USAID | DELIVER PROJECT

Last Mile Costs of Public Health Supply Chains in Developing Countries

Recommendations for Inclusion in the United Nations OneHealth Model

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Abstract
The USAID | DELIVER PROJECT, PATH/WHO Project OPTIMIZE, and VillageReach developed estimates of last mile supply chain costs for public health commodities in developing countries. The estimates responded to a request by the developers of the United Nations OneHealth Model for guidance on how to best include last mile costs in the costing model. The authors propose a "markup" approach in which the OneHealth analyst would apply a last mile transport markup to the supply chain cost value that the model produces. This markup would vary based on the number of tiers in the supply chain and on distance and terrain conditions in the country. The medium markup for a two-tier system would be 50 percent, while the medium markup for a system with three or more tiers would be 25 percent.

Cover photo: Delivery Team Topping Up staff person delivers health commodities to facility in Zimbabwe. USAID | DELIVER PROJECT. 2009.

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Acronyms

ACT	artemisinin combination therapies
ARV	antiretroviral
CMS	central medical stores
DTTU	Delivery Team Topping Up
ED	essential drug
FP	family planning
IAWG	United Nations Interagency Working Group—Costing
LGA	local government authority, Nigeria
SDP	service delivery point
UDP	USAID | DELIVER PROJECT
UN	United Nations

Acknowledgments

The authors are grateful to the members of the United Nations Interagency Working Group–Costing for their feedback on preliminary versions of the findings presented in this report. We also thank David Sarley for his technical guidance and for comments on earlier versions of the report.

Executive Summary

Background

The last mile is that portion of the supply chain that delivers a health product from the last storage point to the consumer at the service delivery point. This paper presents estimates of last mile supply chain costs for public health commodities in developing countries. The estimates are in response to a request by the developers of the United Nations OneHealth Model for guidance on how to best include last mile costs in the model.

Methods

We derived estimates from a secondary analysis of data from 20 supply chain costing studies in six countries. Each examines a somewhat different commodity or set of commodities, including vaccines, antimalarial drugs, contraceptives, antiretrovirals (ARVs), and essential drugs. The study settings are also quite different, each with its own factors that influence cost, and each with different supply chain systems. Moreover, the cost elements that each study included in their calculations were not uniform. For example, some studies included procurement costs whereas others did not.

Findings

Despite differences in underlying costing methods and supply chain contexts, the findings clearly point to a significant role for the last mile as a driver of supply chain costs. As a proportion of commodity value, last mile costs are 17 percent (median); in addition, about half of all supply chain costs are last mile costs (median value of 49 percent). Thus, leaving last mile costs out of a planning and budgeting exercise such as the OneHealth Model may seriously understate system costs. We also found a high degree of variability in last mile costs, both as a percentage of commodity value, volume, or weight and relative to other supply chain costs.

Options for Including Last Mile Costs in the OneHealth Model

Because the OneHealth Model already allows for calculation of last mile training, supervision, storage, cold chain, and management costs, the challenge is how to incorporate last mile *transport* costs. We propose a "markup" approach in which the OneHealth analyst would apply a last mile transport markup to the supply chain cost value that the model produces. This markup would vary based on the number of tiers in the supply chain and on distance and terrain conditions in the country. The medium markup for a two-tier system would be 50 percent, whereas the medium markup for a system with three or more tiers would be 25 percent. As data on supply chain costs from a greater range of studies become available, the OneHealth Model may eventually want to incorporate a more complex algorithm to derive markup factors.

Introduction

This paper presents estimates of last mile supply chain costs for public health commodities in developing countries. The estimates are based on a secondary analysis of data from 20 studies in response to a request by the developers of the United Nations OneHealth Model. The model is a new software tool designed to strengthen health system analysis, costing, and financing scenarios at the country level. Its primary purpose is to assess public health investment needs in low- and middle-income countries (International Health Partnership 2013). Although the model captures many of the costs associated with public health supply chains in developing countries, the developers saw a gap with respect to last mile costs. In early 2011, they requested the guidance of the Logistics Expert Group, a group of outside technical advisors, on how to best include last mile supply chain costs.

Three members of the Logistics Expert Group (USAID | DELIVER PROJECT, PATH/WHO Project OPTIMIZE, and VillageReach) developed preliminary estimates of last mile costs based on recent studies and presented these in January 2011 to the Interagency Working Group–Costing (IAWG), the principal UN group leading the development of the model. IAWG members requested further clarification from the Logistics Expert Group on components of last mile costs, based on a concern that adding last mile costs to the OneHealth Model might generate double-counting of some costs already accounted for between the central and regional level costs, or by other modules of the OneHealth Model. These include, for example, staff time at the service delivery point (SDP). In response to the request of the IAWG, the Expert Group clarified the definition of the last mile (**Box 1**), and provided a more detailed analysis of the components of last mile costs.

Box 1. Defining Last Mile Costs

The last mile is that portion of the supply chain that delivers the health product from the last storage point to the consumer at the service delivery point (SDP). However, because developing country healthcare supply chains can vary greatly, getting from "the last storage point to the SDP" can have multiple meanings (USAID | DELIVER PROJECT 2011). Many countries use a multi-tier system in which products from a central warehouse flow to stores located at regional, and then district levels before moving to SDPs. The "last mile" under this system is the effort of getting the product from the district storage point to the SDP. It would be a mistake, however, to think that all supply chains operate in this way. Many countries do not use the district as a storage point. In some countries, products flow directly from a central warehouse to SDPs. Under this scenario, the "last mile" means getting the product from the central warehouse to the SDP. Like in a three- or four-tier arrangement, the responsibility for transporting the product in a two-tier system may be the responsibility of either the health worker at the SDP or of workers from the central storage point (e.g., in the Delivery Team Topping Up model in Zimbabwe).* Examples of three- or four-tier systems, such as the distribution of family planning products in Nigeria, add a regional or state store because of geographic or administrative reasons. The four-tier system is common for immunization services—for example, in Project OPTIMIZE countries such as Tunisia and Senegal. Vietnam has a five-tier immunization system.

*This is a stylized description of the last mile portion of the supply chain. In reality, the arrangements for the last mile (particularly in terms of mode of transport, responsibility for transport, and frequency of delivery) can change from month to month for the same service delivery point or

The IAWG-Costing further clarified that the OneHealth Model logistics module may already include many of the components of last mile costs, including those related to supply chain management, training, supervision, and storage. In fact, it appears that it is last mile *transport* costs alone that the OneHealth Model omits. Therefore, we

carried out further analyses that isolate the cost of transport to last mile. This paper presents these revised estimates, and our recommendations for applying these findings to the OneHealth Model.

Methods

We reviewed 20 studies,[4] including 1 from PATH/WHO Project OPTIMIZE, 7 from VilllageReach, and 12 from USAID | DELIVER PROJECT (table 1). When interpreting the results, it is important to note that each study looks at a somewhat different commodity or set of commodities, including vaccines, antimalarial drugs, contraceptives, antiretrovirals (ARVs), essential drugs, or a combination of one or more of these products. Moreover, the studies are set in six different countries, each with its own factors that influence cost, and each with different supply chain systems.

Table 1. Studies Included in Last Mile Supply Chain Cost Analysis

#	Commodity type	Source	Country	Geographic coverage	Sites	Tiers
1	Vaccines	PATH 2011	Vietnam	National	40	5
2	Vaccines	MIT Zaragoza 2011	Mozambique	Cabo Delgado Region	88	3
3	Vaccines	MIT Zaragoza 2011	Mozambique	Niassa Region	12	4
4	Malaria (ACT)	ISolutions et al 2010	Nigeria	Bayelsa State	10	4
5	Malaria (ACT)	ISolutions et al 2010	Nigeria	Borno State	10	3
6	Malaria (ACT)	ISolutions et al 2010	Nigeria	Imo State	10	3
7	Malaria (ACT)	ISolutions et al 2010	Nigeria	Ogun State	10	4
8	Essential Drugs	VillageReach 2009	Nigeria	Kano State	10	3
9	Malaria and FP	Warren 2011	Malawi	National	National	2
10	Contraceptives	Sommerlatte & Spisak 2010	Nigeria	Six states	35	4
11	Contraceptives	Sommerlatte & Spisak 2010	Nigeria	Six states	15	3
12	ARVs	Baruwa, Tien, & Sarley 2009	Zambia	Ndola District	3	2
13	ARVs	Baruwa, Tien, & Sarley 2009	Zambia	Ndola District	4	2
14	ARVs	Baruwa, Tien, & Sarley 2009	Zambia	Lusaka District	6	3
15	ARVs	Baruwa, Tien, & Sarley 2009	Zambia	Mpongwe District	3	3
16	ARVs	Baruwa, Tien, &	Zambia	Mpongwe District	2	2

[4] For the purposes of this paper, we count as separate studies when differences in supply chain structure warrant a differential analysis of data collected for a single study. For example, although the Zambia analysis was originally a single study, we report the findings as five separate studies based on differences in the number of supply chain tiers and types of facilities.

#	Commodity type	Source	Country	Geographic coverage	Sites	Tiers
		Sarley 2009				
17	FP & HIV	Sarley, Baruwa, and Tien 2010	Zimbabwe	National	National	2
18	FP & HIV	Sarley, Baruwa, and Tien 2010	Zimbabwe	National	National	2
19	FP, HIV, EDs	Sarley, Baruwa, and Tien 2010	Zimbabwe	National	National	2
20	FP, HIV, EDs	Sarley, Baruwa, and Tien 2010	Zimbabwe	National	National	2

We derived the results from secondary analyses of the datasets for each study. None originally intended to look specifically at last mile costs as we have defined them. The following sections report results by study, summarize the findings, and present our recommendations for incorporating last mile costs in the OneHealth Model.

Results from the Secondary Analysis

For each study, we briefly describe the methods, then report a standard set of cost indicators. We analyze vaccine supply chain costs separately because of the peculiarities of the vaccine supply chain. First, vaccines need cold chain equipment, which raises supply chain costs. Second, they are a very inexpensive commodity, which means that the ratio of supply chain costs to commodity value is typically much higher compared to other, more expensive commodities.

Vietnam: Vaccines

PATH/WHO Project OPTIMIZE collected logistics costs at the national vaccine store, all four regional stores, and a convenience sample of 5 provinces, 10 districts, and 20 health centers (figure 1). Costs included fixed and variable costs for vaccine storage and distribution, including personnel time for logistic activities, management, and reporting activities. The data were for fiscal year 2008. The study calculated outcome measures such as cost per dose, cost per m^3, and cost per value of vaccines handled. Using the Expanded Program on Immunization schedule introduced in 2010, about 3,000 doses of vaccines were delivered annually to each health center in the sample; this corresponds to an annual volume of 0.012 m^3 per health center.

Figure 1. Pipeline and Last Mile Costs for Vaccines, Vietnam, Five-tier System

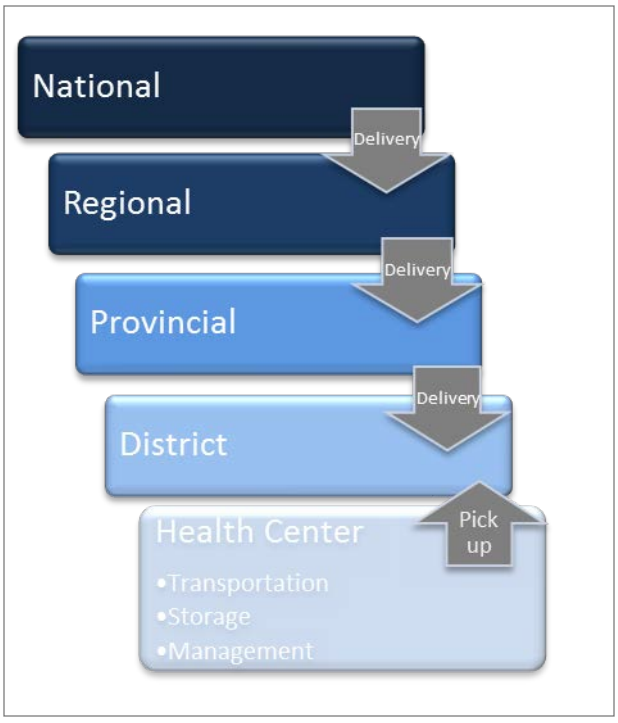


Table 2 shows overall logistics costs by tier and last mile costs disaggregated by main function. In this study, all last mile costs are incurred at the health center. Total supply chain costs are 26 percent of commodity value, with last mile costs making up 13 percent of commodity value, or 55 percent of the total. In this study, the last mile represents the effort of transporting commodities from the district to the health center (2.7 percent of commodity value), cold chain storage at the health center (8.7 percent), and labor costs to manage the commodities at the health center (2.8 percent). Relative to all other logistics costs, last mile costs are 121 percent.

Table 2. Supply Chain Costs for Vaccines, Vietnam

		Average logistic cost expressed as		
	Number of sites sampled	**% of commodity value**	**$ per volume (m^3)**	**$ per weight (kg)**
Supply chain costs by level				
Total	40	25%	$33,600	n.a.
Tier 1 - National	1	0.3%	$500	n.a.
Tier 2 - Regional	4	1%	$1,700	n.a.
Tier 3 - Provincial	5	3%	$3,400	n.a.
Tier 4 - District	10	8%	$10,000	n.a.
Tier 5 - Health Center	20	14%	$18,000	n.a.
Last mile supply chain costs				
Total last mile costs		14%		
Transport costs for vaccine collection		2.7%		
Fuel costs		0.9%		
Labor costs		1.8%		
Equipment (and energy)				
Cold storage equipment (and energy)		8.7%		
Other labor costs		2.8%		
Related measures				
Last mile costs as % of total logistics costs		54%		
Last mile costs as % of all other logistics costs		117%		

Mozambique: Vaccines

VillageReach used a micro costing approach to collect vaccine logistics cost data at the provincial or state level and at SDPs. We present as separate studies the results from two provinces, Niassa and

Cabo Delgado. The average number of doses delivered at the health center was 424 per month in Niassa (1,025 cm^3) and 842 in Cabo Delgado (1,950 cm^3).

Mozambique: Vaccines in Niassa Province

In Niassa province, the sample included 10 randomly chosen health centers, representing slightly higher than 10 percent of the facilities. Using data on activities and costs for the previous 3 months, total monthly and yearly costs were determined. The data was collected in 2009 with vaccine usage amounts from 2008. The study split the data to show the costs from district to SDP as well as the whole cost of logistics from the provincial storage depot to the service delivery point (figure 2). Central level costs include the costs of flying vaccines to the province.

Figure 2. Pipeline and Last Mile Costs for Vaccines, Niassa Province, Three-tier System

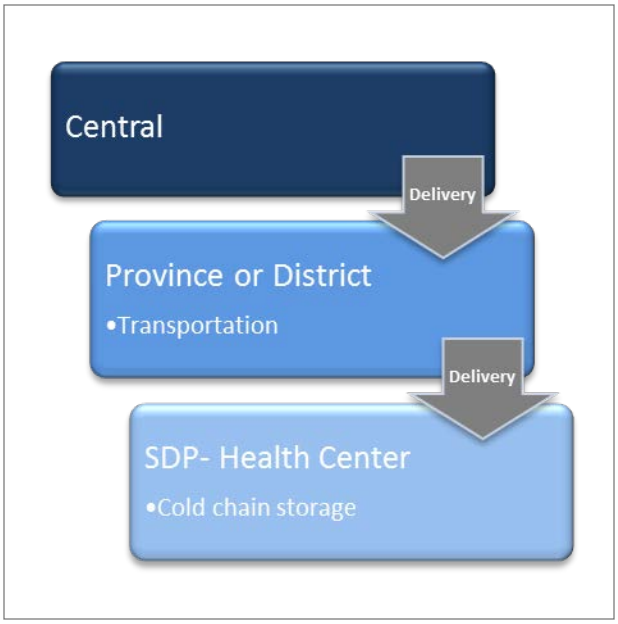


Table 3 shows overall logistics costs by tier and last mile costs disaggregated by main function. Total supply chain costs are 333 percent of commodity value. Last mile costs are 290 percent of commodity value. Last mile costs represent the effort of transporting vaccines directly from the province or district storage point (65 percent of value) plus the cold chain storage costs at the SDP (225 percent of value). As a percentage of all logistics costs, they represent 87 percent. Relative to all other logistics costs, last mile costs are 664 percent.

Table 3. Supply Chain Costs for Vaccines, Mozambique, Niassa Province

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Supply chain costs by level				
Total		333%	$0.27	
Tier 1 - Central	1	2%	$0.00	
Tier 2 - Province or District	9	41%	$0.03	
Tier 3 - SDP - Health Center	10	290%	$0.23	
Last mile supply chain costs				
Total last mile costs		290%	$0.23	
Transport		65%	$0.05	
Cold chain		225%	$0.18	
Related measures				
Last mile costs as % of total logistics costs		87%	87%	
Last mile costs as % of all other logistics costs		664%	664%	

Mozambique: Vaccines in Cabo Delgado Province

In Cabo Delgado province, costs are for all facilities over 1 year. The data collected included fixed and variable costs for vaccine storage and distribution at the district and SDP, including personnel time for logistic activities, transport costs for collecting or distributing vaccines, and cold chain support costs. This model does not include cold chain costs at the provincial store. The data for Cabo Delgado was collected in 2007 with vaccine usage amounts from calendar year 2007. In Cabo Delgado, the last mile is defined as the costs of transport from the province to the SDP and cold chain costs at the service delivery point. The system bypasses district storage depots (figure 3).

Figure 3. Pipeline and Last Mile Costs for Vaccines, Cabo Delgado, Three-tier System

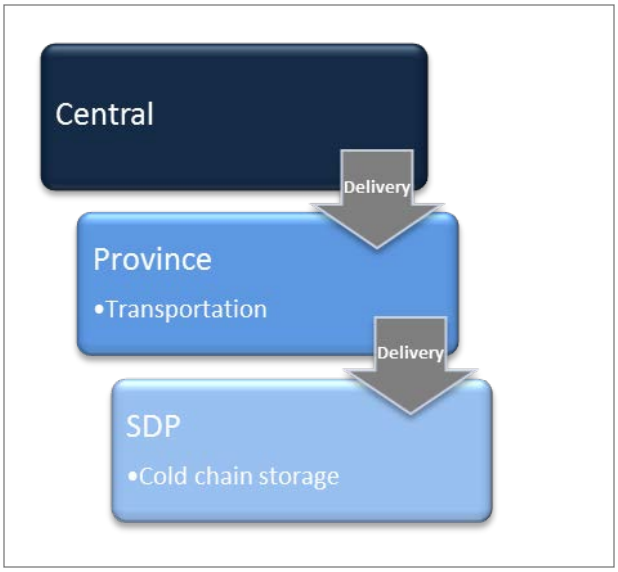


Table 4 shows overall logistics costs by tier and last mile costs disaggregated by main function. Last mile costs are 81 percent of commodity value, 98 percent of all supply chain costs, and 6,317 percent relative to all other logistics costs. The biggest last mile cost is for transport (43 percent of commodity value), followed by cold chain (38 percent).

Table 4. Supply Chain Costs for Vaccines, Mozambique, Cabo Delgado Province

		Average logistic cost expressed as		
	Number of sites sampled	**% of commodity value**	**$ per volume (m^3)**	**$ per weight (kg**
Supply chain costs by level				
Total		82%	$0.07	
Tier 1 - Central	1	1%	$0.00	
Tier 2 - Province	1			
Tier 3 - SDP	88	81%	$0.07	
Last mile supply chain costs				
Total last mile costs		81%	$0.07	
Transport		43%	$0.04	
Cold chain		38%	$0.03	
Related measures				
Last mile costs as % of total logistics costs		98%	98%	
Last mile costs as % of all other logistics costs		6317%	6317%	

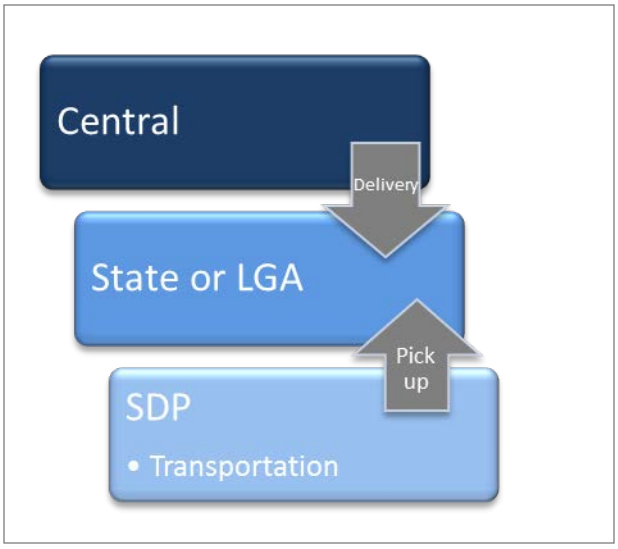
Nigeria: Artemisinin-based Combination Therapies

VillageReach collected logistics cost data at the state level down to the SDP. In each state, the sample included 10 health centers purposively selected to represent far distance (3), medium distance (4), and close distance (3). The study collected data on fixed and variable costs for storage and distribution, including personnel time for logistic activities and transportation costs for collecting or distributing artemisinin-based combination therapies (ACTs). The data for Nigeria was collected in 2010 with ACT usage values from 2009. In Bayelsa, Borno, Imo, and Ogun states, the supply chain costed was a parallel supply chain for ACTs provided by the Global Fund. Additionally, the volume information was not available for the ACT supply chain, as the breakdown of the different ACTs was unknown. The average number of doses delivered per month varied by state from 32 in Borno to 11 in Ogun state. Another consideration affecting the costs in these states is the variety of supply chain designs and the frequencies of distribution. These varied from collection, distribution, hub and spoke, circular routes, with routine distribution frequencies and without routine frequencies. VillageReach did not originally calculate costs at the central level. To make the figures from their studies more comparable to the others presented here, central level costs were added based on the average derived from the USAID | DELIVER PROJECT Nigeria studies discussed here.

Nigeria: ACTs in Bayelsa State

Table 5 shows overall logistics costs by tier and last mile costs disaggregated by main function. Last mile costs, which represent the effort of moving ACTs from the district to the SDP (figure 4), are 54 percent of commodity value.

Figure 4. Pipeline and Last Mile Costs for ACTs, Bayelsa State, Nigeria, Three-tier System



As a percentage of all logistics costs, they represent 80 percent. Relative to all other logistics costs, last mile costs are 398 percent.

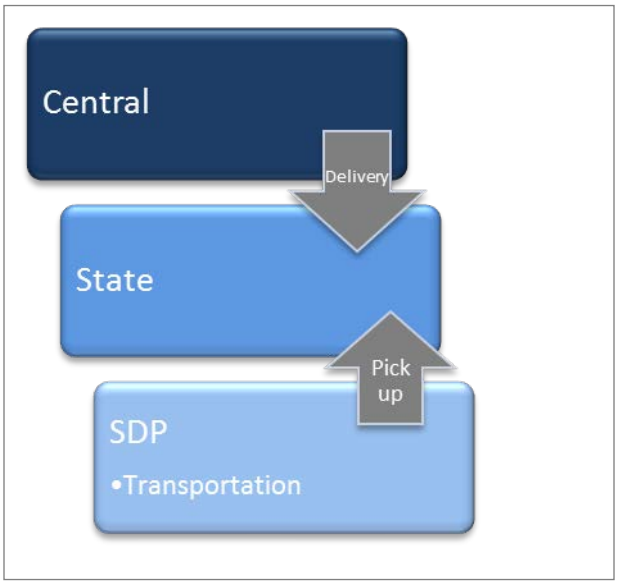
Table 5. Supply Chain Costs for ACTs, Nigeria, Bayelsa State

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Supply chain costs by level				
Total		68%	n.a.	n.a.
Procurement		7%		
Tier 1 - Central	1	5%		
Tier 2 - State or local government authority	9	8%		
Tier 3 - SDP	10	54%		
Last mile supply chain costs				
Total		54%		
Transport		54%		
Related measures				
Last mile costs as % of total logistics costs		80%		
Last mile costs as % of all other logistics costs		398%		

Nigeria: ACTs in Borno State

Table 6 shows overall logistics costs by tier and last mile costs disaggregated by main function. Last mile costs, which represent the effort of moving ACTs from the state level to the SDP (figure 5), are 16 percent of commodity value.

Figure 5. Pipeline and Last Mile Costs for ACTs, Borno State, Nigeria, Three-tier System



As a percentage of all logistics costs, they represent 42 percent. Relative to all other logistics costs, last mile costs are 73 percent.

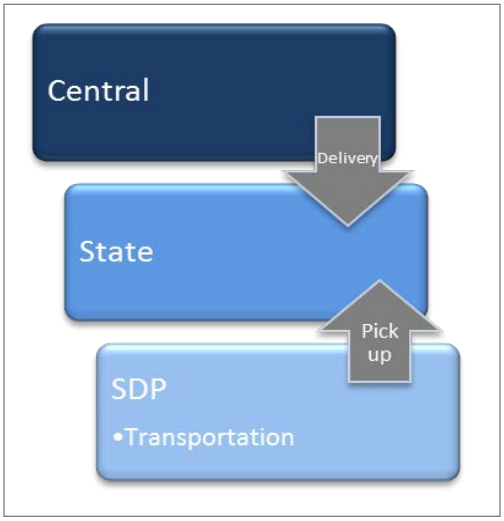
Table 6. Supply Chain Costs for ACTs, Nigeria, Borno State

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Supply chain costs by level				
Total		39%	n.a.	n.a.
Procurement		7%		
Tier 1 - Central	1	5%		
Tier 2 - State	1	10%		
Tier 3 - SDP	10	16%		
Last mile supply chain costs				
Total		16%		
Transport		16%		
Related measures				
Last mile costs as % of total logistics costs		42%		
Last mile costs as % of all other logistics costs		73%		

Nigeria: ACT in Imo State

Table 7 shows overall logistics costs by tier and last mile costs disaggregated by main function. Last mile costs, which represent the effort of moving ACTs from the state level to the SDP (figure 6), are 17 percent of commodity value.

Figure 6. Pipeline and Last Mile Costs for ACTs, Imo State, Nigeria, Three-tier System



As a percentage of all logistics costs, they represent 43 percent. Relative to all other logistics costs, last mile costs are 76 percent.

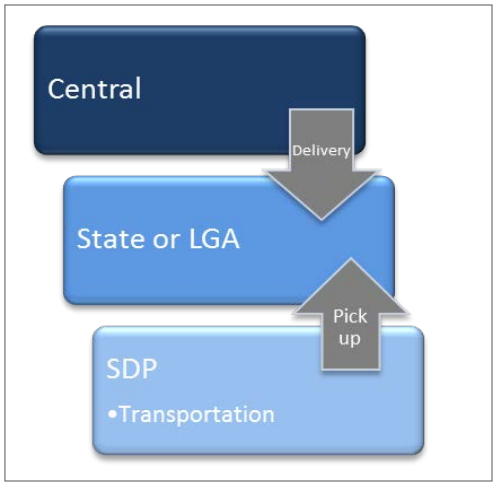
Table 7. Supply Chain Costs for ACTs, Nigeria, Imo State

		Average logistic cost expressed as		
	# sites	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Supply chain cost by level				
Total		39%	n.a.	n.a.
Procurement		7%		
Tier 1 - Central	1	5%		
Tier 2 - State	1	10%		
Tier 3 - SDP	10	17%		
Last mile supply chain costs				
Total		17%		
Transport		17%		
Related measures				
Last mile costs as % of total logistics costs		43%		
Last mile costs as % of all other logistics costs		76%		

Nigeria: ACT in Ogun State

Table 8 shows overall logistics costs by tier and last mile costs disaggregated by main function. Last mile costs, which represent the effort of moving ACTs from the district to the SDP (figure 7), are 3 percent of commodity value.

Figure 7. Pipeline and Last Mile Costs for ACTs, Ogun State, Nigeria, Three-tier System



As a percentage of all logistics costs, they represent 5 percent. Relative to all other logistics costs, last mile costs are 6 percent.

Table 8. Supply Chain Costs for ACTs, Nigeria, Ogun State

		Average logistic cost expressed as		
	# sites	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Supply chain costs by level				
Total		55%	n.a.	n.a.
Procurement		7%		
Tier 1 - Central	1	5%		
Tier 2 - State or local government authority	11	40%		
Tier 3 - SDP	10	3%		
Last mile supply chain costs				
Total		3%		
Transport		3%		
Related measures				
Last mile costs as % of total logistics costs		5%		
Last mile costs as % of all other logistics costs		6%		

Nigeria: Essential Drugs in Kano State

This VillageReach study examined costs of an essential drugs supply chain in Kano state (figure 8). Primary health centers obtain most of their essential drugs through this system, which is financed by a drug revolving fund. Data represent an average cost of logistics from the state level to the SDP. The value of commodities delivered to each local government authority (LGA) and each SDP was not collected as part of this cost study. Only the total value of all commodities at the state level was collected, making it difficult to disaggregate the data available from the LGA level with any accuracy. Volumes were calculated based on volume of drugs sold to a sample of facilities. In this study, the last mile represents the transport costs from the district to the SDP, and includes personnel costs for managing stores at the facility level and the time included for the requisition process that were not included in the other states. As for the ACT supply chain studies described above, the essential drugs study did not calculate central level costs; thus, we have adjusted the totals to include central level costs based on the USAID | DELIVER PROJECT calculations for Nigeria (see below).

Figure 8. Pipeline and Last Mile Costs for Essential Drugs, Kano State, Nigeria, Three-tier System

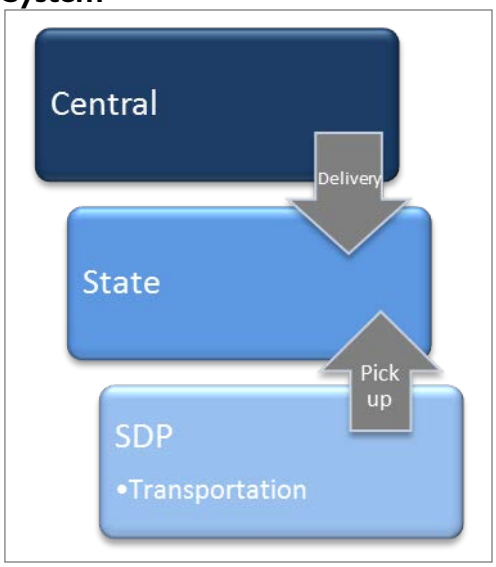


Table 9 shows overall logistics costs by tier and last mile costs disaggregated by main function. Total supply chain costs are 31 percent of commodity value, with last mile costs representing 8 percent of commodity value. As a percentage of all logistics costs, last mile costs are 27 percent. Relative to all other logistics costs, last mile costs are 36 percent.

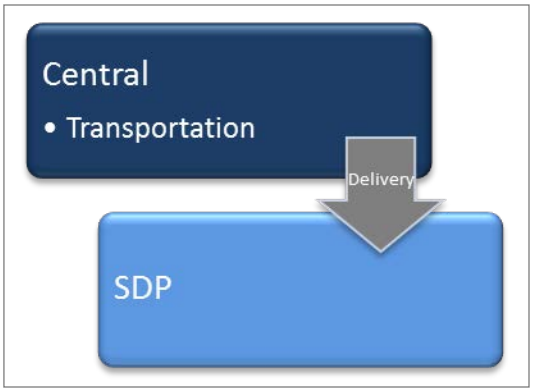
Table 9. Supply Chain Costs for Essential Drugs, Nigeria, Kano State

		Average logistic cost expressed as		
	Number of sites sampled	**% of commodity value**	**$ per volume (m^3)**	**$ per weight (kg)**
Supply chain costs by level				
Total		31%	n.a.	n.a.
Procurement		7%		
Tier 1 - Central	1	5%		
Tier 2 - State	1	10%		
Tier 3 - SDP	10	8%		
Last mile supply chain costs				
Total		8%		
Transport		8%		
Cold Chain		0%		
Related measures				
Last mile costs as % of total logistics costs		27%		
Last mile costs as % of all other logistics costs		36%		

Malawi: Malaria Drugs and Contraceptives

In Malawi, the USAID | DELIVER PROJECT contracted with a private company to deliver malaria and family planning commodities to 612 SDPs around the country. The company delivers directly from a central warehouse to SDPs (figure 9). In this scenario, last mile costs encompass cost of transporting commodities from the center to SDPs.

Figure 9. Pipeline and Last Mile Costs for Malaria Drugs and Contraceptives, Malawi, Two-tier System



Logistics costs as a proportion of commodity value are 7.2 percent, with last mile costs 6.4 percent of commodity value (table 10).

Table 10. Supply Chain Costs for Malaria and Family Planning Commodities, Malawi

		Average logistic cost expressed as		
	Number of sites sampled	**% of commodity value**	**$ per volume (m^3)**	**$ per weight (kg)**
Supply chain costs by level				
Total		7.2%	$464	n.a.
Last mile supply chain costs				
Total		6.4%	$409	
Transport		6.4%	$409	
Related measures				
Last mile costs as % of total logistics costs		88%		
Last mile costs as % of all other logistics costs		752%		

Nigeria: Contraceptives

This USAID | DELIVER PROJECT study collected data on procurement, storage, transportation, and management costs in six states: Anambra, Cross River, Gombe, Kebbi, Plateau, and Ogun. We report here on last mile costs for two variants of the supply chain system: a four-tier system that

distributes to primary health centers and a three-tier system that distributes to secondary health centers.

Nigeria: Four-tier Distribution to Primary Healthcare Centers

The four-tier system includes the contraceptive central warehouse, state central medical stores, LGA, and primary healthcare SDP (figure 10). In this context, last mile supply chain costs include the effort by LGA staff to supervise and train SDP staff, plus costs incurred at the SDP for procurement (completing reports and managing finances for the cost recovery system), transport from the LGA to the SDP, management of products (mainly for management of the logistics management information system and operating costs associated with the facility), and storage.

Figure 10. Pipeline and Last Mile Costs for Contraceptives, Nigeria, Four-tier System

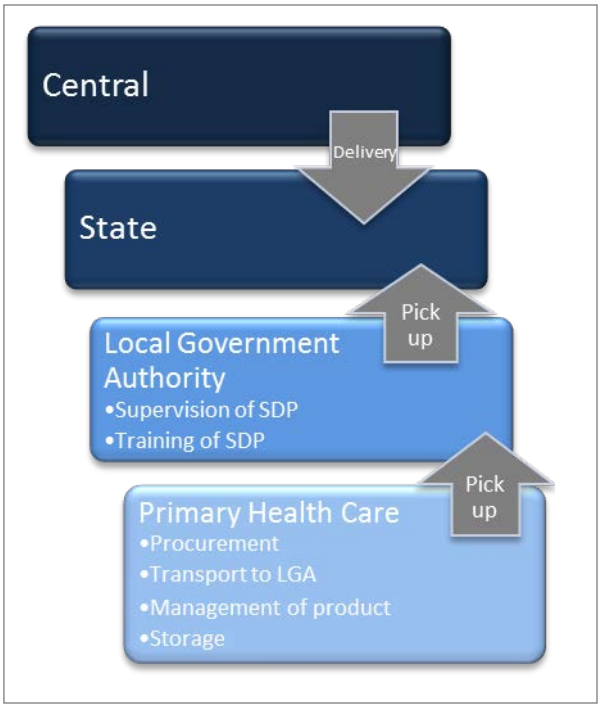


Table 11 shows overall logistics costs by tier and last mile costs by tier and disaggregated by main function. Last mile costs are 63 percent of commodity value. As a percentage of all logistics costs, they represent 55 percent. Relative to all other logistics costs, last mile costs are 120 percent. These figures are based on weighted averages, which mask large variations across sites, mostly due to disparities in the value of commodities passing through each SDP.

Table 11. Supply Chain Costs for Contraceptives, Nigeria, Four-tier System

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Supply chain costs by level				
Total	35	115%	$5,715	$ 46.54
Central procurement		7%	$135	$ 0.83
Tier 1 - Contraceptive central warehouse	1	5%	$99	$ 0.61
Tier 2 - State central medical stores	6	10%	$208	$ 1.34
Tier 3 - Local government authority	12	40%	$1,451	$ 12.94
Tier 4 - Service delivery point (primary)	16	52%	$3,822	$ 30.83
Last mile supply chain costs				
Total		62.7%	$4,195	$ 34.16
Tier 3 - Local government authority		10.3%	$373	$ 3.33
SDP training		0.9%	$33	$ 0.29
SDP supervision labor		4.9%	$178	$ 1.58
SDP supervision transport		4.0%	$145	$ 1.29
SDP Training		0.5%	$17	$ 0.16
Tier 4 - Service delivery point (primary)		52.5%	$3,822	$ 30.83
Procurement costs		4.0%	$287	$ 2.32
Storage costs		31.7%	$2,309	$ 18.62
Transport costs		7.8%	$567	$ 4.58
Management costs		9.0%	$659	$ 5.31
Related measures				
Last mile costs as % of total logistics costs		55%	73%	73%
Last mile costs as % of other logistics costs		120%	276%	276%

As expected, most last mile costs are incurred at the SDP (52 percent of commodity value). The bulk of these are for storage (32 percent of commodity value), followed by management (9 percent) and transport (8 percent). Last mile costs related to SDP supervision and training are also incurred at tier 3 LGAs (10 percent of commodity value).

Nigeria: Three-tier Distribution to Secondary Healthcare Centers

The second system variant in Nigeria includes three tiers: the contraceptive central warehouse, state central medical stores, and hospital SDPs (figure 11). In this variant, last mile supply chain costs

include the effort by state-level staff to supervise and train SDP staff, plus costs incurred at the SDP for procurement, transport from the state depot to the SDP, management of products, and storage.

Figure 11. Pipeline and Last Mile Costs for Contraceptives, Nigeria, Three-tier System

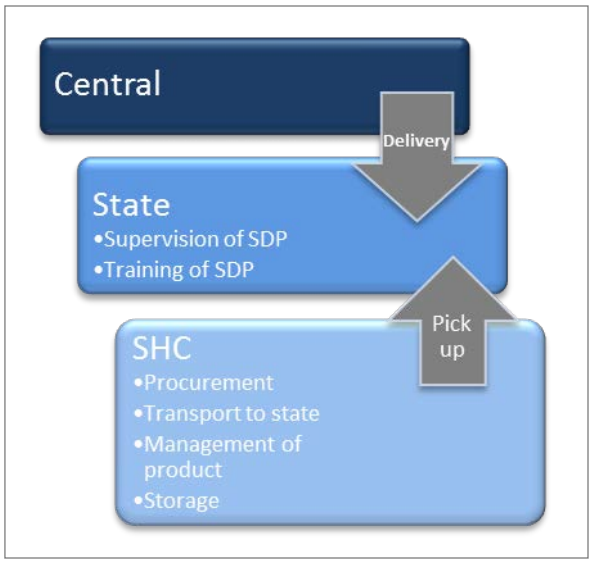


Table 12 shows overall logistics costs by tier and last mile costs by tier and disaggregated by main function for the three-tier system. Last mile costs are 54 percent of commodity value. As a percentage of all logistics costs, they represent 72 percent. Relative to all other logistics costs, last mile costs are 260 percent.

Table 12. Supply Chain Costs for Contraceptives, Nigeria, Three-tier System

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Supply chain costs by level				
Total	15	75%	$2,427	$ 26.43
Central procurement		7%	$135	$ 0.83
Tier 1 - Contraceptive central warehouse	1	5%	$99	$ 0.61
Tier 2 - State central medical stores	6	10%	$208	$ 1.34
Tier 3 - Service delivery point (secondary)	8	52%	$1,985	$ 23.65
Last mile supply chain costs				
Total		53.9%	$2,018	$ 23.86
Tier 2 - State central medical stores		1.6%	$33	$ 0.21
SDP training labor		0.2%	$4	$ 0.03
SDP supervision labor		0.8%	$16	$ 0.11

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
SDP supervision transport		0.6%	$12	$ 0.08
SDP Training		0.0%	0	$ -
Tier 3 - Service delivery point (secondary)		52.3%	$1,985	$ 23.65
Procurement costs		1.7%	$65	$ 0.77
Storage costs		39.7%	$1,506	$ 17.95
Transport costs		2.4%	$91	$ 1.08
Management costs		8.5%	$323	$ 3.85
Related measures				
Last mile costs as % of total logistics costs		72%	83%	90%
Last mile costs as % of all other logistics costs		260%	493%	930%

In the three-tier system, almost all last mile costs are incurred at the SDP (52 percent of commodity value). The bulk of these are for storage (40 percent of commodity value), followed by management (9 percent) and transport (2 percent). A small amount of last mile costs related to SDP supervision and training are incurred at the state central medical stores level (1.6 percent of commodity value).

Zambia: Antiretrovirals

The USAID | DELIVER PROJECT collected data on the antiretroviral (ARV) supply chain in Zambia, including procurement, storage, and distribution costs in 3 districts (1 in the Lusaka province and 2 from the Copperbelt province) and 10 antiretroviral therapy (ART) sites (out of 181 total ARV sites functioning at the time of the study). Unlike the USAID | DELIVER PROJECT studies in Nigeria and Zimbabwe, the Zambia study did not collect data on supervision, training, or management costs (with the exception of operating costs). All values are shown based on weighted averages, which—as in Nigeria—mask large variation across the 10 SDP sites, reflecting wide variation in value of commodities passing through each site. The analysis of last mile costs examines five system variants, including a two- and three-tier system in Ndola district; a three-tier system in Lusaka main district; and two and three-tier systems in Mpwongwe district.

Zambia Ndola District: Two-tier System

In the two-tier system in Ndola district (figure 12), last mile costs include transport from the central medical stores to hospitals, and storage and operating costs at the hospitals.

Figure 12. Pipeline and Last Mile Costs for ARVs, Zambia, Ndola District, Two-tier System

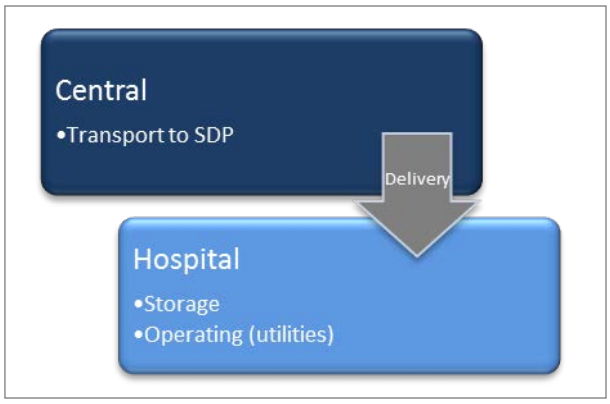


Table 13 shows overall logistics costs by tier and last mile costs by tier and disaggregated by main function for the two-tier system. Last mile costs are 2.5 percent of commodity value. As a percentage of all logistics costs, they represent 25 percent. Relative to all other logistics costs, last mile costs are 34 percent.

Table 13. Supply Chain Costs for ARVs, Zambia, Ndola District, Two-tier System

		Average logistic cost expressed as		
	Number of sites sampled	**% of commodity value**	**$ per volume (m^3)**	**$ per weight (kg)**
Supply chain costs by level				
Total	3	10%	$2,105	n.a.
Procurement		7%	$1,047	n.a.
Tier 1 - Medical stores limited	1	1%	$290	n.a.
Tier 2 - Hospital	2	2%	$768	n.a.
Last mile supply chain costs				
Total		2.5%	$793	
Tier 1 - Medical stores limited		0.1%	$25	
Transport		0.1%	$25	
Tier 2 - Hospital		2.5%	$768	
Storage		1.4%	$448	
Inventory		0.0%	$ -	
Transport		0.0%	$ -	
Operating (utilities)		1.0%	$320	
Related measures				
Last mile costs as % of total logistics costs		25%	38%	
Last mile costs as % of all other logistics costs		34%	60%	

In the two-tier system, almost all last mile costs are incurred at the SDP (2.5 percent of commodity value). These are split between storage (1.4 percent of commodity value) and operating costs (1.0 percent). A small amount of last mile costs related to transport is incurred at the central level (0.1 percent of commodity value).

Zambia Ndola District: Three-tier System

In the three-tier system in Ndola district (figure 13), last mile costs include transport from the district to health centers, and storage and operating costs at the centers.

Figure 13. Pipeline and Last Mile Costs for ARVs, Zambia, Ndola District, Three-tier System

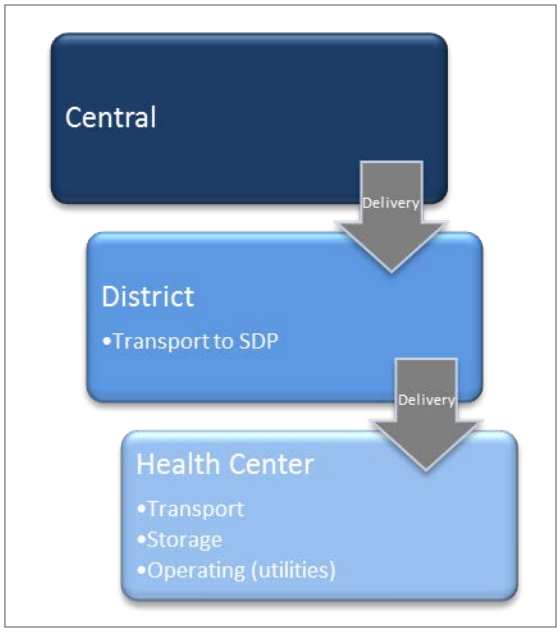


Table 14 shows overall logistics costs by tier and last mile costs by tier and disaggregated by main function for the three-tier system. Last mile costs are 1.4 percent of commodity value. As a percentage of all logistics costs, they represent 14 percent. Relative to all other logistics costs, last mile costs are 17 percent.

Table 14. Supply Chain Costs for ARVs, Zambia, Ndola District, Three-tier System

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Supply chain costs by level				
Total	4	10%	$2,981	n.a.
Procurement		7%	$2,127	

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Tier 1 - Medical stores limited	1	1%	$273	
Tier 2 - District	1	1%	$229	
Tier 3 - Health center	2	1%	$351	
Last mile supply chain costs				
Total		1.3%	$429	
Tier 2 - District		0.2%	$78	
Transport		0.2%	$78	
Tier 3 - Health center		1.1%	$351	
Storage		1.1%	$332	
Transport		0.1%	$14	
Operating (utilities)		0.01%	$4	
Related measures				
Last mile costs as % of total logistics costs		14%	14%	
Last mile costs as % of all other logistics costs		17%	17%	

In this system, most last mile costs are incurred at the service delivery point (1.11 percent of commodity value), and almost all are related to storage. Some last mile costs related to transport are incurred at the district level (0.24 percent of commodity value).

Zambia Lusaka Main District: Three-tier System

In the three-tier system in the Lusaka main district (figure 14), last mile costs include transport from the district to the SDP, and storage and operating costs at the SDP.

Figure 14. Pipeline and Last Mile Costs for ARVs, Zambia, Lusaka Main District, Three-tier System

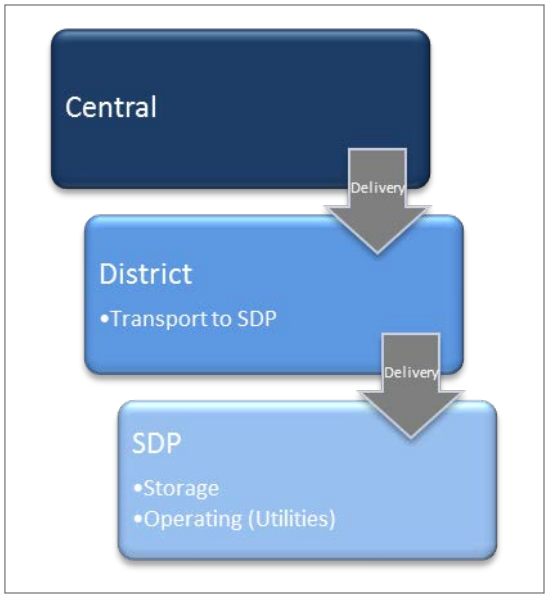


Table 15 shows overall logistics costs by tier and last mile costs by tier and disaggregated by main function for the three-tier system. Last mile costs are 1.6 percent of commodity value. As a percentage of all logistics costs, they represent 17 percent. Relative to all other logistics costs, last mile costs are 20 percent.

Table 15. Supply Chain Costs for ARVs, Zambia, Lusaka Main District, Three-tier System

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Supply chain costs by level				
Total	6	10%	$1,993	n.a.
Procurement		7%	$1,047	n.a.
Tier 1 - Medical stores limited	1	1%	$273	n.a.
Tier 2 - District	1	1%	$224	n.a.
Tier 3 - Health center	4	1%	$449	
Last mile supply chain costs				
Total		1.6%	$535	
Tier 2 - District		0.3%	$86	
Transport		0.3%	$86	
Tier 3 - Health center		1.3%	$449	

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Storage		1.2%	$409	
Operating (utilities)		0.1%	$40	
Related measures				
Last mile costs as % of total logistics costs		17%	27%	
Last mile costs as % of all other logistics costs		20%	37%	

In this three-tier system, most last mile costs are incurred at the service delivery point (1.3 percent of commodity value), and almost all are related to storage. Some last mile costs related to transport are incurred at the district level (0.29 percent of commodity value).

Zambia Mpongwe District: Three-tier System

In the three-tier system in Mpongwe district (figure 15), last mile costs include transport from the district to SDPs, and storage and operational costs at the SDPs.

Figure 15. Pipeline and Last Mile Costs for ARVs, Zambia, Mpongwe District, Three-tier System

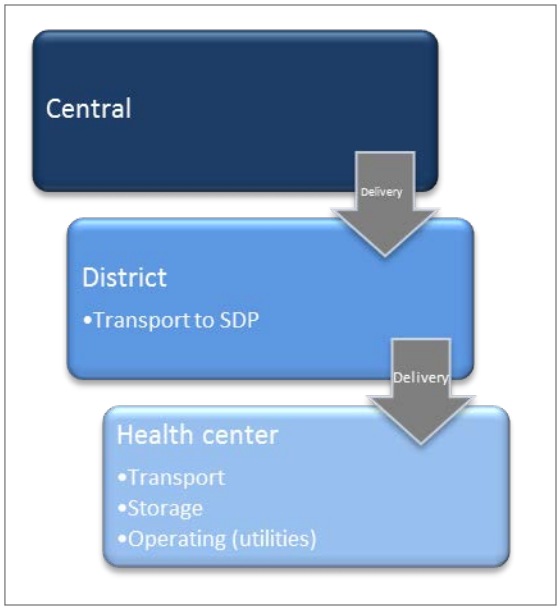


Table 16 shows overall logistics costs by tier and last mile costs by tier and disaggregated by main function for the three-tier system. Last mile costs are 17 percent of commodity value. As a percentage of all logistics costs, they represent 59 percent. Relative to all other logistics costs, last mile costs are 147 percent.

Table 16. Supply Chain Costs for ARVs, Zambia, Mpongwe District, Three-tier System

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Supply chain costs by level				
Total	3	28%	$5,990	n.a.
Procurement		5%	$1,408	n.a.
Tier 1 - Christian Health Association	1	6%	$1,602	n.a.
Tier 2 - District	1	1%	$272	n.a.
Tier 3 - Health center	1	17%	$2,708	n.a.
Last mile supply chain costs				
Total		16.9%	$2,716	
Tier 2 - District		0.03%	$9	
Transport		0.03%	$9	
Tier 3 - Health center		16.9%	$2,708	
Storage		15.6%	$2,503	
Transport		0.6%	$92	
Operating (utilities)		0.7%	$113	
Related measures				
Last mile costs as % of total logistics costs		59%	45%	
Last mile costs as % of all other logistics costs		147%	83%	

In this three-tier system, almost all last mile costs are incurred at the SDP (17 percent of commodity value), and almost all are related to storage. Transport costs are minimal, just 0.03 percent of commodity value at the district level, and 0.6 percent at the health center.

Zambia Mpongwe District: Two-tier System

In the two-tier system in Mpongwe district (figure 16), last mile costs include costs of transport from the center to hospitals, and storage and operating costs at the hospitals.

Figure 16. Pipeline and Last Mile Costs for ARVs, Zambia, Mpongwe District, Two-tier System

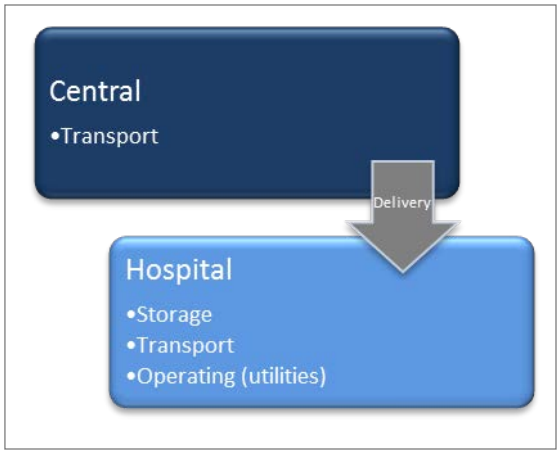


Table 17 shows overall logistics costs by tier and last mile costs by tier and disaggregated by main function for the two-tier system. Last mile costs are 5 percent of commodity value. As a percentage of all logistics costs, they represent 44 percent. Relative to all other logistics costs, last mile costs are 78 percent.

Table 17. Supply Chain Costs for ARVs, Zambia, Mpongwe District, Two-tier System

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Supply chain costs by level				
Total	2	12%	$3,529	n.a.
Procurement		5%	$1,408	n.a.
Tier 1 - Christian Health Association	1	6%	$1,602	n.a.
Tier 2 - Hospital	1	1%	$520	n.a.
Last mile supply chain costs				
Total		5.2%	$1,643	
Tier 1 - Christian Health Association		4.0%	$1,123	
Transport		4.0%	$1,123	
Tier 2 - Hospital		1.2%	$520	
Storage		0.5%	$223	
Transport		0.4%	$168	
Operating (utilities)		0.3%	$129	
Related measures				
Last mile costs as % of total logistics costs		44%	47%	

		Average logistic cost expressed as		
	Number of sites sampled	% of commodity value	$ per volume (m^3)	$ per weight (kg)
Last mile costs as % of all other logistics costs		78%	87%	

In this two-tier system, most of the last mile costs are transport costs incurred moving the product from the central to the hospital (4 percent of commodity value). Last mile costs at the hospital SDP are 1.2 percent of commodity value, divided between storage (0.5 percent), transport (0.4 percent), and operating costs (0.3 percent).

Zimbabwe: Contraceptives, HIV Supplies, and Essential Drugs

This USAID | DELIVER PROJECT study examined the cost of the Delivery Team Topping Up (DTTU) system for supplying 11 contraceptive and HIV products, how costs would change if different products were added to the delivery routes, and how the DTTU compares to a more traditional, pull essential drug system. Based on the vendor-managed inventory system that many commercial firms use, this system transfers stocktaking and top-up calculation tasks from facility medical staff to delivery teams. The Zimbabwe study collected information in a way similar to the USAID | DELIVER PROJECT studies in Nigeria and Zambia.

The DTTU is a two-tier system (figure 17). Tier 1 costs include all the transport, management, and storage costs at the central and branch level, whereas tier 2 costs include management and storage functions at the SDP. In this context, last mile costs include the costs of transporting products from the central level to SDPs, associated supervision, and cost of commodity management and storage at SDPs.

Figure 17. Pipeline and Last Mile Costs for Contraceptives, HIV supplies, and Essential Drugs, Zimbabwe, Two-tier DTTU

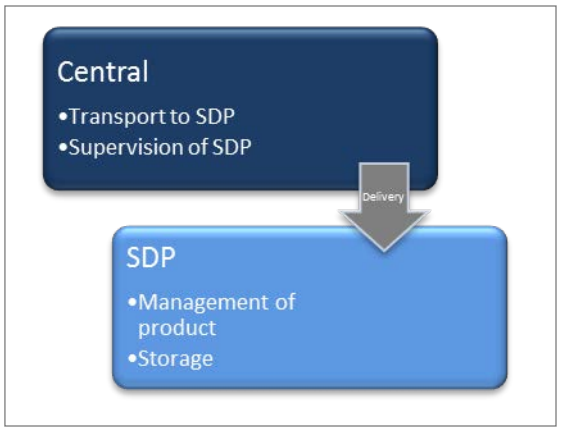


Table 18 shows overall logistics costs by tier and last mile costs by tier and disaggregated by main function for the two-tier system for each of four study scenarios. Scenario 1 uses data from the existing DTTU system. Scenarios 2, 3, and 4 use informed assumptions from staff and key

stakeholders. Last mile costs range from 22.55 percent of commodity value in scenario 1 to 16.57 percent in scenario 4. As a percentage of all logistics costs, they represent about 80 percent in all four scenarios. Relative to all other logistics costs, last mile costs are between 394 percent and 490 percent. As with the Nigeria and Zambia studies, the cost as a percentage of commodity value varies substantially across health facilities, depending on the value of commodities passing through and other factors.

Table 18. Supply Chain Costs, Zimbabwe, Two-tier DTTU

		Average logistic cost expressed as % of commodity value			
	# sites	Scenario 1 (FP + HIV)	Scenario 2 (FP + HIV)	Scenario 3 (FP + HIV + ED)	Scenario 4 (FP + HIV + ED)
Supply chain costs by level					
Total	33	28%	26%	24%	20%
Tier 1	4	19%	17%	12%	9%
Tier 2 - SDP	29	9%	9%	11%	11%
Last mile supply chain costs					
Total		22.6%	20.8%	19.0%	16.6%
Tier 1		13.8%	12.0%	7.6%	5.2%
Transport to SDP		10.2%	8.4%	5.6%	4.4%
Supervision of SDPs, labor		2.4%	2.4%	1.5%	0.2%
Supervision of SDPs, fuel & per diems		1.2%	12%	0.6%	0.6%
Tier 2 - SDP		8.9%	8.8%	11.4%	11.4%
Storage costs		5.0%	5.0%	7.7%	7.7%
Management costs		3.8%	3.8%	3.7%	3.7%
Related measures					
Last mile costs as % of total logistics costs		81%	80%	80%	83%
Last mile costs as % of all other logistics costs		434%	401%	395%	490%

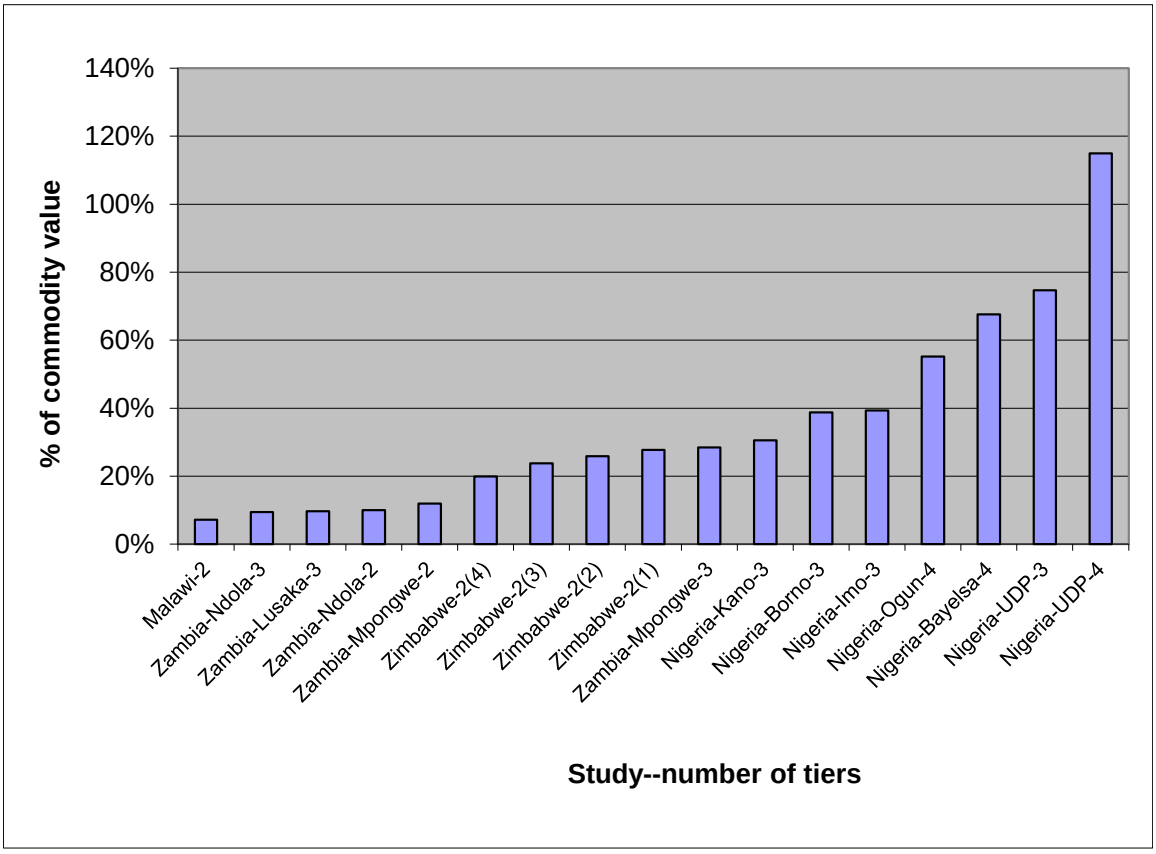
Summary of Findings

Looking across the 20 studies, we can draw some useful inferences about how the OneHealth Model might incorporate last mile supply chain costs. To reflect the underlying differences in vaccine supply chains versus supply chains for other commodities, each section first presents results for non-vaccine commodities followed by the vaccine results.

Total Supply Chain Costs

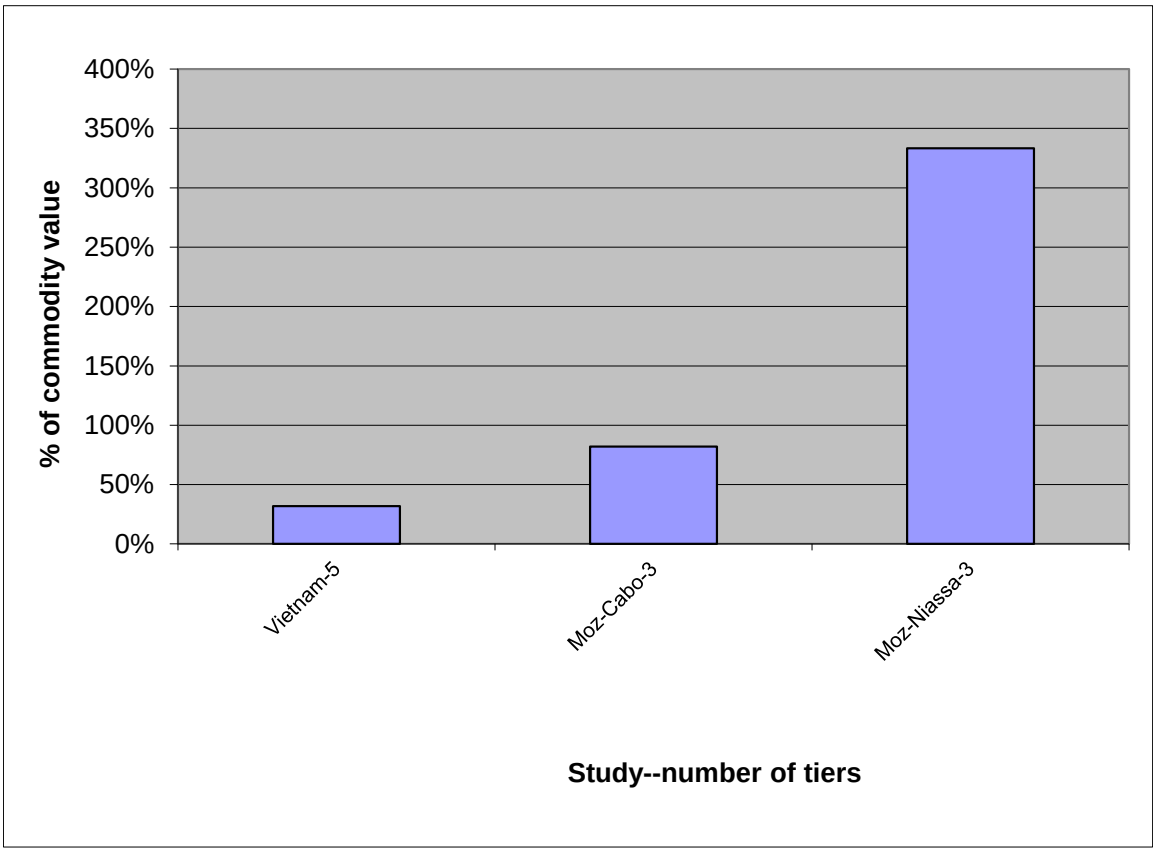
Total supply chain costs as a proportion of commodity value range between 7 percent in Malawi and 115 percent in Nigeria (figure 18), with a median of 28 percent.

Figure 18. Total Supply Chain Costs as a Percentage of Commodity Value



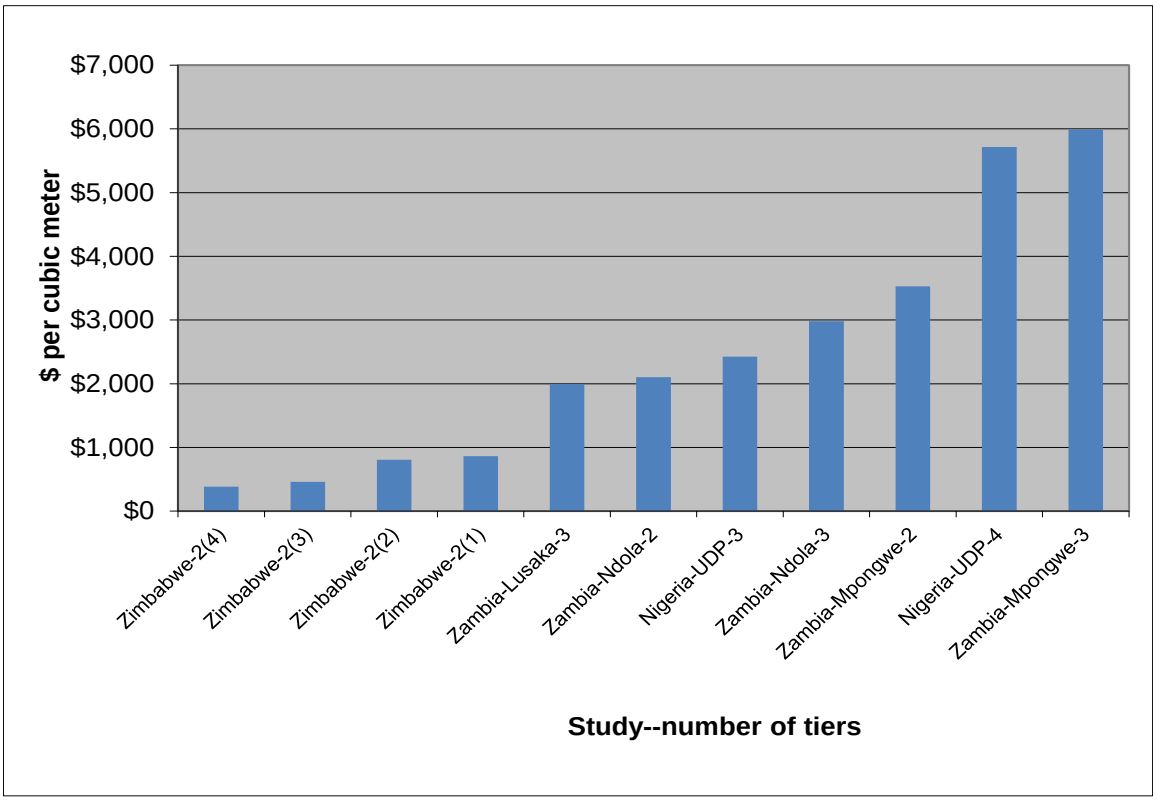
Meanwhile, total supply chain costs as a proportion of vaccine value range from 32 to 333 percent (figure 19).

Figure 19. Total Supply Chain Costs as a Percentage of Commodity Value: Vaccines



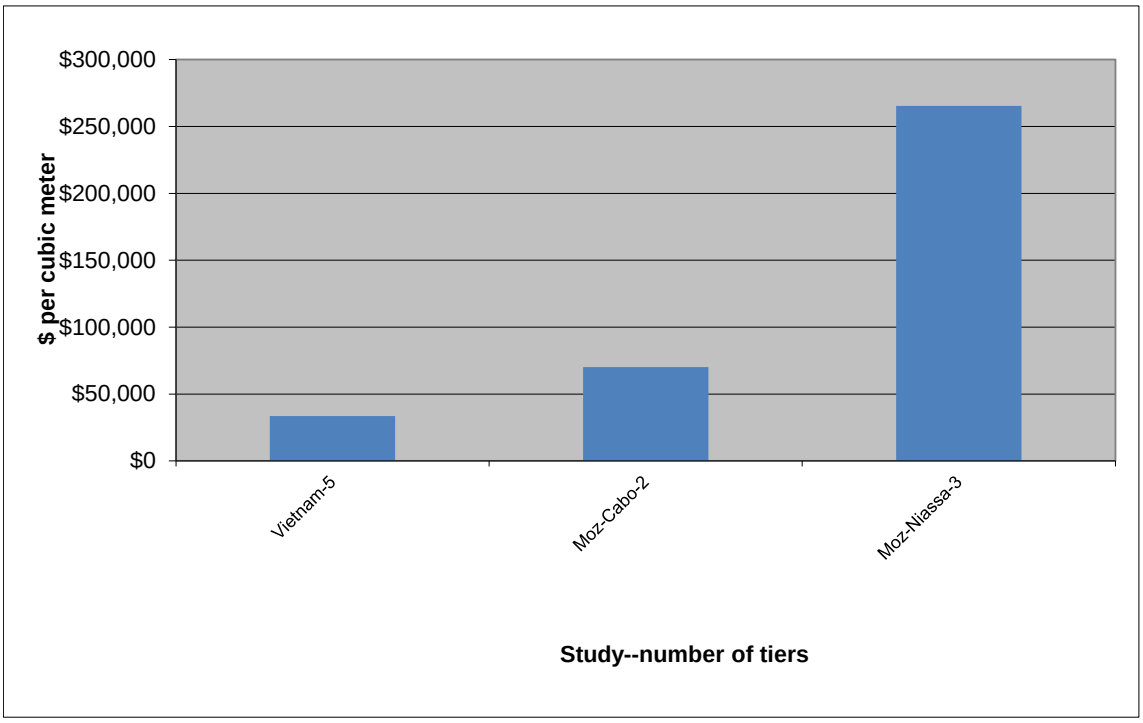
If we compare total supply chain costs with the volume of commodities as measured in cubic meters, we can see that costs range from about $400 per m^3 in Zimbabwe to almost $6000 per m^3 in Zambia (figure 20).

Figure 20. Total Supply Chain Costs per Cubic Meter of Commodity



Supply chain costs per cubic meter of vaccines are much higher, from $34,000 in Vietnam to over $250,000 in one province in Mozambique (figure 21).

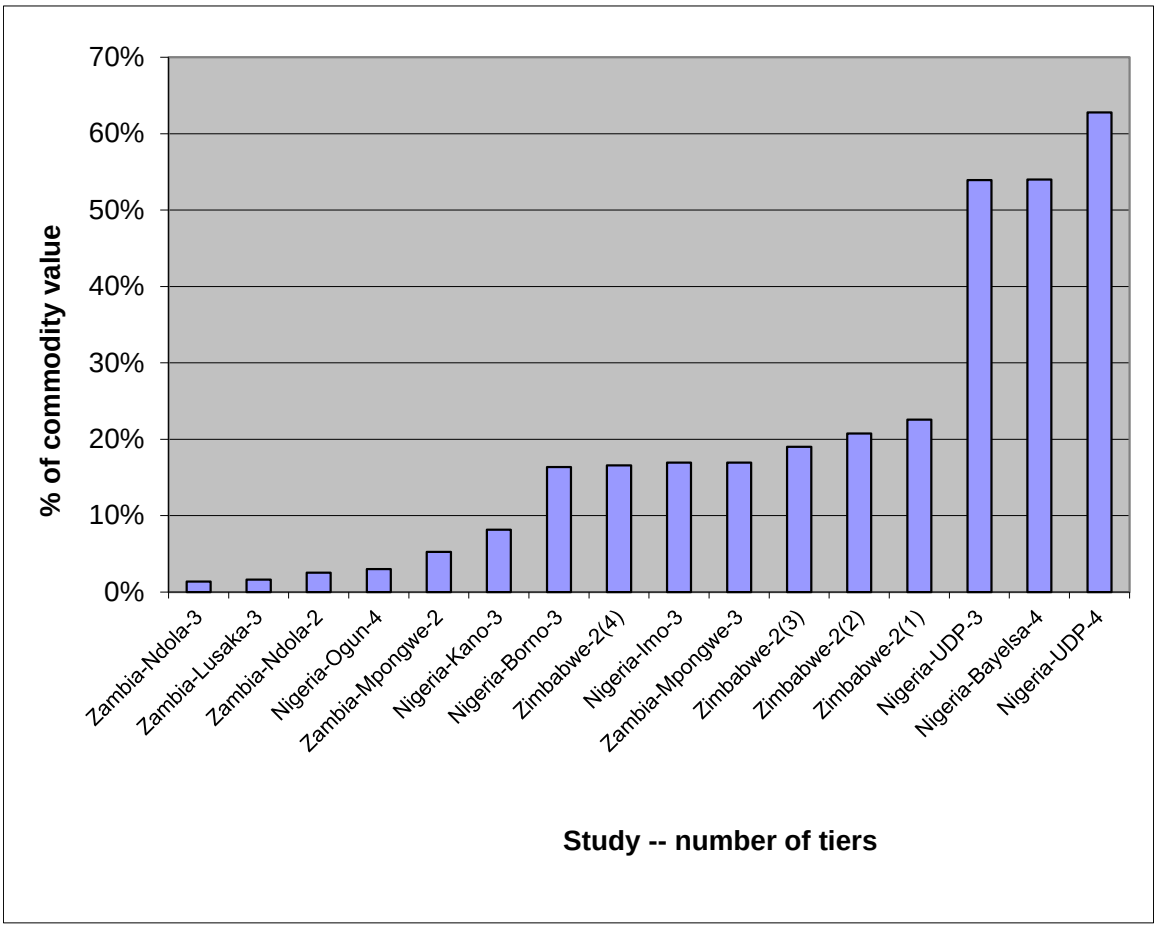
Figure 21. Total Supply Chain Costs per Cubic Meter of Commodity: Vaccines



Last Mile Supply Chain Costs

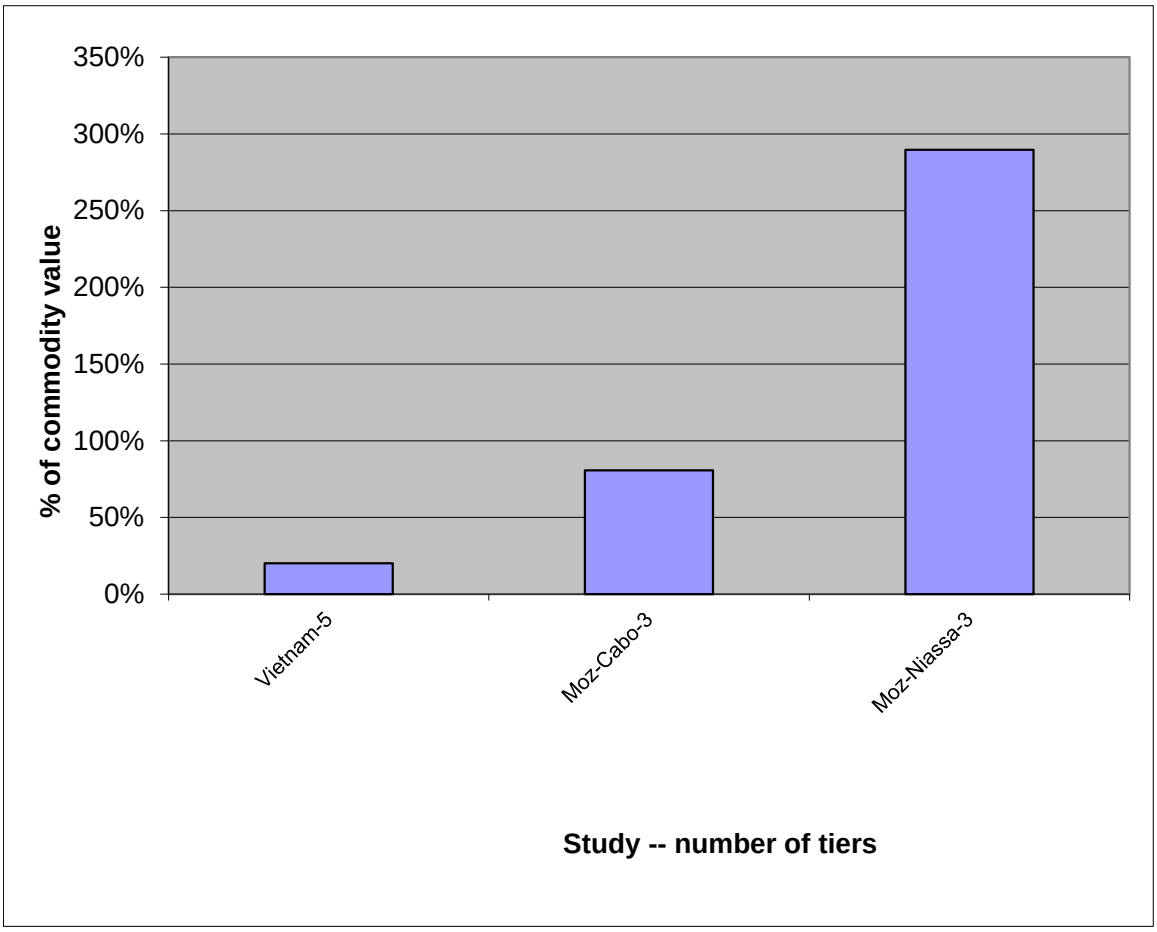
Last mile supply chain costs as a proportion of commodity value range from 1 percent to 63 percent with a median of 17 percent (figure 22).

Figure 22. Last Mile Supply Chain Costs as a Percentage of Commodity Value



Last mile costs for vaccines as a proportion of all supply chain costs range from 20 percent in Vietnam to 80 and 280 percent in the two provinces in Mozambique (figure 23).

Figure 23. Last Mile Supply Chain Costs as a Percentage of Commodity Value: Vaccines



Last mile costs in terms of volume as measured by cubic meters (figure 24) and per weight in kilograms (figure 25) show a similar pattern.

Figure 24. Last Mile Costs per Cubic Meter of Commodity Distributed

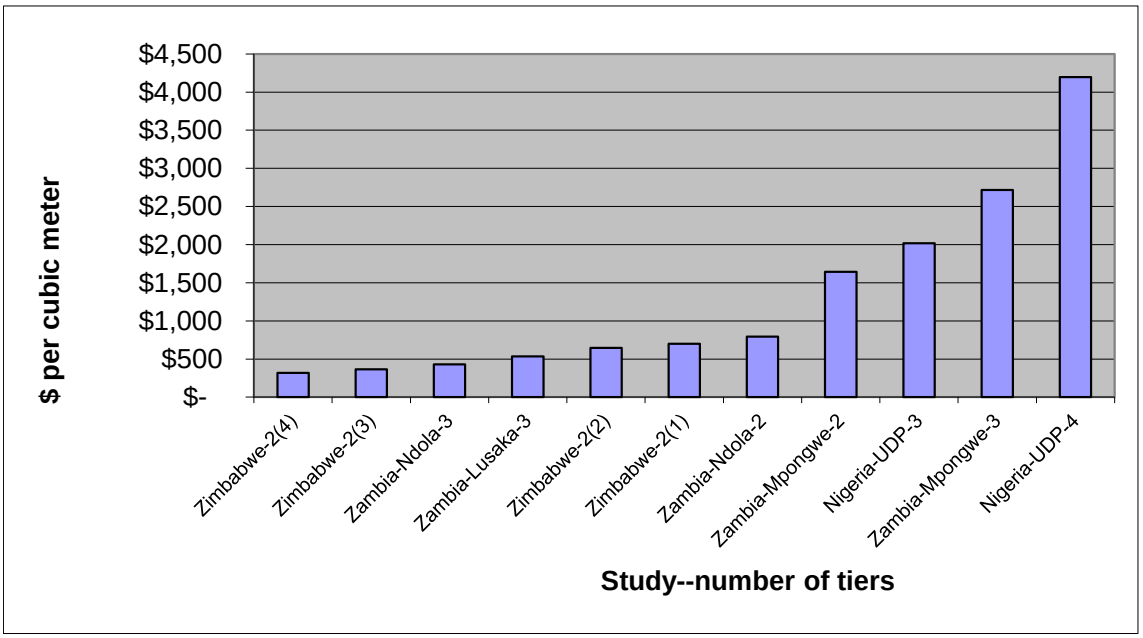
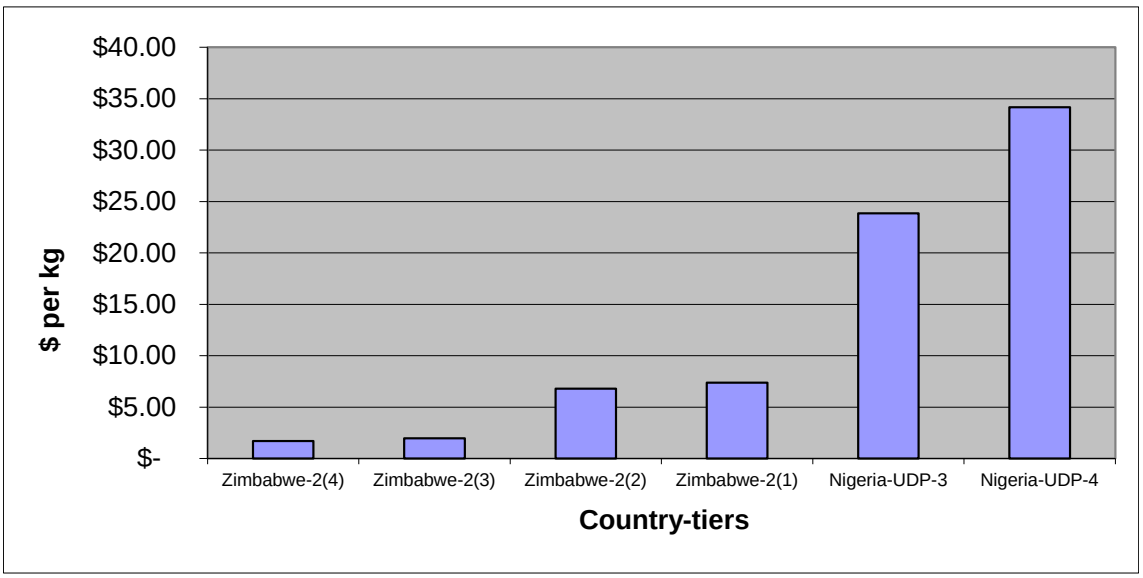
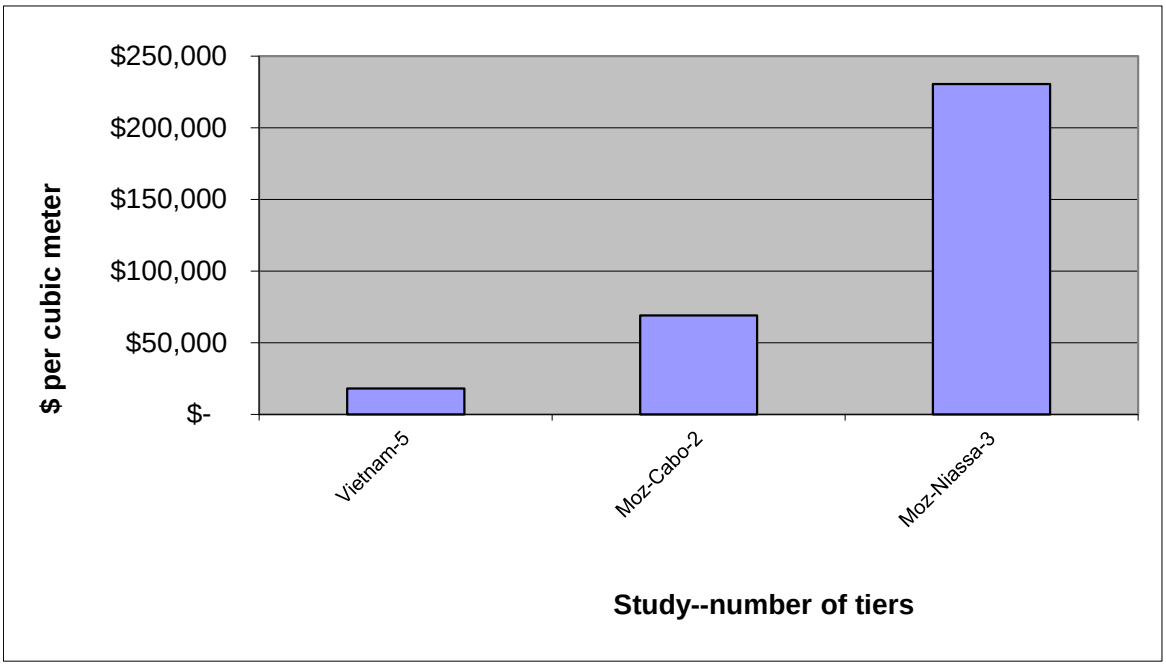


Figure 25. Last Mile Costs per Kilogram of Commodity Distributed



Last mile costs per cubic meter of vaccines distributed is much higher, between $18,000 and $230,000 (figure 26).

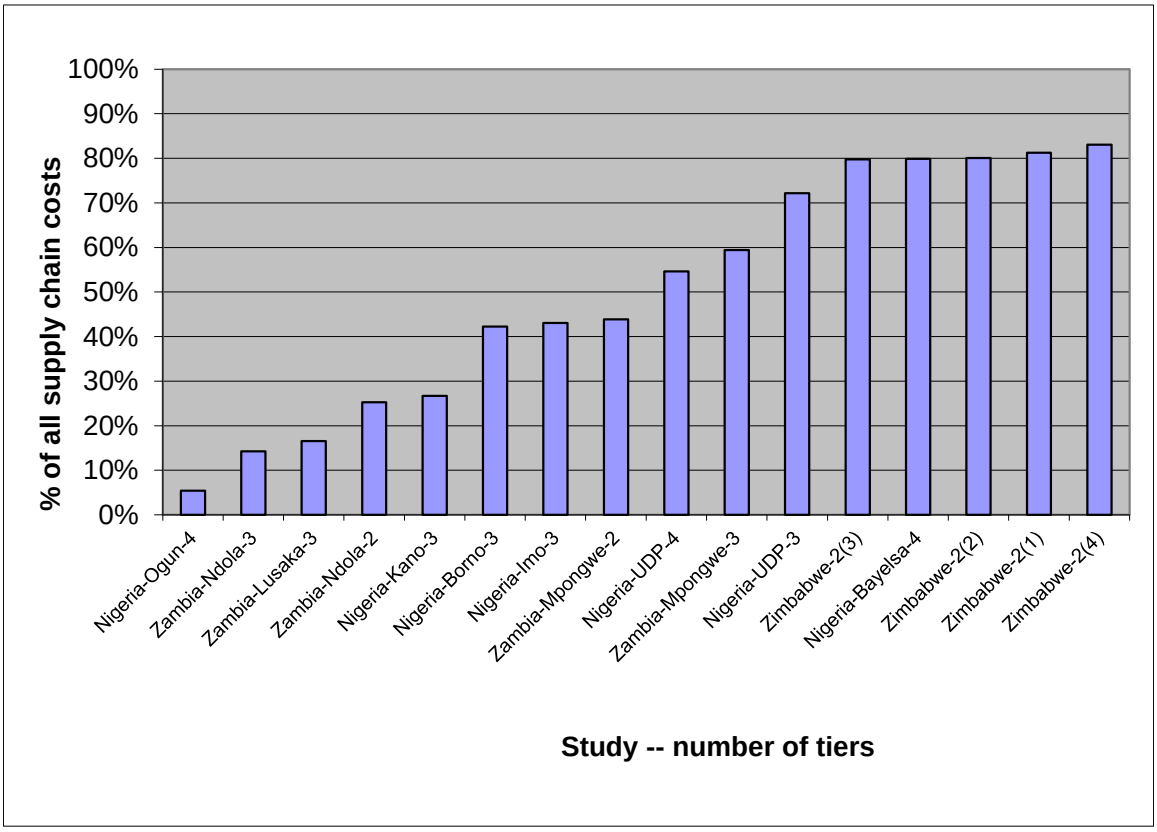
Figure 26. Last Mile Costs per Cubic Meter of Commodity Distributed: Vaccines



Last Mile Costs as Percentage of Total Supply Chain Costs

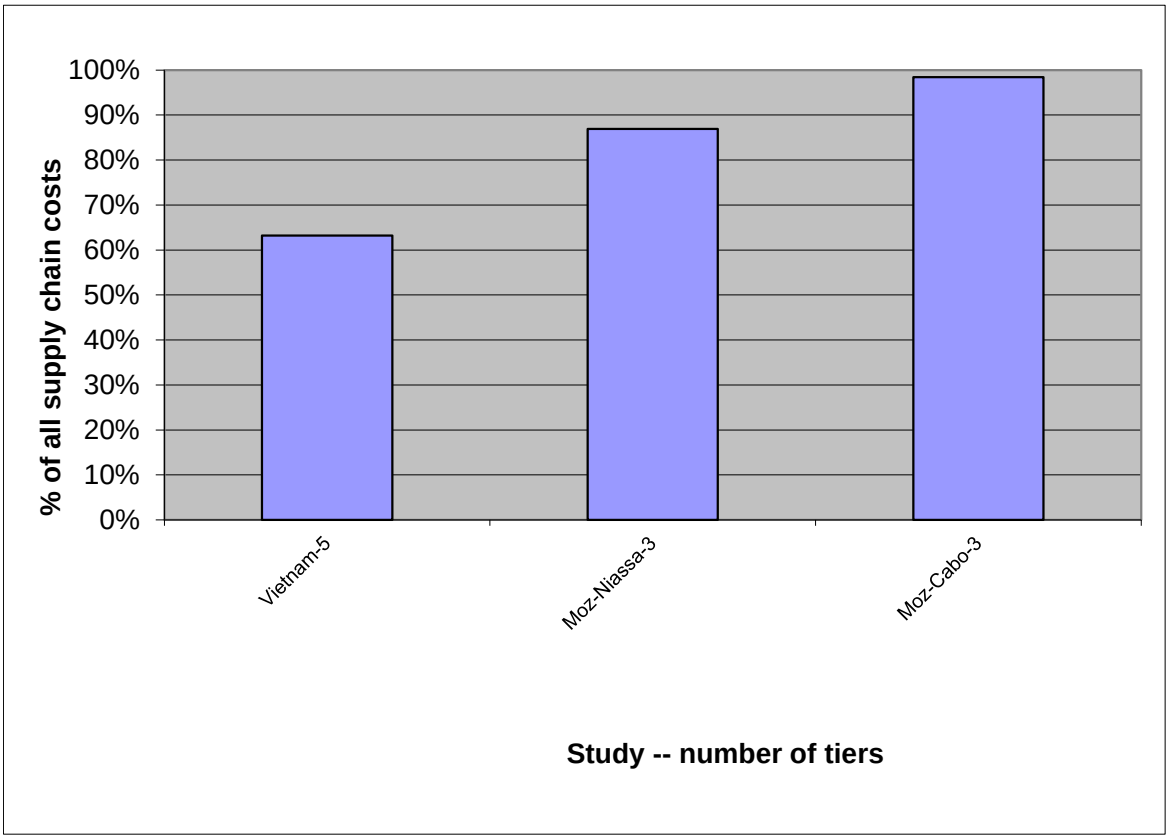
Last mile costs as a proportion of all supply chain costs are quite significant, over 40 percent in 11 of 16 studies (figure 27), with a median value of 49 percent.

Figure 27. Last Mile Supply Chain Costs as a Percentage of Total Supply Chain Costs



Last mile costs as a proportion of all vaccine supply chain costs is generally higher, ranging from 63 to 98 percent (figure 28).

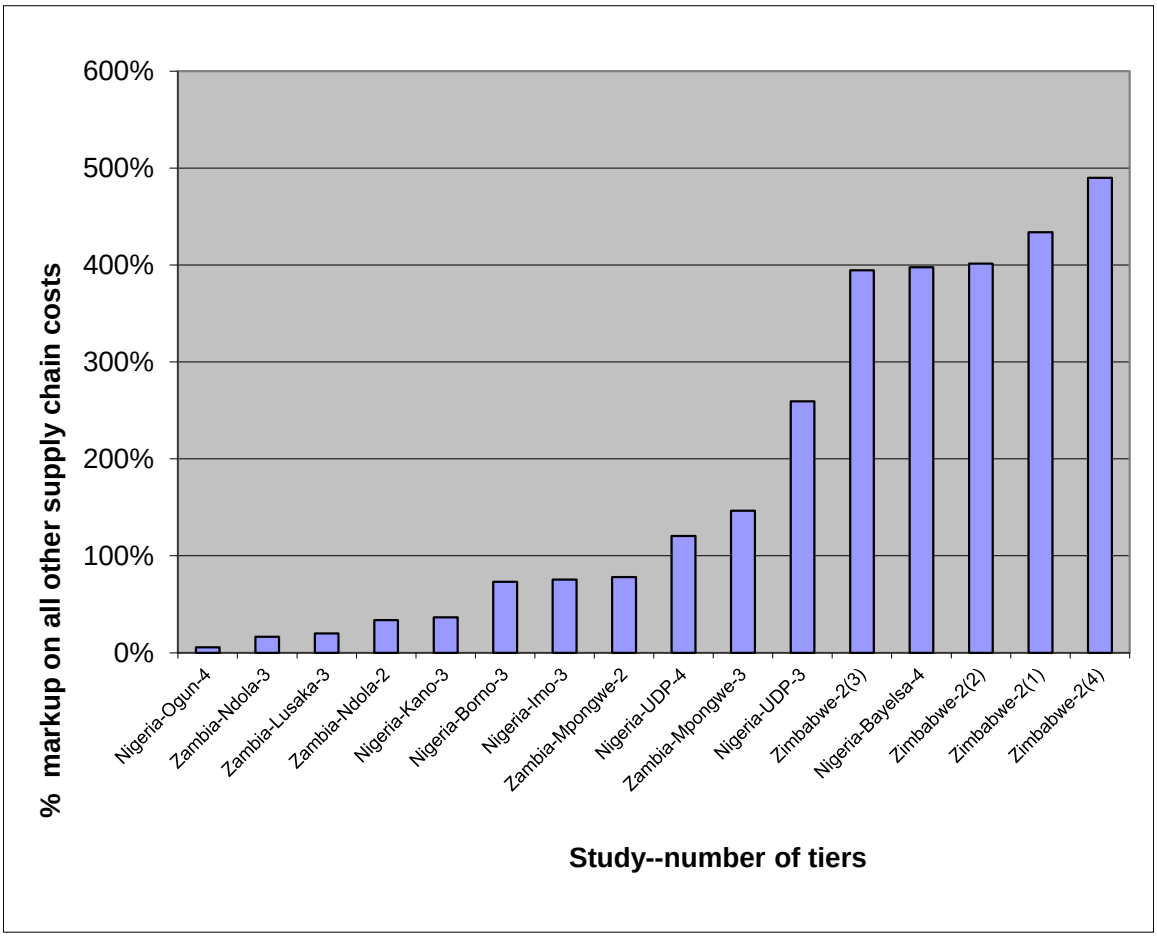
Figure 28. Last Mile Supply Chain Costs as a Percentage of Total Supply Chain Costs: Vaccines



Last Mile Costs as Percentage of All Other Supply Chain Costs

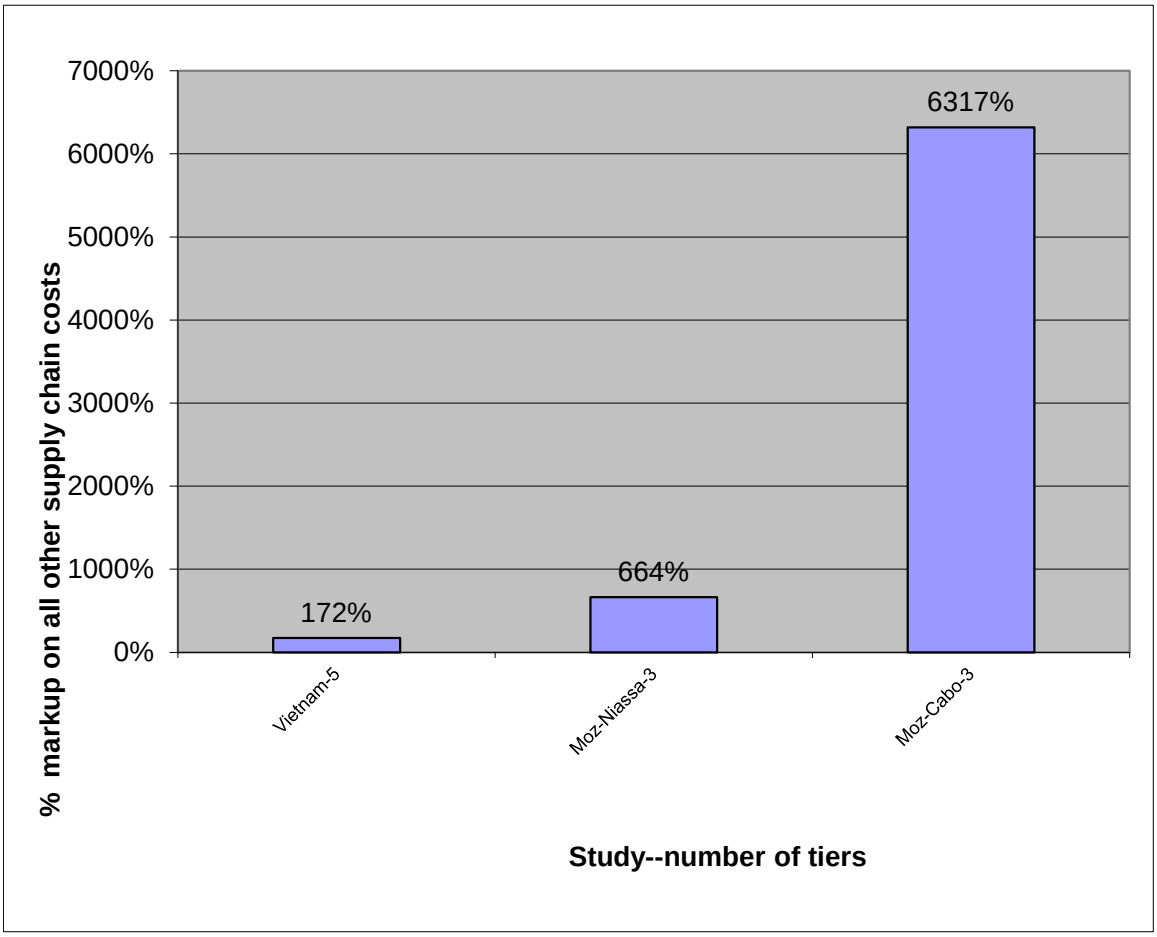
Last mile costs as a proportion of all other supply chain costs exhibit a large variation, from 17 percent in Zambia to almost 500 percent in Zimbabwe, with a median value of 99 percent (figure 29).

Figure 29. Last Mile Supply Chain Costs as a Percentage of All Other Supply Chain Costs



If we look only at vaccines, this percentage is significantly higher, ranging from 172 percent in Vietnam to over 6000 percent in Mozambique (figure 30).

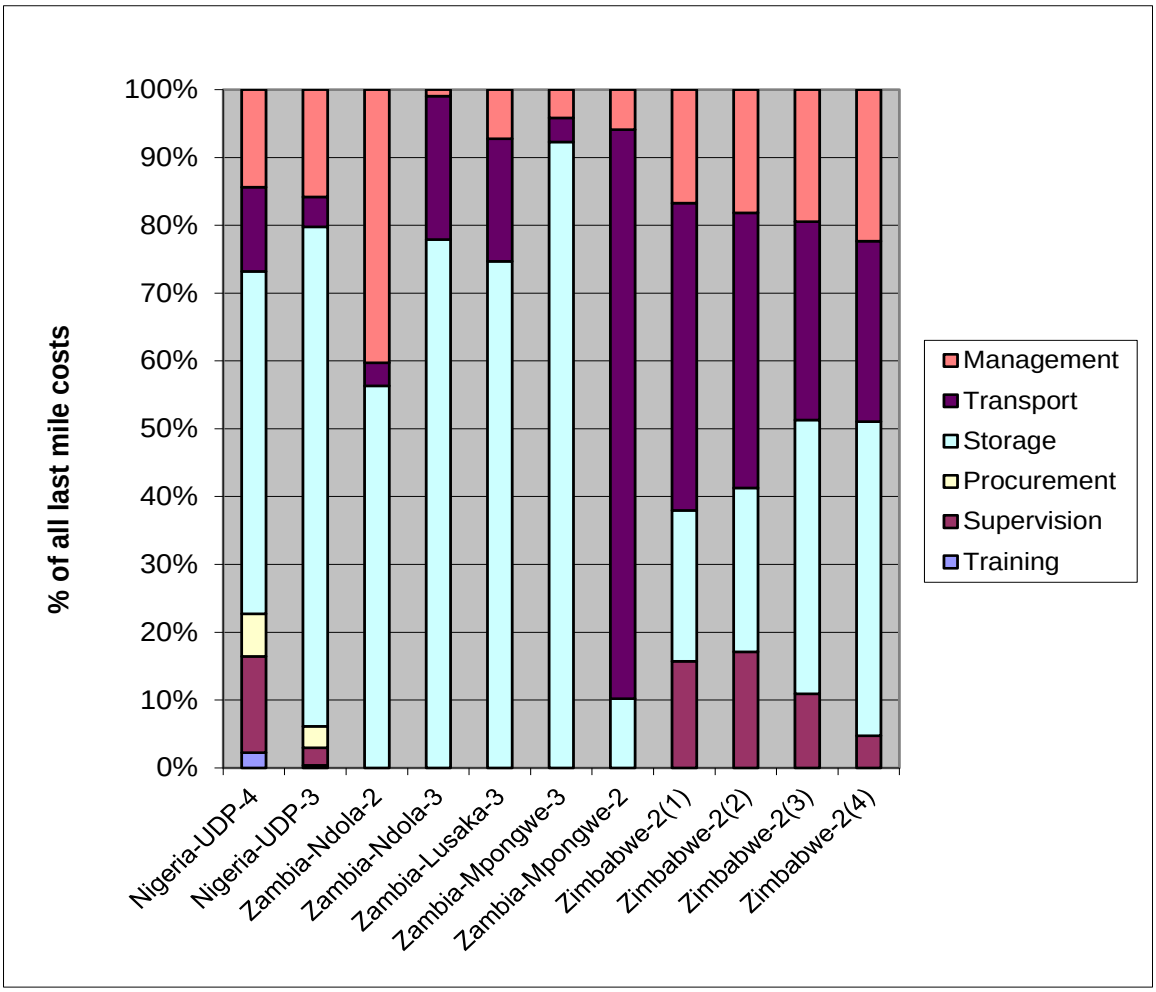
Figure 30. Last Mile Supply Chain Costs as a Percentage of All Other Supply Chain Costs: Vaccines



Distribution of Last Mile Costs by Component

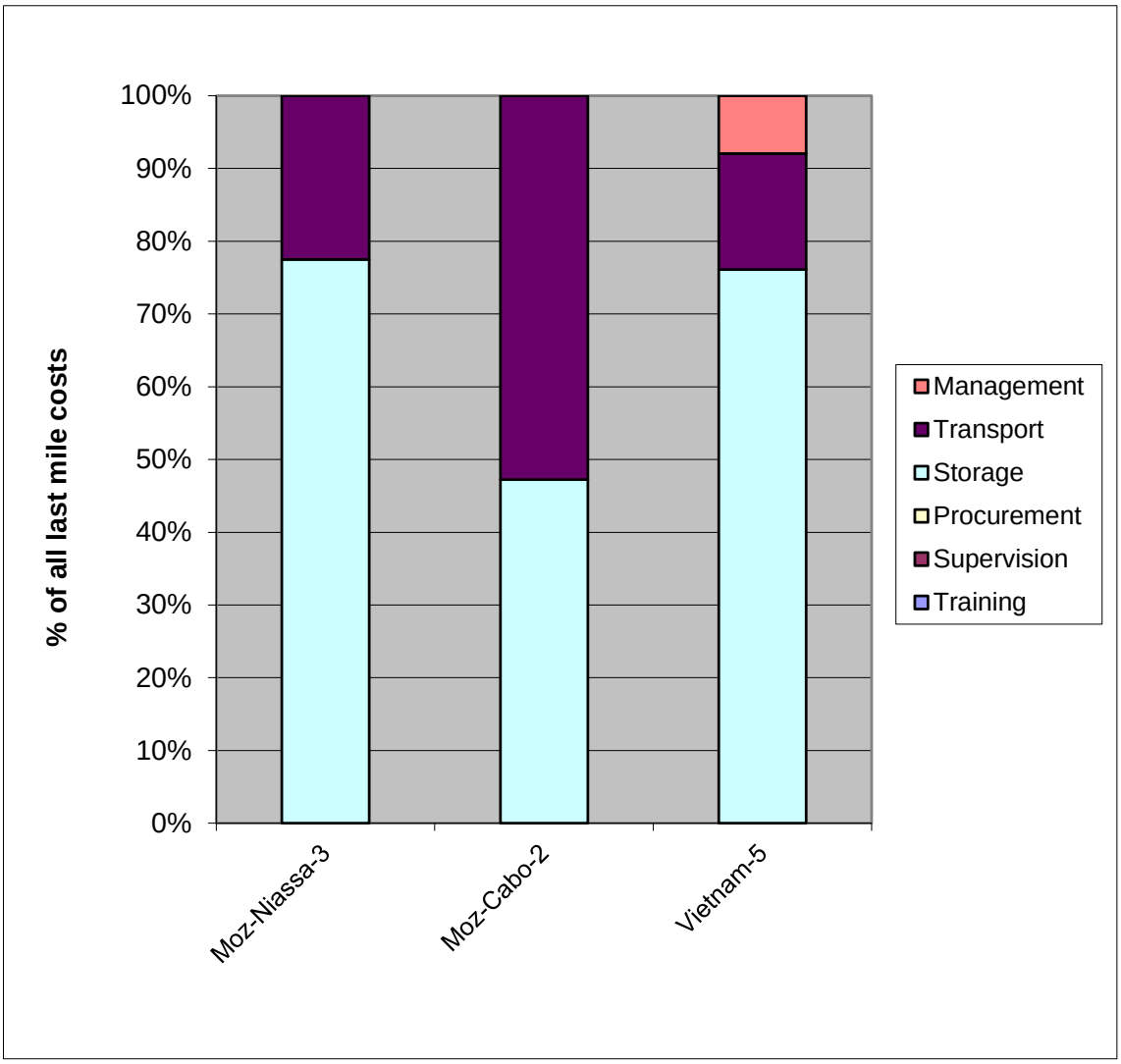
Fourteen of the 20 studies provide detail on the components of last mile costs, which we have standardized into the categories of management, transport, storage, procurement, supervision, and training. As figure 31 shows, the relative weights of these components vary substantially, with management, storage, and transport costs making up the bulk of last mile costs. In Zimbabwe, for example, transport costs play a significant role, as would be expected when deliveries are made directly from the central warehouse to the SDP. Not all studies collected cost information in all the categories, so the results are not strictly comparable. For example, the Zambia study did not collect information on training and supervision costs.

Figure 31. Components of Last Mile Costs



The storage component dominates last mile costs for vaccines, reflecting the cost of refrigeration (figure 32).

Figure 32. Components of Last Mile Costs: Vaccines



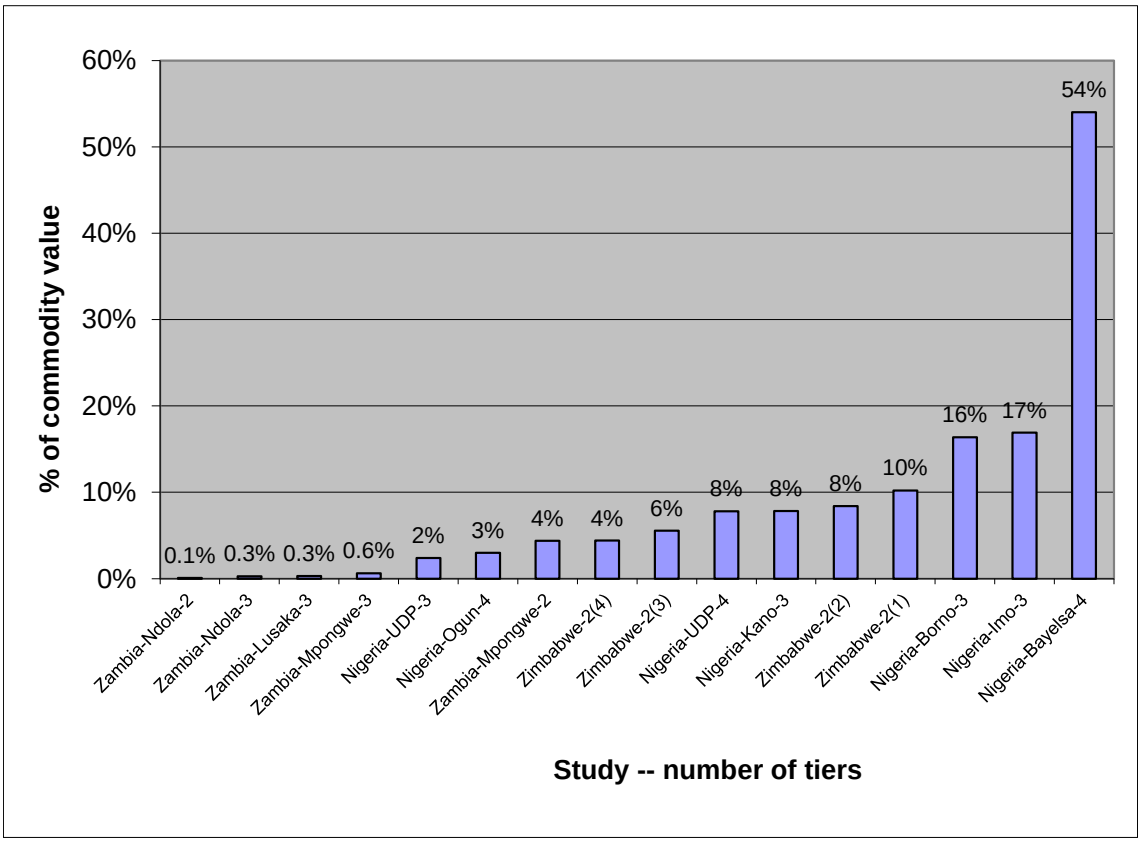
Last Mile Transport Costs

As noted, the OneHealth Model already can accommodate most last mile cost elements including personnel, storage, training, supervision, procurement, cold chain, and management. The one element missing from the OneHealth model is transport. This section analyzes transport costs from the 20 studies to feed into recommendations to the OneHealth development team on how to best incorporate these costs.

Last Mile Transport Costs as a Proportion of Commodity Value

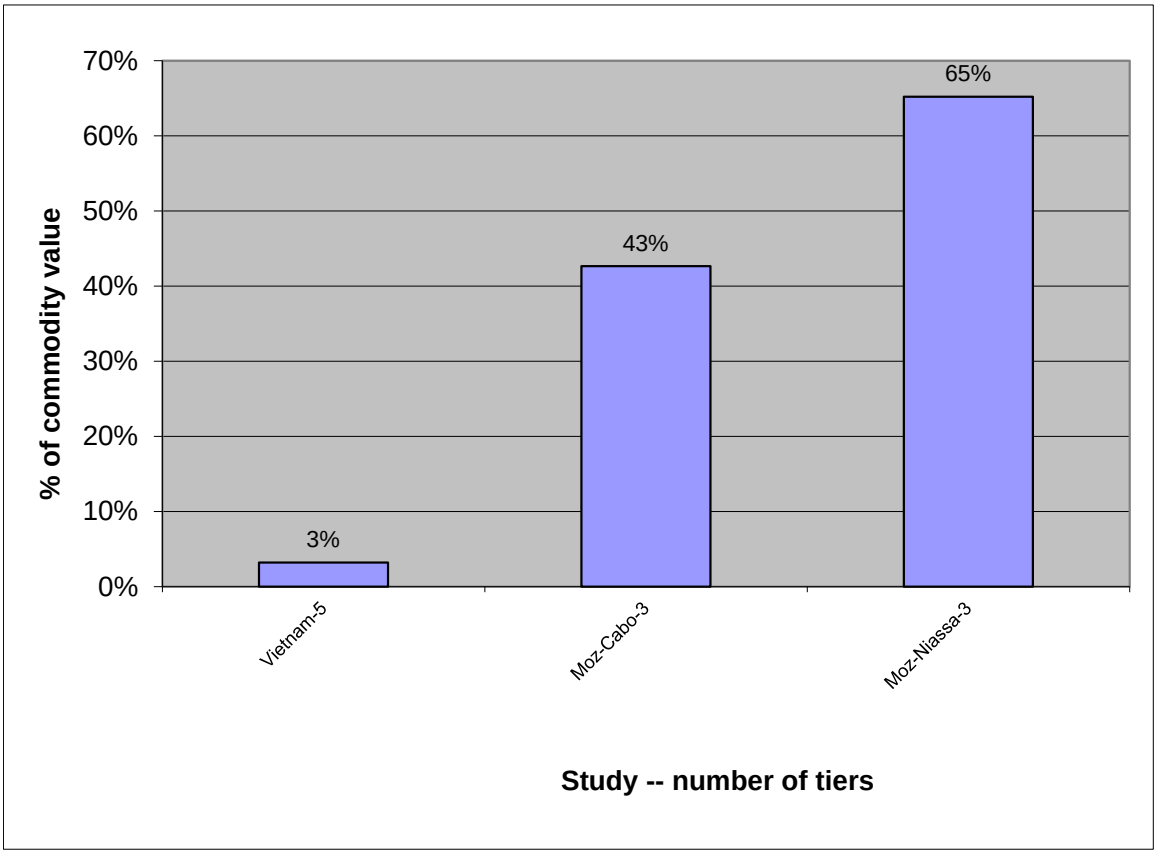
Last mile transport costs as a proportion of commodity value range from under 1 percent in four of the five Zambia studies to 54 percent in one of the Nigeria studies, with most between 2 and 17 percent (figure 33).

Figure 33. Last Mile Transport Costs as a Percentage of Commodity Value



Last mile transport costs as a proportion of vaccine value range are relatively low in Vietnam (3 percent), but much higher in the two Mozambique studies (43 and 65 percent) (figure 34).

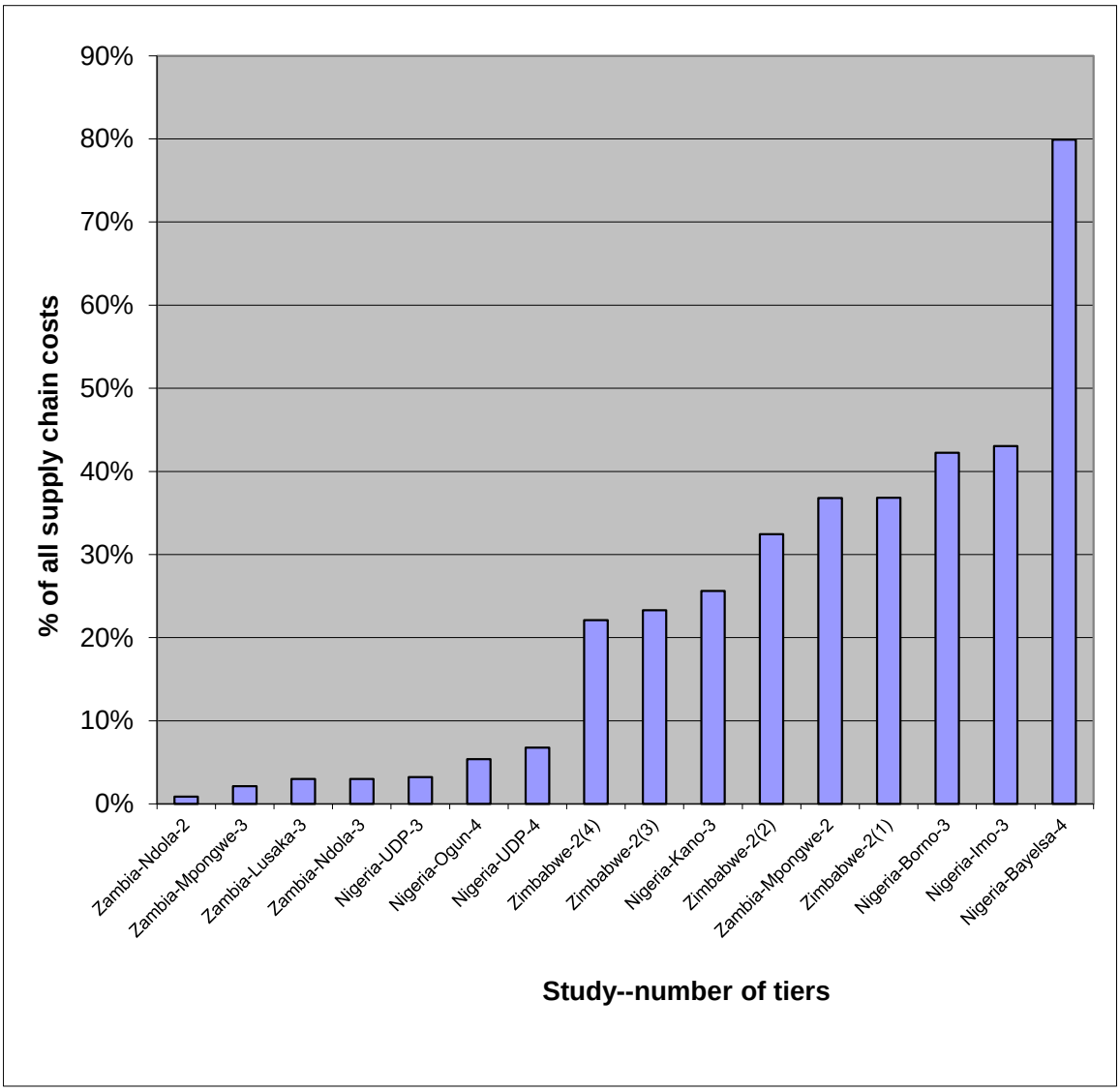
Figure 34. Last Mile Transport Costs as a Percentage of Commodity Value: Vaccines



Last Mile Transport Costs as a Proportion of all Supply Chain Costs

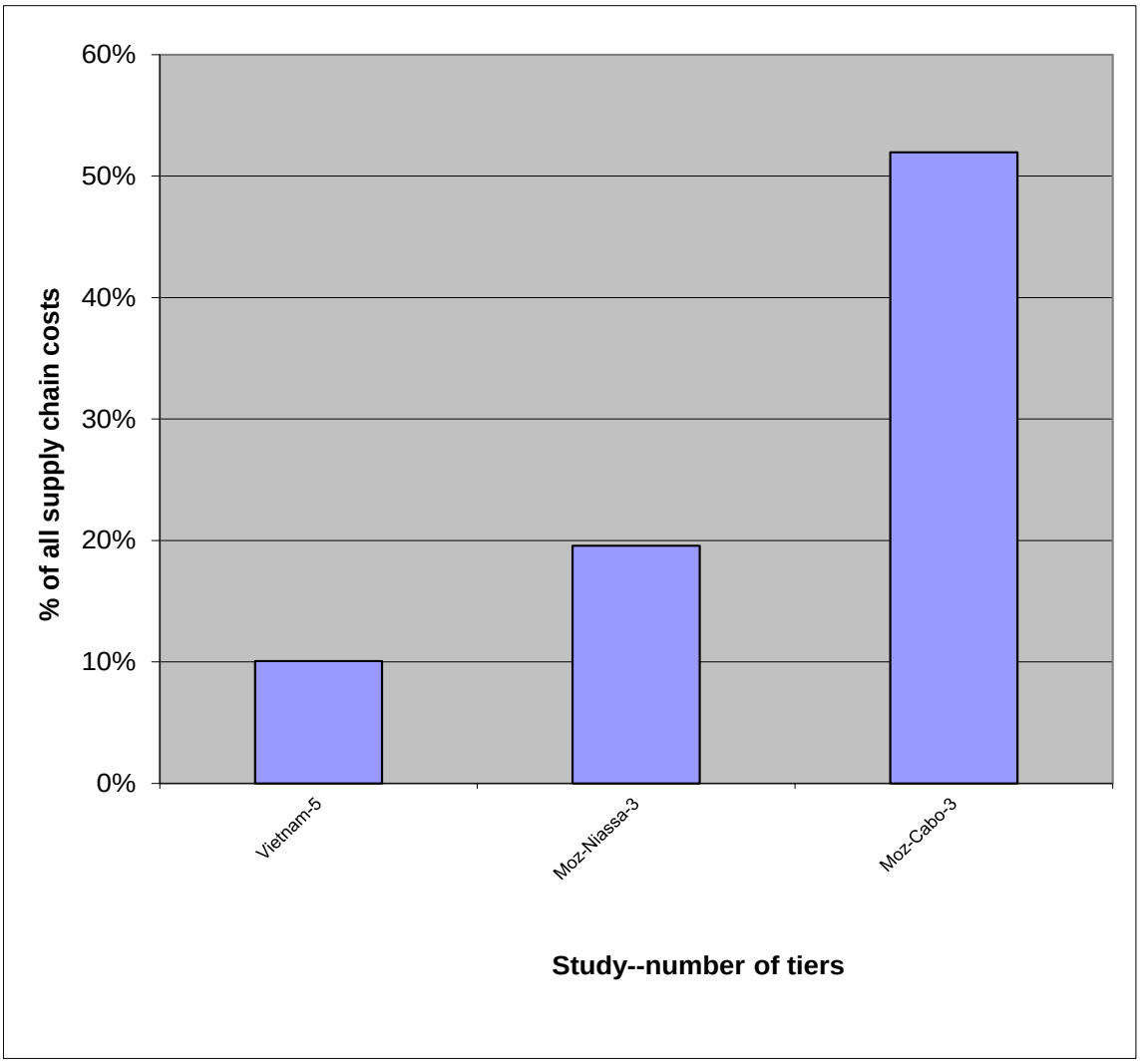
Last mile transport costs as a proportion of all supply chain costs varies substantially, from under 1 percent in Zambia to over 80 percent in some of the Nigeria studies (figure 35).

Figure 35. Last Mile Transport Costs as a Percentage of all Supply Chain Costs



Last mile transport costs as a proportion of all vaccine supply chain costs vary from 10 percent in Vietnam to 20 and 50 percent in Mozambique (figure 36).

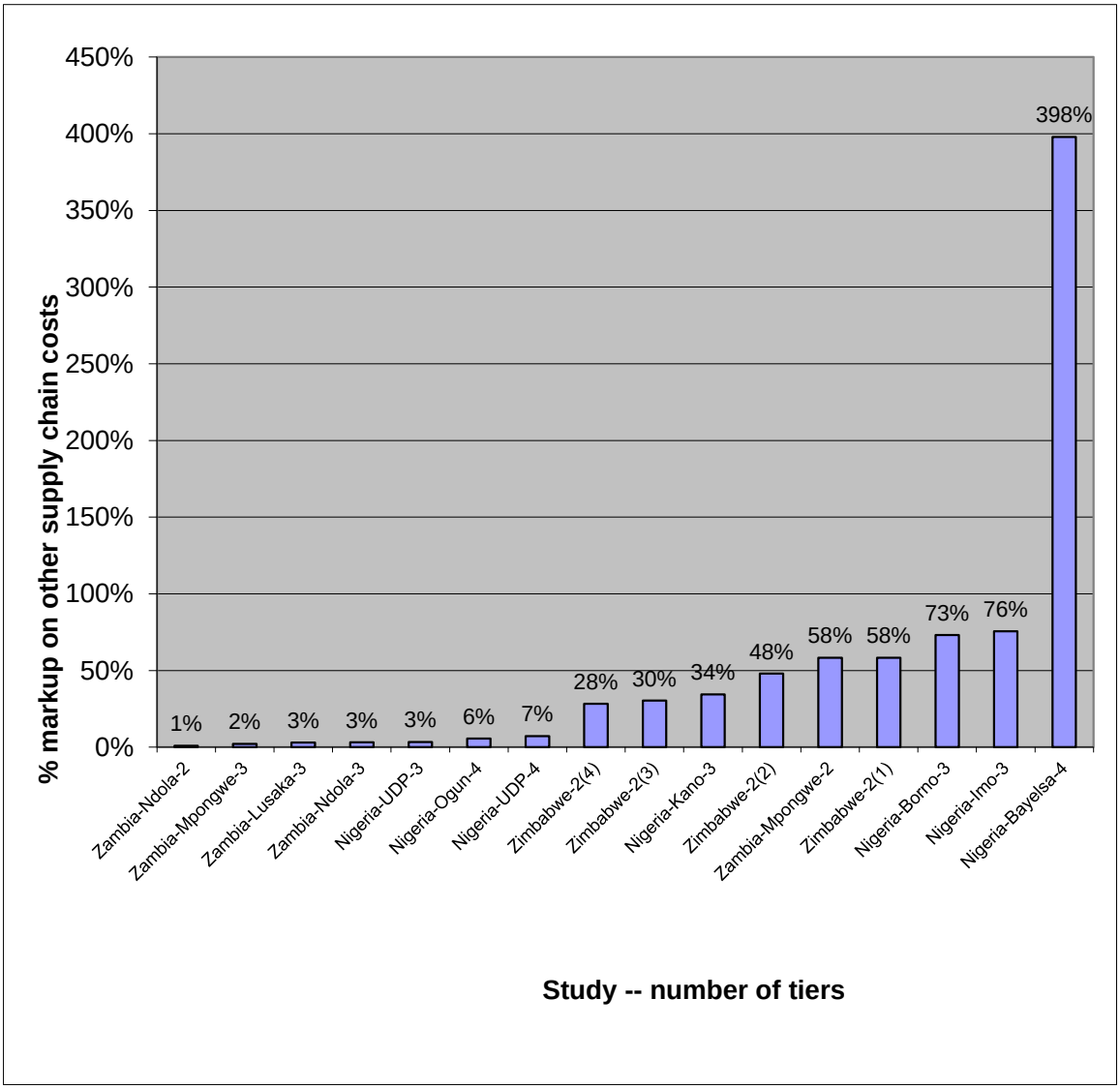
Figure 36. Last Mile Transport Costs as a Percentage of All Supply Chain Costs: Vaccines



Last Mile Transport Costs as a Proportion of All Other Supply Chain Costs

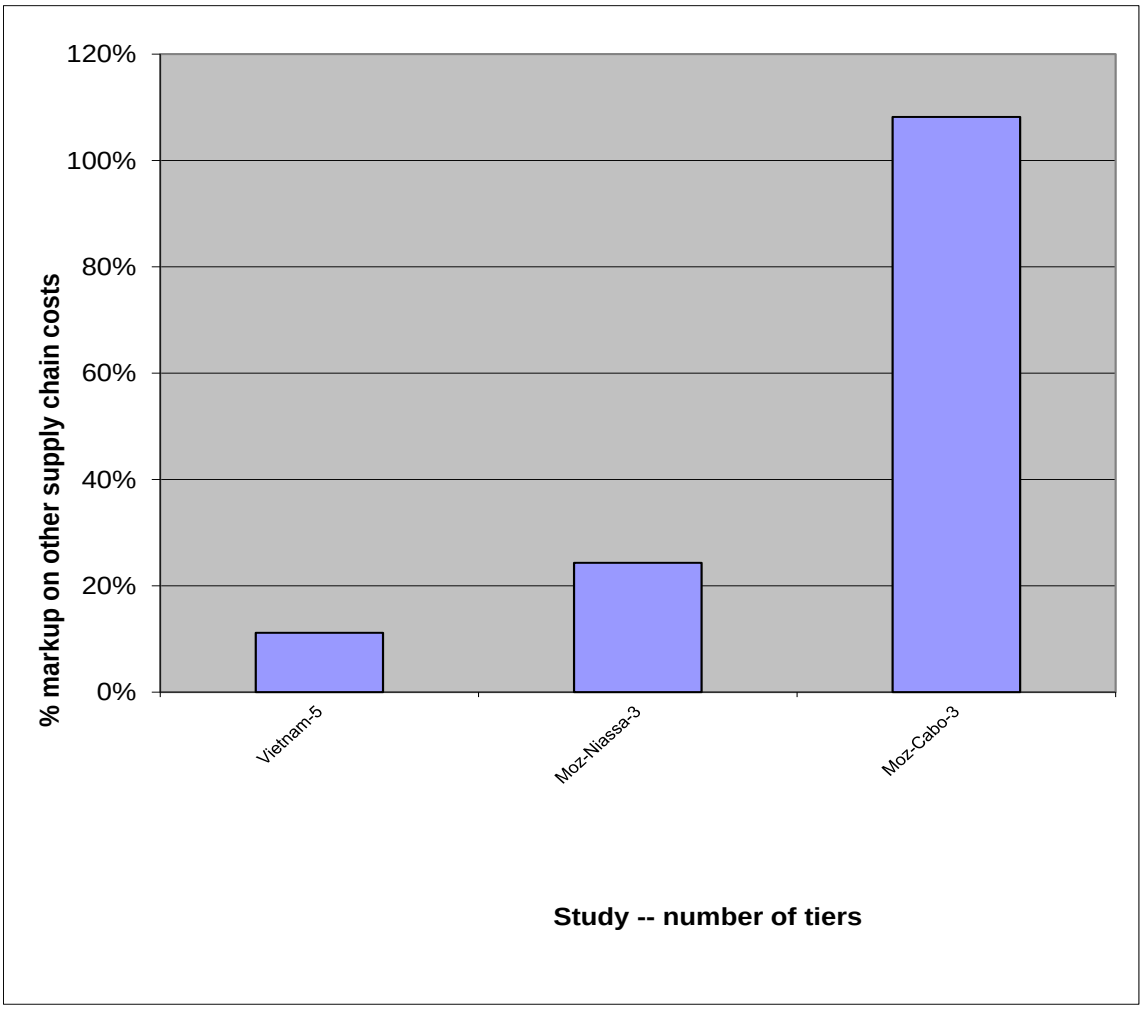
Last mile transport costs as a proportion of all other supply chain costs, a measure that can be thought of as a last mile transport "markup," also vary greatly, from under 10 percent in four of the five Zambia studies and Nigeria, to 400 percent in one of the Nigerian studies (figure 37).

Figure 37. Last Mile Transport Costs as a Percentage of All Other Logistics Costs



Looking at vaccines, last mile transport costs as a proportion of all other supply chain costs also vary greatly (figure 38).

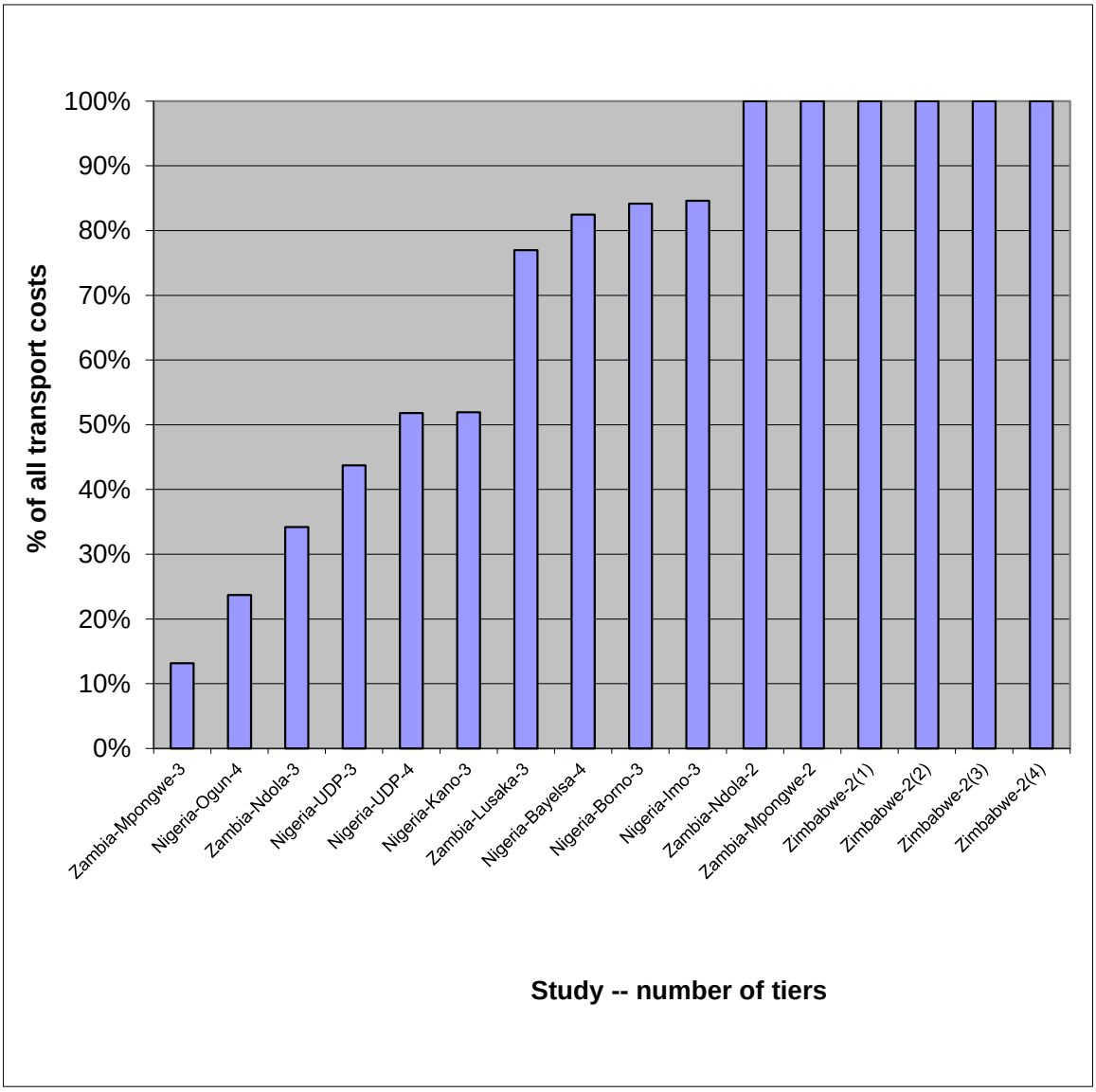
Figure 38. Last Mile Transport Costs as a Percentage of All Other Logistics Costs: Vaccines



Last Mile Transport Costs as a Proportion of All Transport Costs

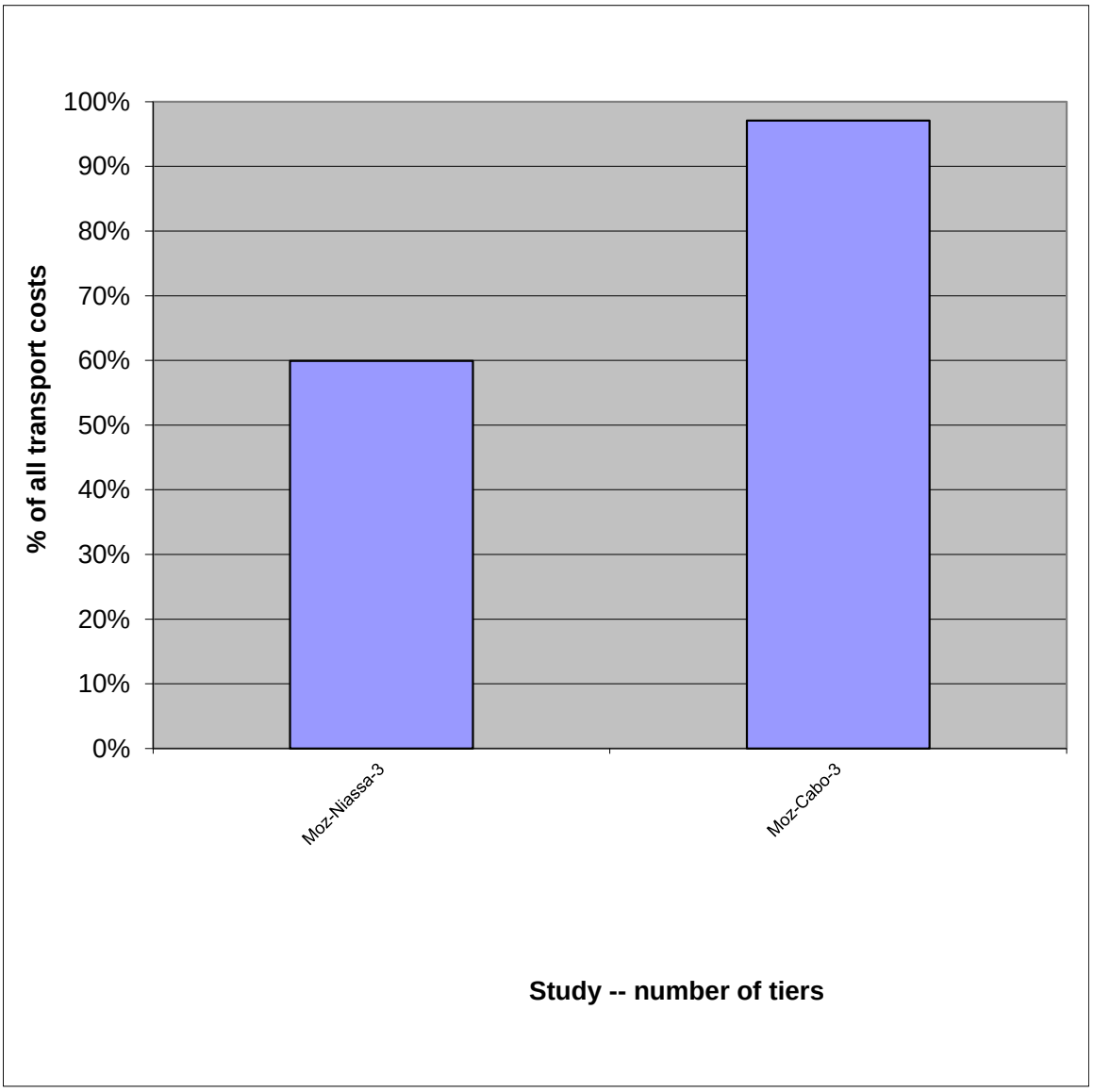
Last mile transport costs as a proportion of all transport costs range from less than 20 percent in Zambia to 100 percent in several of the studies that analyze two-tier supply systems (figure 39).

Figure 39. Last Mile Transport Costs as a Proportion of All Transport Costs



Looking at vaccines only, last mile transport costs as a proportion of all transport costs are between 60 and 97 percent (figure 40).

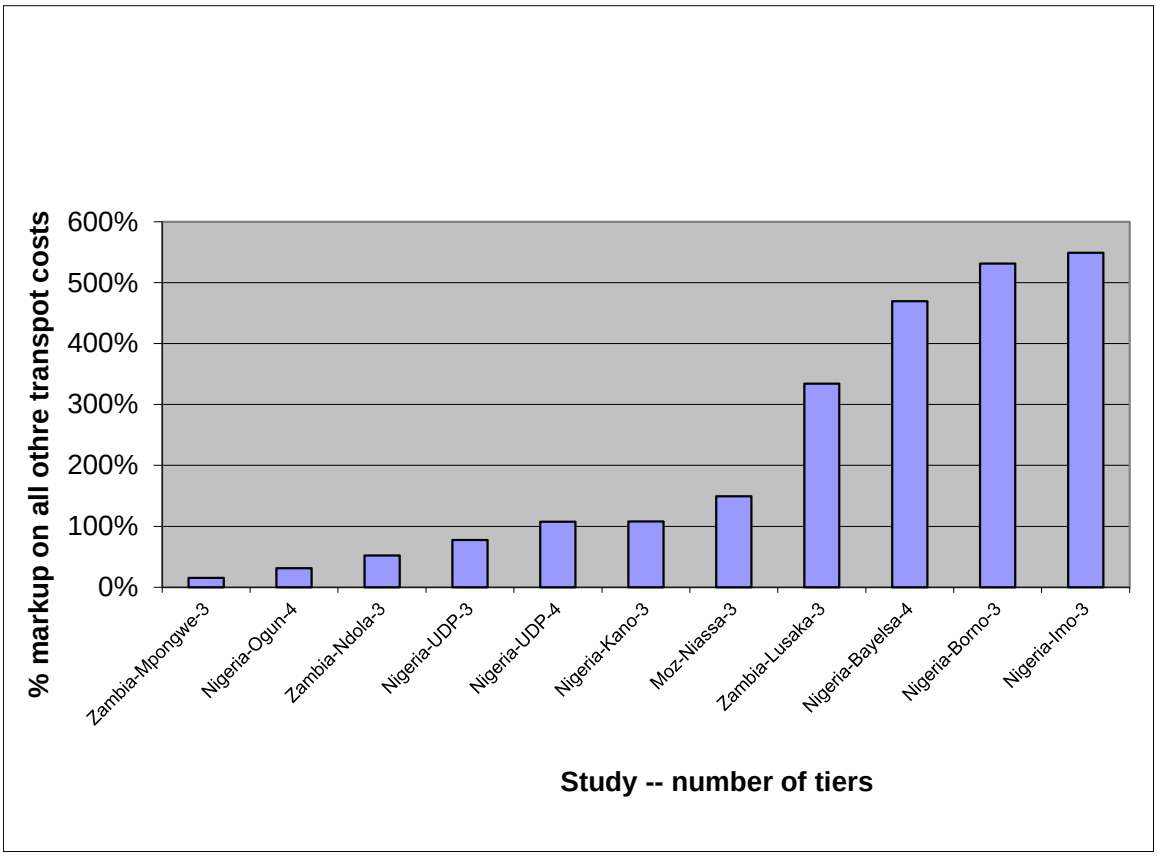
Figure 40. Last Mile Transport Costs as a Proportion of All Transport Costs: Vaccines



Last Mile Transport Costs as a Proportion of All Other Transport Costs

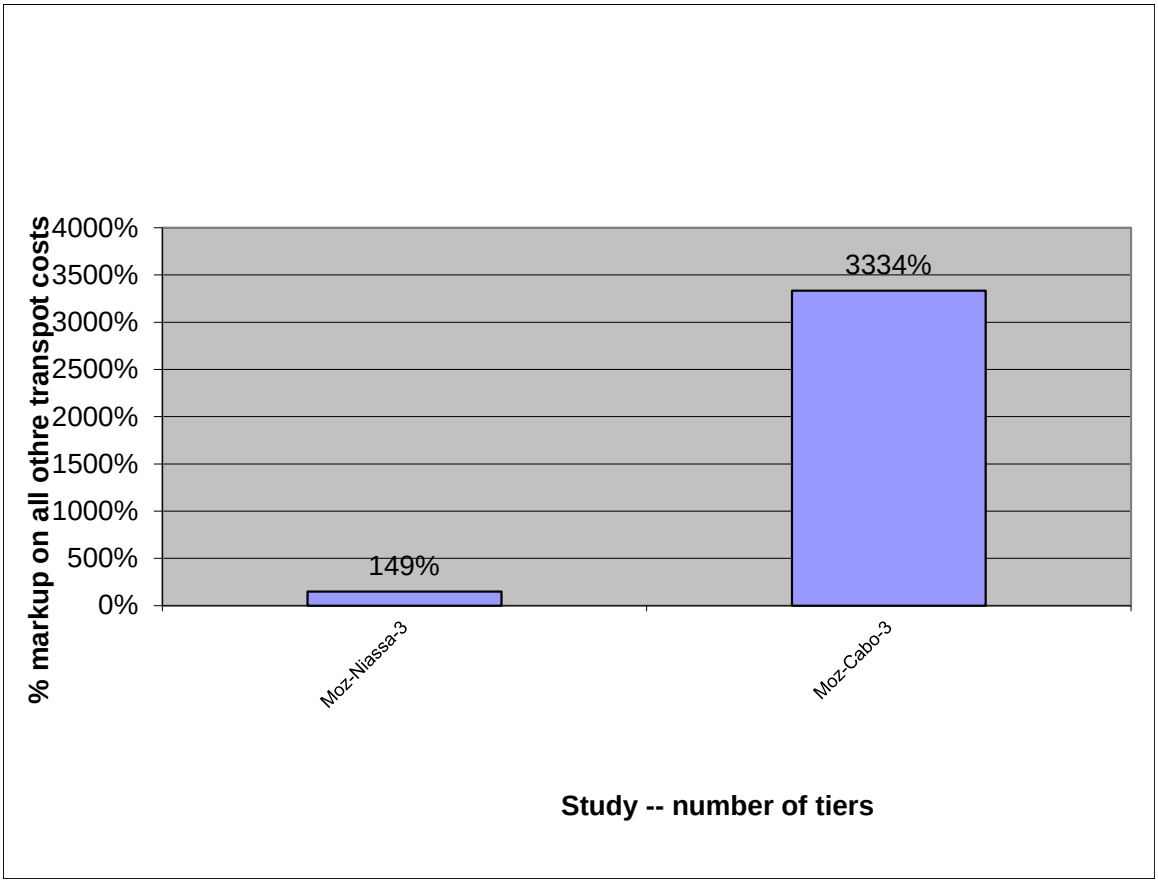
Last mile transport costs as a proportion of all other transport costs also vary substantially, from 15 percent to over 500 percent (figure 41).

Figure 41. Last Mile Transport Costs as a Proportion of All Other Transport Costs



For vaccines, last mile transport costs as a proportion of all other transport costs vary are 149 and over 3000 percent (figure 42).

Figure 42. Last Mile Transport Costs as a Proportion of All Other Transport Costs: Vaccines



Discussion

We reanalyzed findings from 20 recent studies to give guidance on how the OneHealth Model might include a proxy estimate of last mile supply chain costs. As noted, although the concept of "last mile" is clear—that part of the supply chain that delivers the health product from the last storage point to the consumer at the SDP—the practical meaning of last mile can vary greatly in developing countries depending on the circumstances of the country and the structure of the supply chain.

Several limiting factors require care in comparing the results across studies. Most importantly, the cost elements that each study included in their calculations were not uniform. For example, some studies included procurement costs whereas others did not. Moreover, costs were collected at different times, introducing possible distortions due to exchange rate fluctuations and inflation. In addition, the analyses were carried out on very different systems, not only in terms of number of tiers, but also level of system performance and client demand for certain commodities. The analyses also looked at different commodities. Commodities vary in their value, with some such as ARVs being costly and compact compared to low-cost, bulky items such as condoms. Vaccines are so different compared to other types of commodities—they are inexpensive and compact, yet require sophisticated cold storage—that they necessitated an analysis wholly separate from the other commodities.

Even when taking into account these differences, last mile costs are significant. As a proportion of commodity value, last mile costs for non-vaccine commodities were 28 percent (median) and over 60 percent for vaccines. About half of all non-vaccine supply chain costs and over half of vaccine supply chain costs were last mile costs. Clearly, leaving last mile costs out of a planning tool such as the OneHealth Model may seriously understate system costs.

The results also show that last mile costs are highly variable, both as a percentage of commodity value, volume, or weight, and relative to other supply chain costs. Several factors might explain these variations:

- *Geographic distance covered.* Logically, the larger the size of the area covered, the higher the costs.
- *Terrain/type of transport required.* The more difficult the terrain and less developed the transport infrastructure, the higher the costs. For example, rural areas with rough roads will demand higher vehicle and maintenance costs.
- *Efficiency of the system design.* The more efficient the design, the lower the cost. There are a variety of system designs for distributing to the last mile, and a wide variety of efficiencies in the systems. Among other things, the efficiency is affected by the regularity of the implementation of the system, whether it is a push or pull system, the people involved, the number of levels, and the extent to which each level is involved.
- *Commodity throughput.* In general, the higher the throughput, the lower the cost per commodity value, because the system can spread the fixed costs of operating the supply chain across a larger amount of commodities. If volume exceeds a certain level, then the overall costs of the system will be higher. Factors affecting throughput include what the supply chain design can manage, the population density, the frequency and prevalence of the drug used, the available supply of

the drug, and many others. In predicting costs, it is important to determine the volume of commodity per facility and the overall volume moved.

- *Frequency of commodity distribution*. The more frequent the distribution, the higher the costs.
- *Value of the commodity*. Naturally, the logistics costs as a percentage of the value of the commodity varies widely based on the actual value of the commodity.
- *Need for cold chain*. Commodities such as vaccines that require refrigeration will drive up costs.

The Markup Approach for Including Last Mile Costs in the OneHealth Model

Existing OneHealth Models already allow for appropriate calculation of last mile training, supervision, storage, cold chain, and management costs. The challenge, then, is how to incorporate last mile *transport* costs. To address this challenge, we propose a relatively simple approach that applies a last mile transport "markup" to the supply chain cost value that the OneHealth Model produces. Because the cost value that OneHealth produces already reflects many of the underlying factors that cause cost to vary, a markup approach (as opposed to adding an absolute percentage) assures that the added value of last mile transport costs also reflects this variation. In particular, using a markup approach removes possible distortions based on the value of the commodity. We suggest applying markup factors based on the number of supply chain tiers and adjusting for distance and terrain, as shown in table 19. The factors are based on the median values derived from the 20 studies as discussed in detail above, after eliminating some extreme results.

Table 19. Recommended Last Mile Transport Cost Markup Factors

Number of supply chain tiers	Distance and terrain adjustment		
	Low (short distances / easy terrain)	Medium	High (long distances / rough terrain)
Two tiers	40%	50%	60%
Three or more tiers	20%	25%	30%

The analyst using the OneHealth Model would apply the appropriate markup factor as shown in the illustration in table 20. For example, if OneHealth generates total supply chain costs of $10 million for a two-tier system, and the system is composed of relatively short distances and easy terrain, the analyst would apply a last mile transport cost markup factor of 40 percent, thus adding $4 million to the total supply chain cost. Similarly, if OneHealth generates total supply chain costs of $10 million for a three-tier system, and the system is composed of relatively long distances and rough terrain, the analyst would apply a last mile transport cost markup factor of 30 percent, thus adding $3 million to the total supply chain cost. The OneHealth Model should also give the analyst the flexibility to further alter these markup factors according to local conditions

Table 20. Example of Calculating Last Mile Transport Costs Using Markup Factors

Number of supply chain tiers	Distance and terrain	Supply chain cost produced by OneHealth model	Last mile transport markup factor	Estimated additional cost of last mile transport
2 tiers	Low	$10 million	40%	$4 million
3 + tiers	High	$10 million	30%	$3 million

Conclusion

We propose a simple way for the OneHealth Model to incorporate last mile transport costs into its estimates. As data on supply chain costs from a greater range of studies become available, the OneHealth Model may eventually want to incorporate a more complex algorithm to derive markup factors. This algorithm could use a standard set of cost drivers (geography, distance, terrain, efficiency of system design, etc.) and associate each with a cost impact. This approach would yield country-specific estimates for markup rates.

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