Stabilizing Supply and Avoiding National-Level Stock Outs of ACTs in an Era of Wide ACT Scale-Up

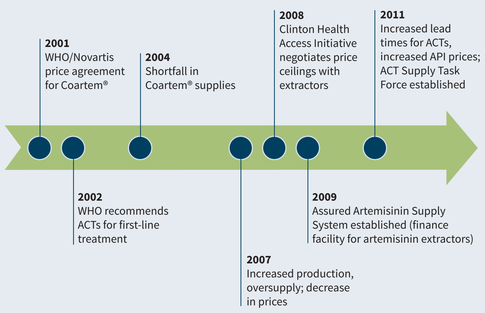
Rima Shretta, Management Sciences for Health
Prashant Yadav, WDI, University of Michigan

The demand for **artemisinin-based combination therapy (ACT)** has grown sharply since its recommendation by the World Health Organization in 2002. However, the rates at which endemic countries have scaled-up their use have varied, resulting in a cycle of volatile supply and demand. Although various short-term solutions have alleviated country-level stockouts, without robust mechanisms to build resilience in the supply chain, these uncertainties have the potential to disrupt global ACT supply.

Challenges in the Global ACT Supply Chain

- Long production cycle for *Artemisia annua* (14 months from planting to shipping)
- Limited availability of the active pharmaceutical ingredient (API)
- Inaccurate and untimely country demand forecasts
- Fragmented extraction and manufacturing market with high transaction costs
- Lack of transparency in the supply chain
- Artemisinin price fluctuations
- Limited suppliers of finished products

Figure1. The Volatile History of the ACT Market



Challenges with Country-Level ACT Supply Chains

- Procurement and supply management problems
  - Inadequate planning and forecasting
  - Long procurement lead times of up to 200 days
  - Inefficient storage, distribution, and inventory management systems
  - Inaccurate or incomplete data and management information systems
  - Emergencies
- Financial flow uncertainty
  - Lengthy grant approval process
  - Grant disbursement and report delays
  - Donor procurement issues

Coping with Demand and Supply Uncertainty

Collaborative Forecasting

This requires a good understanding of demand variability (red items in figure 2). Sharing data and demand forecast information across supply chain players improves transparency and supply chain coordination.

Aligning Product Manufacturing and Distribution Strategies with Demand Variability

The best product manufacturing and inventory deployment strategies are based on a healthy balance of manufacturing to order and manufacturing to stock (red and purple items in figure 2). This requires:

- Knowledge of product demand uncertainties and lead times
- Alignment of incentives among manufacturers, partners, and other stakeholders

Pooling Demand and Supply Risks

A supply chain can manage demand volatility by (red and purple items in figure 2):

- Aggregating demand across multiple customers or geographical areas
- Pooling multiple suppliers to meet uncertain demand

Sharing Risk

Demand uncertainty may be unevenly distributed across stakeholders in the supply chain (e.g., extractors, API manufacturers, ACT manufacturers, funders, country governments). The risk from demand uncertainty can be shared more equitably by addressing the red, blue, and purple items in figure 2 by:

- Minimum purchase commitments
- Quantity flexibility contracts
- Buyback contracts
- Revenue sharing

Rolling Horizon Forecast/ Volume Commitments

This requires that funding agencies commit to manufacturers to purchase a certain quantity of the product over time (red, blue, and purple items in figure 2). Manufacturers will then:

- Guarantee a maximum lead-time and upside purchase flexibility with defined contractual penalties
- Provide discounted, low acquisition costs
- Be incentivized by guaranteed minimum quantities
- Be inclined, with donors, to share demand uncertainty risk

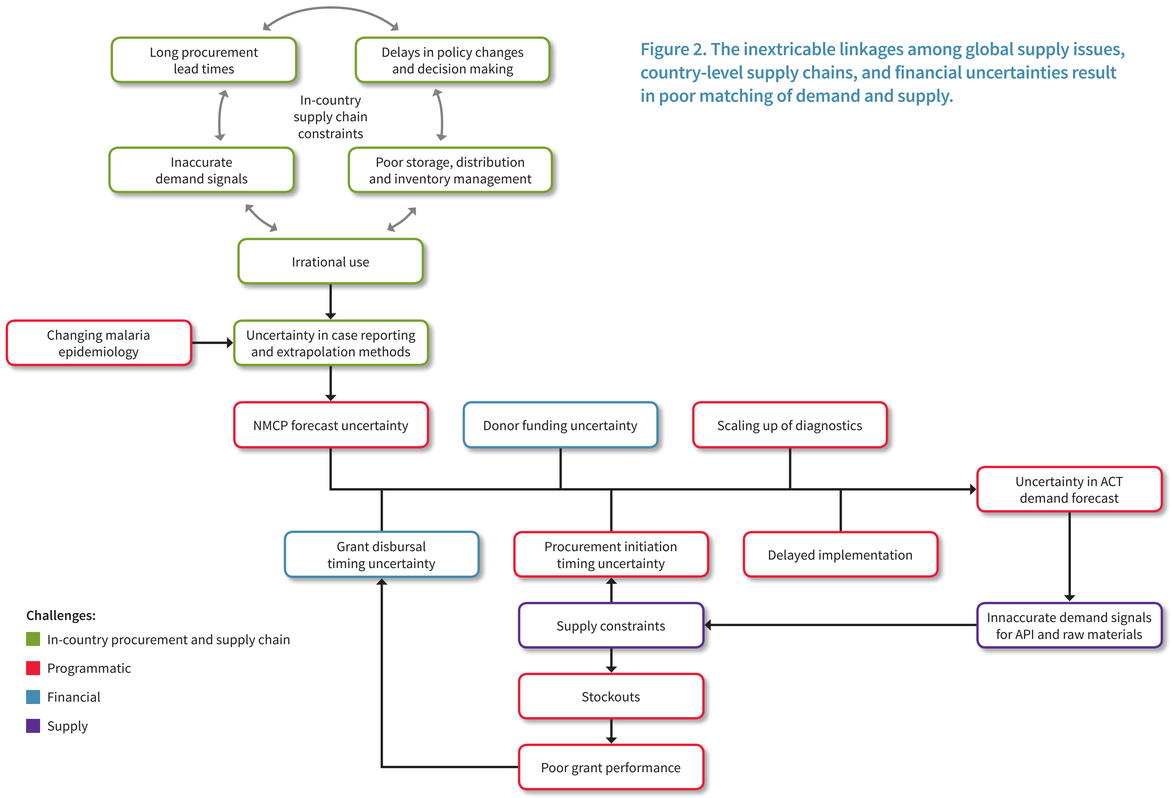


Figure 2. The inextricable linkages among global supply issues, country-level supply chains, and financial uncertainties result in poor matching of demand and supply.

Global Supply Hubs/Physical Buffer Stock

These can be manufacturer-held buffer stocks, rotating product buffers, and non-rotating emergency buffers (red, purple, and green items in figure 2).

- Short lead-times, enabling rapid response
- Discounted pricing
- Financing of initial stockpile with a rolling working capital fund that is replenished when orders are placed
- Rotating stocks
  - Challenging to implement
  - Manufacturers incentivized by guaranteed minimum quantities
  - Low risk of product expiry
  - Depends on the stockpile and all orders are emergencies
- Non-rotating emergency stocks
  - Easy to establish
  - Balance of demand and excess stock will incentivize manufacturers to not under-forecast and to share information
  - High risk of expiry if the amount of stock is not estimated properly
  - Holding buffer stock across multiple manufacturers requires multiple shipments
  - Unfinished product allows maximum shelf life

Financial Buffer Funds

Bridge funds that countries can deploy for procurement (addressing the red and blue portions in figure 2):

- Funds replenished as resources become available
- No lead time benefits or pricing benefits; relies on the finished product being readily available
- Minimal oversight and administrative burden
- Guaranteed funding incentivizes countries and manufacturers
- Significant risk of loss if country does not repay
- Decisions to release funds must be made quickly; sufficient due diligence may be impossible
- May create a parallel mechanism for releasing funds, undermining existing processes
- Undermines the mechanism to enforce performance conditions
- Freedom to select the manufacturer and product
- Not limited to stockpiled products

Table 1. Snapshot of Options

	Rolling Horizon Forecast/ Volume Commitments	Collaborative Forecasting	Aligning Product Manufacturing and Distribution Strategies with Demand Variability	Pooling Demand and Supply Risks	Sharing Risk through Better Contracting	Physical Buffer Stocks			Financial Buffer Funds
						Manufacturer Held	Rotating	Non-Rotating Emergency	
Management ease	√ (if willing)	√ (if willing)	√ (if willing)	√	√	√	√	√	√
Impact on stockouts	√	√	√	√	√	√	√	√	√
Potential impact on lead time	X	X	√	√	X	√	√	√	X
Cost to implement	X	X	X	X	X	√	√	√	√
Pricing benefits	√	√	√	√	√	X	√	√	X
Value for money	√	√	√	√	√	√	√	√	√
Risk	X	X	X	X	X	√	√	√	√
Examples	UNICEF long- term agreements with manufacturers; collaborative planning, forecasting, replenishment	Collaborative planning, forecasting, and replenishment		PAHO regional group purchasing of vaccines	Wal-Mart and other retailers	GDF; UNICEF (vaccines)	PEPFAR/SCMS	Global Drug Facility (GDF) 2nd-line TB drugs; PMI ACTs; ARV Access for Africa	PEPFAR/PMI emergency commodity fund; Pledge Guarantee for Heath; Assured Artesmisinin Supply Service (A2S2); AMC; UNICEF line of credit

√ = Makes an impact of intervention on variable; X = little or no impact of intervention on variable

Conclusion

A mix of strategies is required to stabilize the artemisinin and ACT markets.

- Share information across the supply chain; mechanisms are needed for better information sharing among farmers, extractors, and manufacturers
- Use forecast commitments to enable manufacturers to keep larger amounts of inventory at each stage of the production cycle
- In the short and medium terms, apply physical and financial buffers; buffers of finished products will facilitate stable inventory and financial buffer funds will address funding disruptions
- In the medium to long terms, create a voluntary standard for extractors to ensure appropriate purchasing and sales practices, minimum quality and ethical standards, and homogeneity in the quality of raw material
- Use collaborative forecasting to understand the global supply and demand and to match product manufacturing and distribution strategies
- Pool demand and supply risks through rolling volume commitments and better contracting to allow risk sharing among stakeholders and a more predictable supply
- In the long term, make significant investments in country-level system strengthening to minimize demand uncertainties

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