

Expanded Program on Immunization Versus Medical Store Department's Vaccine Supply Chain Management in Tanzania: A Cost Minimization Analysis.

Authors: Ngwegwe C. B¹, Diana P. M², Amani T.M³, Omary. S⁴.

¹ Ngwegwe Christopher Bulula, Ministry of Health, Dar es Salaam, Tanzania

² Diana Philemon Mwiru, Lecturer & Coordinator of Post graduate studies, School of Business, University of Dar es Salaam, Tanzania

³ Aman Thomas Mori, Postdoctoral Fellow and Senior Health Economist, Centre for International Health, Section for Ethics and Economics, University of Bergen, Norway.

⁴ Omary Swalehe, Senior Lecturer, University of Mzumbe, Dar es Salaam, Tanzania.

Affiliation: EAC Regional Centre of Excellency for Vaccines, Immunization and Health Supply Chain Management (EAC-RCEVIHSCM)

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ABSTRACT

In July 2016, the Management of the Ministry of Health (MoH) in Tanzania decided to delegate the functions of vaccine supply chain management from Medical Store Department (MSD) to Expanded Program in Immunization (EPI), with the aim of reducing vaccine storage and distribution costs. This followed an increased debt owed by MoH, whereby MSD charged 11.6% and 20.4% per invoice value for vaccines and injection supplies as costs for storage and distribution, respectively.

A retrospective cost-minimization study that was conducted to estimate the costs associated with storage and distribution of vaccines at EPI and MSD in 2018. The study

used an ingredients approach to estimate resource use. The study used the government perspectives and capital costs were appropriately annuitized and discounted at 3%. Microsoft Excel sheets, 2016 was used for data analysis and results presented in tables and pie charts, with input data from UNICEF forecasting tool, WHO capacity and volumes estimation tool, diesel generator calculator and supply chain service fee estimator version 1.02. The results indicated that, the total operational costs for vaccine supply chain at MSD was estimated at \$2,031,656, which was three times higher than the costs at EPI, which was \$543,650. The main operational cost driver at MSD was distribution cost (40%) due to large numbers of dry trucks, which contributed to high costs

of fuel and travel allowances. At EPI the main cost driver was storage costs due to building costs incurred in 2018 for renovation and construction of new warehouses for vaccines and injection material storage.

Therefore, the cost of vaccine supply chain management system i.e. storage and distribution costs were lower at EPI compared to MSD. This evidence justifies the decision made by the MOH in 2016 to delegate the functions of vaccine supply chain management system from MSD to EPI.

INTRODUCTION

The establishment of Expanded Program in Immunization (EPI) in 1974 in developed and developing countries averted two-third million deaths of under-five children from vaccine preventable diseases like pertussis, polio, diphtheria, tuberculosis, measles and tetanus (1). It is estimated to date that over 80% of the children worldwide have received vaccination with the third dose of DTP (Diphtheria, Tetanus and Pertussis) containing vaccines (2).

However, a strong health system was mounted on effective and efficient health supply chain systems to deliver health commodities to achieve intended health outcomes (3). The

success of EPI depended on the vaccines supply chain systems to transport vaccines and related supplies from manufactures to the service delivery points(4).

In Tanzania, prior to the health reforms in 1990s, EPI was responsible for vaccine supply chain management, with its fleets at national, regional and district level. It transported the vaccines from national level to regional level. After the health sector reforms in 1990, the EPI transport unit was placed under the management of the Ministry of Health while procurement, storage and distribution were placed under the Medical Store Department (MSD), which adapted the same model of supply chain from EPI.

MSD charged the MOH 11.6% and 20.4% of invoice value for vaccines and its related supplies, as costs of storage and distribution respectively. The debt that MSD owed the MOH increased significantly following introduction of new and expensive vaccines (PCV-13, Rota, Pentavalent) into routine immunization, from 2002. From January 2014 to December, 2015 the debt increased by 25.2% i.e. from US\$ 8.4 million to US\$ 33.4 million. Moreover, countries like Tanzania who have accessed new vaccines through GAVI co-financing policy and Advanced Market Commitment (AMC) agreement between GAVI and

manufacturers, which led to reduction of vaccine price (5), will graduate from Gavi support once they become middle income country, projected in 2025. Therefore, the achievement of immunization program must be sustained with government funding, and new vaccines should be accommodated in the pipeline, otherwise the lives of children will be at risks (6). As a result, in July 2016, the management of the MOH decided to delegate the functions of vaccine supply chain management from MSD to EPI with the aim of reducing vaccine storage and distribution costs.

Several studies have indicated countries strategies and innovations that have developed and created to address the vaccines supply chain challenges particularly in ensuring continuous availability of vaccines at affordable or reduced costs. But, prior to implementation of new innovation or strategy in supply chain systems, countries must be able to measure the supply chain costs and select the alternative approach which is least costly and increase net income (7). It's important for countries while addressing the vaccines supply chain challenges, particularly on new vaccines introductions not to think of storage and transportation options only (8) but financial and operational

benefits the country will achieve (9). In Benin and Mozambique, supply chain systems re-designing contributed to reductions of logistical costs and increased vaccines availability (9)(10)(11). In other studies, efficiency in vaccine supply chain could be achieved by reduction of supply chain tiers (3)(12). Therefore, studies of health economics such as Cost minimization studies which measure and compares input costs between two interventions with equivalent outcomes are crucial in determining the alternative and least costly options (13).

To ensure sustainability of immunization programs, costing analysis involving vaccine costs, supply chain costs and service delivery should be conducted (14), and information shared to decision makers to advocate for resource mobilization as well as supply chain optimization/re-designing (11)(15). In addition, findings of studies of economic evaluation like cost minimization analysis will guide decision makers to select the least costly alternative approach of immunization program operations, to ensure vaccines and immunization services are provided to clients at affordable costs and good quality.

METHODOLOGY

A retrospective cost-minimization analysis study, with government perspectives, was conducted to estimate the costs incurred in vaccines' supply chain management between MSD and EPI for a period of January to December 2018. The study applied Micro-costing method (ingredient based) to identify, quantify and enumerate resources used by the two institutions in vaccine supply chain management. Resource-use data were collected through desk review of various documents/reports and a face to face interview with key staff at MSD and EPI, using checklist. The questions were related to human resources management (number, salaries, per diems and other benefits, travel and transport allowances), vaccines logistics (vaccine procurement, storage and distribution) and capital investment (vehicles, cold chain equipment, trainings). These resources used were quantified and further categorized into recurrent cost-line items and capital costs as well as into activity-based costing component, composed of program management, storage and distribution. The capita costs (building, cold chain equipment, vehicles, training and maintenance of cold chain equipment) were appropriately annuitized and discounted at 3%. Data were entered into the Microsoft

excel sheets, 2016 for analysis, with input data from other tools. Various tools were used to quantify and enumerate resources used, such as diesel generator calculator (www.power-calculation.com) with input data from UNICEF- *A quick reference guide on Dimension and Power Consumption of Standard Walk in Cold and Freezer Rooms*, were used to estimate the costs of energy consumption of generators per day at EPI, while at MSD the costs were provided by the accounts finance department. Other tools such as Tanzania distance road chart from TANROADS were used to estimate the average distance covered per vehicle per quarter, biannual and annually depending on the distribution model and frequency employed by MSD and EPI. The WHO Volume calculator for capacities and volumes were used to determine the volume of vaccines and injection materials delivered per regions and the vehicles capacities, that lead to determination frequency of delivery. Generally, both MSD and EPI had the same distribution model starting at central vaccine store in Dar es Salaam and ends at Regional Vaccine stores, with vaccines distributed quarterly and injection materials biannually. Costs were collected in both USD and Tanzania shillings depending on how they

appeared on the expenditure receipts and other records (1 USD = 2240 TSH).

RESULTS

The total operational costs (recurrent and capital) for vaccine supply chain management at EPI was estimated to be US \$ 543,650 with 49.4% being the recurrent costs and 50.6% capital costs (vaccines, injection materials and related costs excluded). (Table 1). Salaried labor, transport and fuel constituted 30.2% and 23.1% respectively of the total recurrent costs, while for the total capital costs, buildings and vehicles constituted 19.9% and 13.2% respectively. (Figure 1 & 2.)

On activity per costing, storage, distribution and program management costed \$ 234,424, \$184,621 and \$ 124,605 respectively. (Figure 3).

At MSD, the operational cost drivers for vaccines supply chain were distribution (40%) and program management (37.6%). (Table 2 & Figure 1). The high costs of distribution were contributed by management of large number of dry trucks that led to high costs of fuel and transport allowances. Table 3.

At EPI, the operational cost driver was storage which contributed by high building costs (46%). This was due to cost incurred in 2018 for renovation and construction of new warehouses for vaccines and dry materials storage. Table 3 & Figure 2.

Table 1: Total vaccine supply chain costs at EPI

Recurrent Costs	USD	% Cost
Salaried labour	62,063	11.4
Special Task		2.0
Labour/Attendants	10,741	
Per diem & Travel		4.8
Allowances	25,973	
Transport & Fuel	81,071	14.9
Utilities and		1.2
Communications	6,775	
Vehicle Maintenance	32,000	5.9
Printing Costs/Stationeries	2,232	0.4
Cold chain Energy	45,333	8.3
Others	2,232	0.4
Sub Total (Recurrent) Costs	268,420	49.4
Capital Costs	USD	%
Cold chain equipment	30,977	5.7
Maintenance costs (CCE & Generator)	14,663	2.7
Vehicles	71,549	13.2
Forklifts	27,783	5.1
Other equipment	7,102	1.3
Buildings	108,025	19.9
Trainings	14,589	2.7
Others	540	0.1
Sub Total Capital costs	275,229	50.6

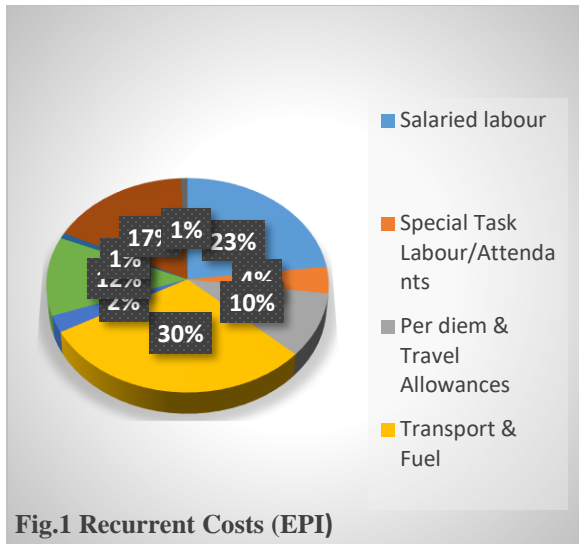


Fig.1 Recurrent Costs (EPI)

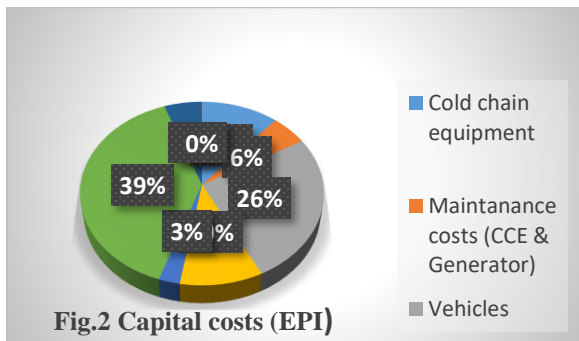


Fig.2 Capital costs (EPI)

Table 2: Total vaccine supply chain costs at MSD

Activity	USD	
Distribution		
• Transport and fuel		
• Vehicle maintenance	424,929	51
• Vehicles	225,929	27
	168,415	20
Total (distribution)	819,287	100
	169,067	37.0
Storage	64,784	14.4
• Cold chain energy	43,304	9.6

• Cold chain equipment	36,084	8.0
• Maintenance	4,464	1.0
• Generators and forklifts	107,143	23.8
• Other equipment	24,553	5.5
• Building		
• Others		
Total (Storage)	449,400	100

Program Management

• Salaried labor	410,569	43.2
• Special task worker	17,678	2.3
• Per diems and allowances	184,330	24.2
• Printing and stationery	13,392	1.8
• Utilities	44,286	5.8
• Trainings	92,714	12.2

Total (program management)	762,969	100
TOTAL OPERATIONAL COST	2,031,656	

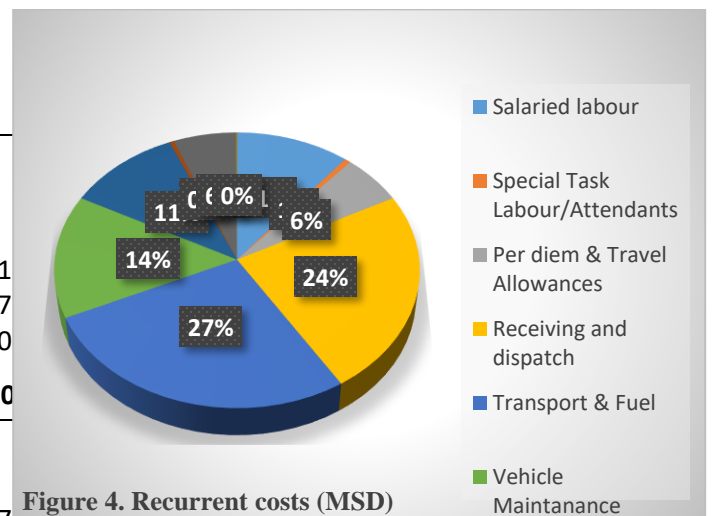


Figure 4. Recurrent costs (MSD)

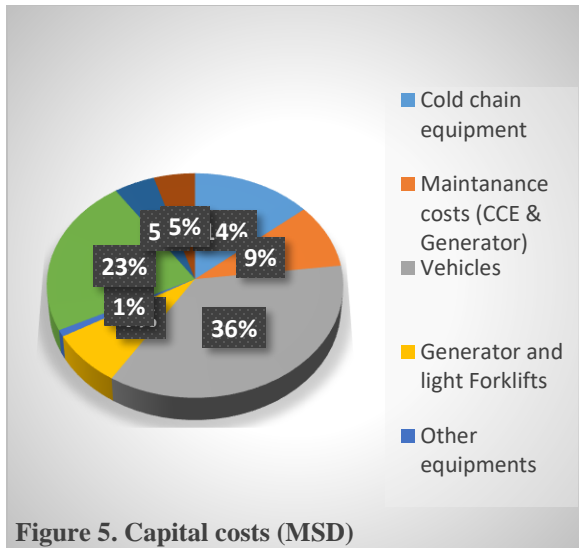


Figure 5. Capital costs (MSD)

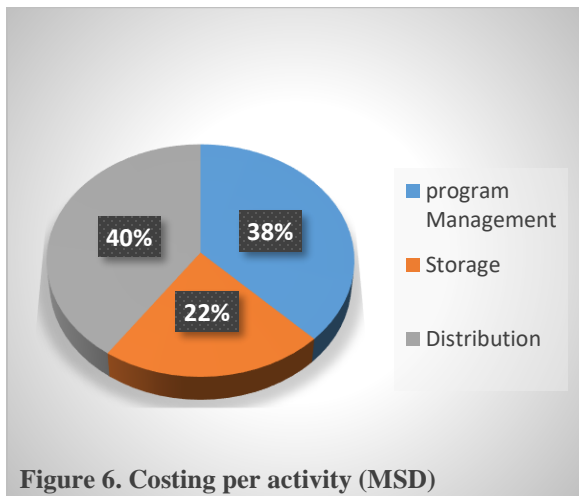
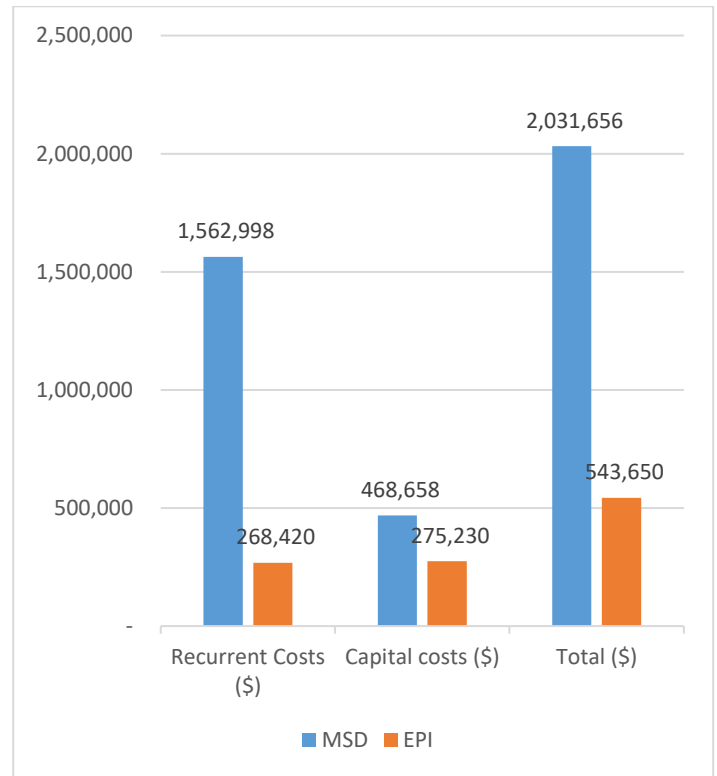


Figure 6. Costing per activity (MSD)

Figure 7: Cost comparison between MSD and EPI



CONCLUSION AND DISCUSSION

The study showed that the total operational costs for vaccines supply chain management were three times higher with MSD than with EPI (vaccines and injection supplies excluded).

Therefore, it was cheaper to operate the vaccine supply chain system management under EPI than at MSD considering that, the operational cost at EPI were expected to

decline further in subsequent years, due to depreciated and annuitized value of the buildings, which contributed to 46% of storage costs (Table 4).

The findings of this study indicated that it's appropriate to use the operational recurrent costs rather than capital investment costs, when making decision of which intervention has the least cost of storage and distribution of essential health commodities, since the capital costs cannot be replaced regularly once incurred.

Also, the study only focused on vaccines supply chain costs from national to regional stores. Another study should be conducted to establish the costs of vaccine supply chain at district and service delivery levels, in conjunction with service delivery costs. Likewise, another study to determine the cost effectiveness of the vaccines supply chain system between MSD and EPI could be conducted.

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Conflict of Interest:

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