocs/pdf/whozip27e/whozip27e.pdf> (April, 2011)
- CA Cameron, M Ewen, D Ross-Degnan, D Ball, R Laingameron. 2008. *Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis*. Available online at [http://www.who.int/medicines/technical\\_briefing/tbs/lancetmedprices.pdf](http://www.who.int/medicines/technical_briefing/tbs/lancetmedprices.pdf) (accessed May, 2011)
- Clement, W., M. Tuma, and E. Walter. et al 2005. *The European Pharmaceutical Wholesale Industry: Structure, Trends and Socio-economic Performance*. Available at [www.phagro.de/\\_phagro/upload/standpunkte/5f2908e7-2729-46a6-850f-b348243dbf77.pdf](http://www.phagro.de/_phagro/upload/standpunkte/5f2908e7-2729-46a6-850f-b348243dbf77.pdf) (accessed April 2011)
- Dicko, M. 2011. "Project Optimize: Supply Chain Integration in Senegal." Presentation to Global Health Council Meeting, Washington, DC, April 13.
- Foster, S. 1991. Supply and Use of Essential Drugs in SSA: Some Issues and Possible Solutions. *Soc Sci Med* 32(11):1201–1218.
- Global Health. 2008. *From More to Better: Towards Leveraging Supply Chain Innovation Across Global Health Initiatives*. Available at [www.zlc.edu.es/archivos/616/descargas/GH%20preread%20MCL\\_04%20%282%29.pdf](http://www.zlc.edu.es/archivos/616/descargas/GH%20preread%20MCL_04%20%282%29.pdf) (accessed May 23, 2011)
- Govindraj, R., and C. H. Herbst. 2010. *Applying Market Mechanisms to Central Medical Stores: Experiences from Burkina Faso, Cameroon, and Senegal*. Available at <http://siteresources.worldbank.org/HEALTHNUTRITIONANDPOPULATION/Resources/281627-1095698140167/ApplyingMarketMechanisms.pdf> (accessed May 23, 2011)
- Hawthorne, N., and C. Anderson. 2009 The Global Pharmacy Workforce: A Systematic Review of the Literature. *Human Resources for Health* 7:48.
- Healthcare Distribution Management Association. 2004. *The Vital Link in Healthcare*. Available at [www.healthcaredistribution.org/press\\_room/pdf/vitallink\\_092705.pdf](http://www.healthcaredistribution.org/press_room/pdf/vitallink_092705.pdf) (accessed May 23, 2011)
- Jacoby. 2009. *The Economist Guide to Supply Chain Management*. Bloomberg press New York.
- McCabe, A. 2009. *Private Sector Pharmaceutical Supply and Distribution Chains: Ghana, Malawi and Mali*. Available at <http://apps.who.int/medicinedocs/documents/s17508en/s17508en.pdf> (accessed April 2011)
- Optimize. 2008. *Landscape Analysis: Analysis of EVSM Indicators*. Available at [www.path.org/files/TS\\_opt\\_la\\_evsm\\_indicators.pdf](http://www.path.org/files/TS_opt_la_evsm_indicators.pdf) (accessed May 23, 2011)
- Optimize. 2009. PowerPoint Presentation available at [http://www.path.org/files/TS\\_opt\\_vac\\_supply\\_chains.pdf](http://www.path.org/files/TS_opt_vac_supply_chains.pdf) (accessed May, 2011)
- USAID | DELIVER PROJECT. 2008. *Delivery Team Topping Up: Bringing about Reliable Distribution in Difficult Environments*. Available at [http://deliver.jsi.com/dlvr\\_content/resources/allpubs/logisticsbriefs/ZW\\_DTTUBrin.pdf](http://deliver.jsi.com/dlvr_content/resources/allpubs/logisticsbriefs/ZW_DTTUBrin.pdf) (accessed May 23, 2011)
- USAID | DELIVER PROJECT. 2010. *Innovative Mobile Phone Use Improves Access to Drugs and Medical Supplies in Africa*. Available at

[http://deliver.jsi.com/dlvr\\_content/resources/allpubs/logisticsbriefs/InnoMobiPhonImpAcc.pdf](http://deliver.jsi.com/dlvr_content/resources/allpubs/logisticsbriefs/InnoMobiPhonImpAcc.pdf) (accessed May 23, 2011)

USAID | DELIVER PROJECT. 2011. *Supply Chain Integration: Seamlessly Linking the Pieces*. Available at [http://deliver.jsi.com/dlvr\\_content/resources/allpubs/logisticsbriefs/SCIntSeamLinkPiec.pdf](http://deliver.jsi.com/dlvr_content/resources/allpubs/logisticsbriefs/SCIntSeamLinkPiec.pdf) (accessed May 23, 2011)

VillageReach. 2011. Available at <http://villagereach.org/where-we-work/mozambique/> (accessed April 2011)

Vision Reporters. 2011. Vaccine Shortage Hits Local Hospitals. Available at [www.newvision.co.ug/D/8/13/749176](http://www.newvision.co.ug/D/8/13/749176) (accessed April 2011)

World Health Organization. 2004a. *Equitable Access to Essential Medicines: A Framework for Collective Action*. WHO Policy Perspectives on Medicines. Available at [http://whqlibdoc.who.int/hq/2004/WHO\\_EDM\\_2004.4.pdf](http://whqlibdoc.who.int/hq/2004/WHO_EDM_2004.4.pdf) (accessed May 22, 2011)

World Health Organization. 2004b. *The World Medicines Situation*. Available at [www.searo.who.int/LinkFiles/Reports\\_World\\_Medicines\\_Situation.pdf](http://www.searo.who.int/LinkFiles/Reports_World_Medicines_Situation.pdf) (accessed May 22, 2011)

World Health Organization. 2010. *Increasing Access to Health Workers in Remote and Rural Areas Through Improved Retention*. Global Policy Recommendations. Geneva, Switzerland: World Health Organization.

# Appendix A. Developing Country Supply Chain

