Modeling the values of private sector agents in multi-echelon humanitarian supply chains

Corinne Carland, Gilberto Montibeller,
Jarrod Goentzel

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Acknowledgements

- Research Team: Corinne Carland, Gilberto Montibeller, Jarrod Goentzel
- Partners: Malaria Consortium, President's Malaria Initiative, Global Development Lab

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Humanitarian organization (HO) engagement with private sector supply chains

Acute market failures

- Following natural disasters and complex emergencies
- Increasingly HOs leverage private sector supply chains by distributing cash or vouchers to beneficiaries (Barrett, Bell, Lentz, & Maxwell, 2009; Albu, 2010; Sivakumaran, 2011; Ryckembusch, et al., 2013)

Chronic market failures

- Impeding development goals for health, food, etc.
- HOs support both public and private sector supply chains to deliver more affordable and available products (Cameron, Ewen, Ross-Degnan, Ball, & Laing, 2009; Cameron, Ewen, Mantel-Teeuwisse, Leufkens, & Laing, 2011; Ewen, Zweekhorst, Regeer, & Laing, 2017)

Proposal: Better engagement options can be designed by satisfying the distinct objectives of agents in the supply chain but also considering alignment of objectives across the end-to-end supply chain to make the overall humanitarian effort more successful.

Importance of malaria diagnostics

- Widespread presumptive treatment
  - One study found that 74% of febrile patients were given antimalarials but only 35% had a positive mRDT result*
- Social cost of misdiagnosis
  - Artemisinin resistance is a global public health risk
  - Wasted resources

*Mbonye, A., Lal, S., Cundill, B., Hansen, K. S., Clarke, S., & Magnussen, P. (2013). Treatment of fevers prior to introducing rapid diagnostic tests for malaria in registered drug shops in Uganda. *Malaria Journal*, *12*(1), 131.

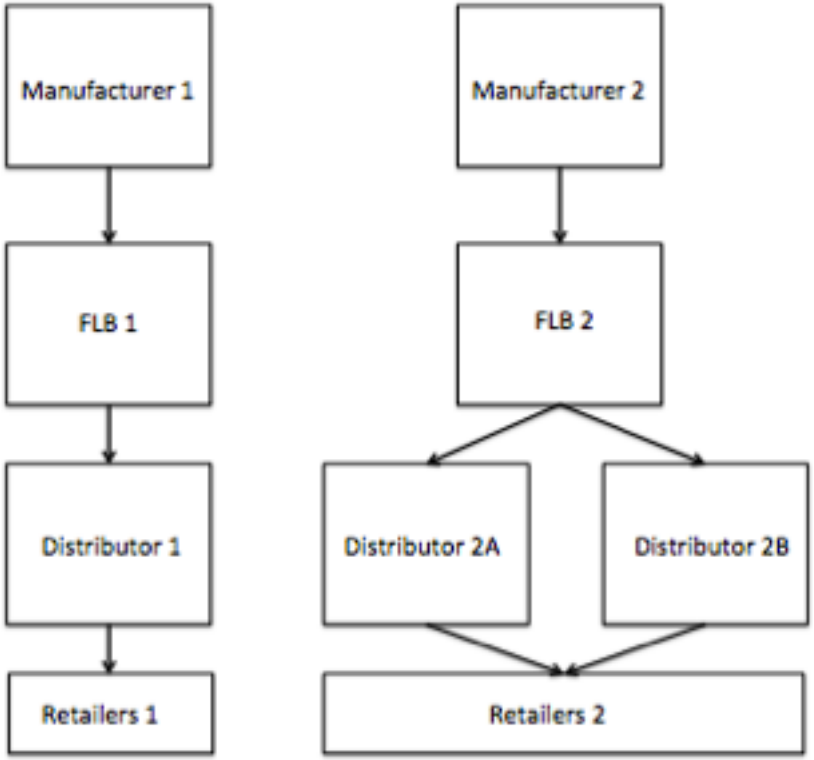
Private sector role

Healthcare service provider	Number (%)
Private health provider	496 (53.1)
Drug shop	279 (29.9)
Private clinic	217 (23.2)
Managed at home	228 (24.4)
Government health facility	154 (16.5)
Rural health center	120 (12.8)
Hospital	34 (3.6)
Community health worker	31 (3.3)
Traditional healer	13 (1.4)
Spiritual healer/church	12 (1.3)

Awor, P., Wamani, H., Bwire, G., Jagoe, G., & Peterson, S. (2012). Private sector drug shops in integrated community case management of malaria, pneumonia, and diarrhea in children in Uganda. *The American journal of tropical medicine and hygiene*, *87*(5 Suppl), 92-96.

Malaria Consortium pilot

- An “enhanced malaria RDT bundle” in the heavily populated Wakiso district in Uganda
  - training to retailers
  - biohazard disposal
  - marketing
  - barcoding of device
- Two manufacturers selected
- Reached around 180 private sector clinics, drug shops, and pharmacies in the district



Research design

- Data collection
  - 2 of 2 first line buyers
  - 2 of 3 distributors
  - Two focus groups comprising 28 retailers
- Analysis
  - Weights for various criteria in deciding to stock
  - Value function for each criterion
  - Value of business model options for each supply chain actor

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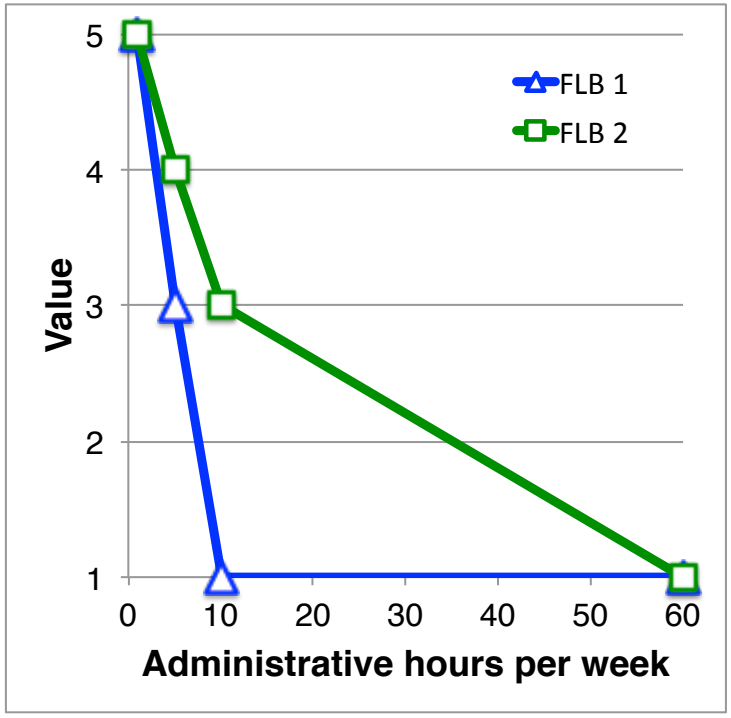
Table 1. Decision criteria and normalized weights (%) for supply chain agents; all weights are normalized to 100.

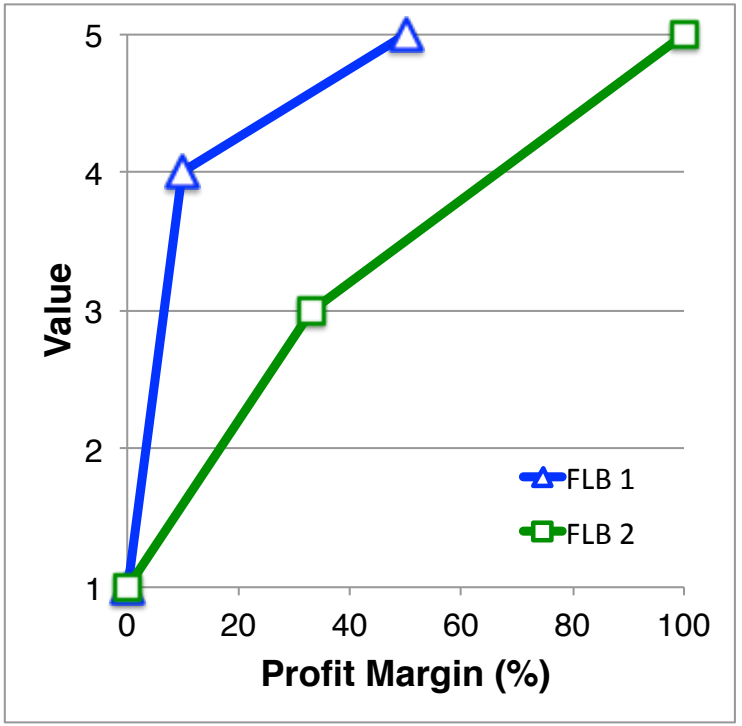
Criteria	Retailers (based on median value, n=28)	Distributor 1	Distributor 2	FLB 1	FLB 2
Training	10.8				
Time per sale	10.5				
Awareness/ads	9.6				
Customer satisfaction	9.6				
Time to delivery	9.6				
Quality	9.0			20.9	19.8
Price of device	9.0			23.3	15.4
Cost of device	8.4	16.5	14.6	7.0	22.0
Sales of other products (Cross sales)	8.4	11.6	13.0		17.6
Other opportunities	7.8				
Volume of sales	7.4	16.5	16.3		
Expiration date		14.9	15.4		
Efficiency (of distribution)		14.9	14.6		
Profit		14.0	13.0	4.6	11.0
Cost of training		11.6	14.6		
Relationship with NGO				23.3	12.1
Administrative time				20.9	2.2

Note: Cost is defined as the amount paid by the agent to procure the device and price is the amount received by the agent upon sale.

Value functions

Respondents provided a numerical value for points on a continuum between the upper and lower performance bounds, which were assigned the highest value (5) and lowest value (1) respectively. Piecewise linear interpolation was used to create a continuous value function.





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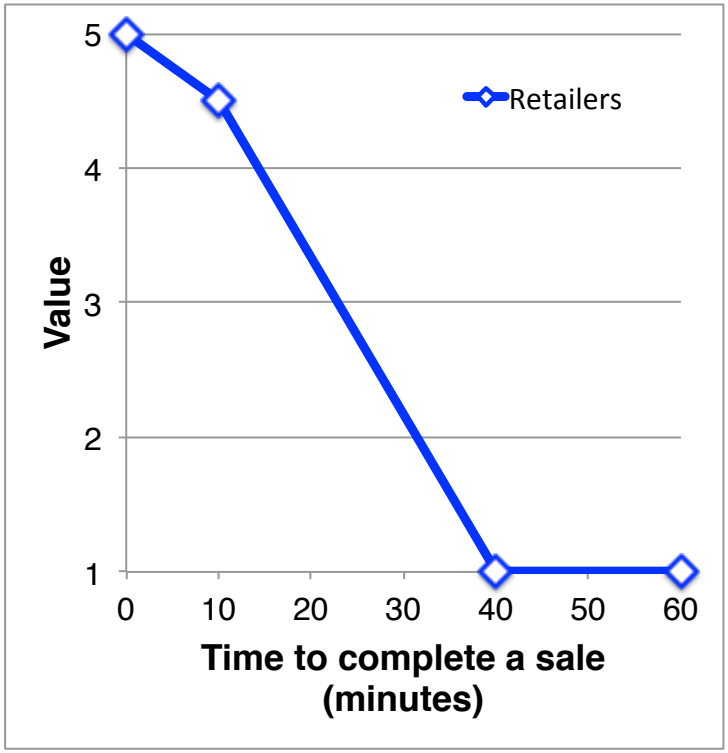

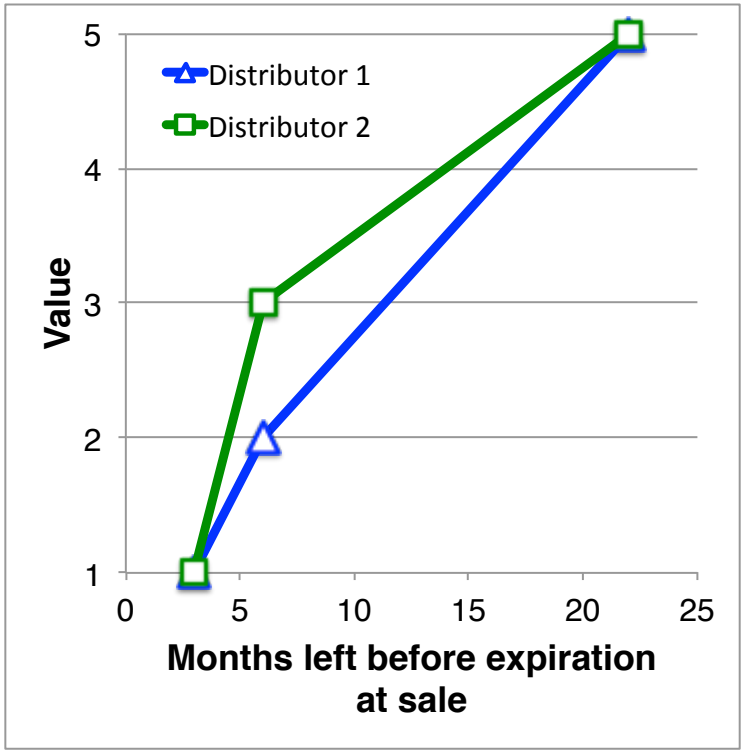

Business model observations

- Retailers value training and are most concerned about time to complete a sale
- Distributors bear most of the stock risk
- First line buyers have different business strategies

Evaluate private sector engagement options (bundles of subsidies and services)

Table 2. Description of the options evaluated.

Option A	Do not sell malaria rapid diagnostic tests
Option B	Sell non-WHO approved devices
Option C	Sell WHO-approved devices with no NGO services
Option D	Subsidy with no NGO services
Option E	Subsidy with NGO services of advertising, biohazard/barcoding, training (the "enhanced bundle" in the case study pilot)
Option F	NGO services of training only; no subsidy
Option G	NGO services of advertising only; no subsidy
Option H	NGO services of biohazard/barcoding only; no subsidy
Option I	NGO services of advertising and training; no subsidy
Option J	NGO services of biohazard/barcoding and training; no subsidy
Option K	NGO services of advertising and biohazard/barcoding; no subsidy
Option L	NGO services of advertising, biohazard/barcoding, and training; no subsidy
Option M	Sell malaria rapid diagnostic tests as part of a "malaria service" model, no NGO services

Table 4. Overall value for supply chain agents from 1 (low) to 5 (high); overall rank of the values from 1 (best) to 13 (worst). Note: the two distributors' and first line buyers' results are averaged.

	Values			Combined Value Supply Chain ($= V_F + V_D + V_R$)	Ranks		
	FLB (V_F)	Distributor (V_D)	Retailer (V_R)		FLB	Distributor	Retailer
Option A	2.04	2.15	2.14	4.29	13	13	12
Option B	2.41	3.08	1.86	7.35	12	4	13
Option C	2.97	3.08	2.80	8.85	7	5	10
Option D	2.82	3.00	2.79	8.61	9	8	11
Option E	**3.77**	2.59	3.57	9.93	**1**	12	3
Option F	2.75	2.71	3.28	8.74	11	11	5
Option G	2.79	3.08	3.12	8.99	10	6	7
Option H	3.16	3.05	2.87	9.08	5	7	8
Option I	3.02	2.74	3.61	9.37	6	9	2
Option J	3.39	2.72	3.36	9.47	4	10	4
Option K	3.44	3.09	3.21	9.74	2	2	6
Option L	3.43	**3.11**	**3.79**	**10.33**	3	**1**	**1**
Option M	2.97	3.09	2.86	8.92	8	3	9
Minimum	*2.04*	*2.15*	*1.86*				
Median	*2.97*	*3.05*	*3.12*				
Maximum	*3.77*	*3.11*	*3.79*				

Conclusions

- General implications
  - First application of multi-attribute value analysis (MAVA) to quantify the economic and non-economic objectives of agents spanning an integrated multi-echelon supply chain
  - Demonstrate how HOs can use value functions and criteria weights from MAVA to evaluate and create options and, thus, design better private sector supply chain engagement
  - Varying business objectives and risks among agents indicates an opportunity to design business models and risk sharing contracts that are better aligned with incentives.
- Malaria implications
  - For retailers, malaria diagnosis should be framed as a service to be provided rather than a product to be sold.
  - Services may be as, or more, important than subsidies to improve stock levels
- Limitations
  - Single case study to date. Generalization is limited and further validation is needed.
  - Assumptions about the nature of preferences, e.g. preferential independence among criteria.
  - Ability of decision makers in providing quantitative preference information.

http://cite.mit.edu/reports/malaria-rapid-diagnostic-test-evaluation

Comprehensive Initiative on Technology Evaluation

Evaluating Business Criteria for Scaling Stock of Malaria Rapid Diagnostics

Corinne Carland*, Gilberto Montibeller**, Jarrod Goentzel*
*Massachusetts Institute of Technology, **Loughborough University

Background & Motivation

In spring 2015, researchers in the Comprehensive Initiative on Technology Evaluation (CITE) at MIT developed a study to better understand the scalability of malaria rapid diagnostic tests (mRDTs) in Uganda. mRDTs offer a fast and accurate means of diagnosing malaria in settings where microscopy is unavailable or unreliable. The diagnostic tests are promising for the private sector because they require no fixed asset investment or electricity, are easy to interpret, and entail relatively little training.

In much of the developing world, feverish patients are diagnosed with malaria without confirmation by mRDT or microscopy.[1] Diagnosing malaria by clinical symptoms alone is very challenging because many malaria symptoms are nonspecific and overlap with other indications. One study found that 74% of patients with fevers in Uganda were given antimalarial medication but only 35% of the patients actually had a positive mRDT result.[2] Over-diagnosis of malaria is common not only in Uganda, but across sub-Saharan Africa.[3–10]

Accurate diagnosis is important, since non-discriminant treatment could lead to widespread resistance to artemisinin, the base compound for artemisinin-based combination therapies (ACTs). This could incite a global public health crisis, as "no other antimalarial medicines are available that offer the same level of efficacy and tolerability as ACTs, and few promising alternatives are available in the immediate research and development pipeline."[11]

The private sector uptake for mRDTs is especially critical in countries like Uganda where the majority of patients first seek care from private clinics, pharmacies, and drug shops.[12] However, in only 3 of 10 countries recently surveyed did private-for-profit sector availability exceed 20%; one of these countries was Uganda.[2] Higher stock levels in the private sector supply chain are critical for increasing access and use of the devices in many countries.

Most mRDT studies have focused on factors that influence patient decisions, with some study of retailer decisions, and no study of their upstream supplier decisions.[13–18] A study in Uganda found significant heterogeneity in retailer adoption of mRDTs, but the reasons were unclear; the authors offered one consideration (minimum order quantity from wholesalers) and called for further research on adoption decisions.[19] This study fills a gap in understanding the mRDT decision making

Key Recommendations

The results of this study indicate that private sector preferences and priorities vary by agent role in the supply chain, and include a wide range of factors that influence the decision to stock mRDTs. Two recommendations emerge from this study:

1. For retailers, **malaria diagnosis should be framed as a service** to be provided rather than a product to be sold.

2. Business objectives and risks vary among agents in the supply chain, indicating an **opportunity to design business models and risk sharing contracts** that are better aligned with incentives.