Vaccine xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Review

Integration of vaccine supply chains with other health commodity supply chains: A framework for decision making

Q1 Prashant Yadav[a,*], Patrick Lydon[b], Julianna Oswald[c], Modibo Dicko[d,1], Michel Zaffran[b,2]

[a] William Davidson Institute, Ross School of Business, and School of Public Health, University of Michigan, Ann Arbor, MI, USA
[b] Expanded Programme on Immunization, Department of Immunization, Vaccines and Biologicals, World Health Organization, 20 Avenue Appia | CH-1211 Geneva 27 Switzerland
[c] Ross School of Business, University of Michigan, Ann Arbor, MI, USA
[d] Health Supply & Solar Systems (H3S), Systèmes Solaires & Logistique de Santé, Cité El Farako, Porte 145 Rue 806, Bamako, Mali

ARTICLE INFO

Article history:
Received 30 May 2014
Received in revised form
21 September 2014
Accepted 1 October 2014
Available online xxx

Keywords:
Vaccine supply chain
Supply chain integration
Vaccine delivery
Vaccine distribution
Cold chain logistics
Supply chain segmentation

ABSTRACT

One of the primary objectives of National Immunization Programs is to strengthen and optimize immunization supply chains so that vaccines are delivered to the end recipients effectively, efficiently and sustainably. As a result of larger investments in global health and a wider portfolio of vaccines, global agencies are recognizing the need for vaccine supply chains to operate at their most optimal levels. Integration with other supply chains is often presented as a strategy to improve efficiency. However, it remains unclear if the proposed benefits from integration of vaccine supply chains with other supply chains will outweigh the costs. This paper provides a framework for deciding where such integration offers the most significant benefits. It also cautions about the pitfalls of integration as a one size fits all strategy. It also highlights the need for systematic collection of cost and efficiency data in order to understand the value of integration and other such initiatives.

1. Introduction

One of the primary objectives of National Immunization Programs (NIPs) is to ensure the uninterrupted availability of high quality vaccines to immunization service delivery points. Delivering vaccines effectively, efficiently and sustainably requires a strong and optimized immunization supply chains. Supply chains for vaccines and essential medicines are under increasing pressure to operate more effectively and efficiently [1–3]. Large scale investments and a wider portfolio of vaccines have highlighted the need to achieve higher efficiency in vaccine supply chains [1,4–7]. This recent focus on efficiency has led to an increased focus on merging multiple disease-specific supply chains such as vaccines, maternal and child health medicines and family planning products, into one integrated supply chain. As many new and underused vaccines of public health importance are being introduced in developing countries, lack of capacity in the vaccine supply system is becoming a key bottleneck. Integrating the supply chains for essential medicines and vaccines is also being touted as a possible way to address the capacity bottlenecks faced by new vaccines. While EPI was intended to be used for multiple cold chain products, in the recent past vaccines were the only health products requiring a cold chain, and a vertical supply chain was justified. Oxytocin (to prevent and treat post partum hemorrhage), some antiretroviral drugs, diagnostic tests, antibiotics and a growing number of other pharmaceutical products require controlled-temperature storage [5]. This has led to a renewed inquiry into supply chain integration between vaccines and other public health products.

A typical Ministry of Health (MOH) in a Low Income (LIC) or Lower Middle Income Countries (LMIC) runs multiple program-based supply chains, of which the Expanded Program on Immunization (EPI) and vaccine supply chain is one. A recent WHO study in 13 countries found that on an average, there are 18 procurement agencies and 84 distribution channels in each country [8]. Proponents of such an architecture, which leads to almost separate supply chains for each disease program, argue that disease-specific supply chains allow better management span of control and allow supply chain strategy to be better aligned with the program

* Corresponding author. Tel.: +1 734 936 3913.
E-mail addresses: yadavp@umich.edu (P. Yadav), lydonp@who.int (P. Lydon), julianna.oswald@gmail.com (J. Oswald), dickomod@gmail.com (M. Dicko), zaffranm@who.int (M. Zaffran).
[1] Tel.: +223 66 34 89 84/75 43 34 41.
[2] Tel.: +41 22 791 5409.

http://dx.doi.org/10.1016/j.vaccine.2014.10.001
0264-410X/

strategy. Program-specific supply chains allow for the design of policies and procedures to achieve program-specific service targets. Others argue that this fragmented structure leads to redundancy, unnecessary complexity and poor coordination. Some argue that multiple parallel supply chains result in poor economies of scale and scope and therefore higher costs and lower efficiency. In theory, integrating vaccine supply chains with those for other health products could improve overall efficiency by distributing the costs of warehousing, transport and other such shared functions across a number of program areas. While some challenges still exist in the supply chains for EPI vaccines, in many countries the EPI supply chain is functioning reasonably well relative to some other disease programs [9]. Integration across multiple products adds tremendously to the complexity of supply chain management. Integrating vaccine supply chains with other supply chains requires intensive and complex coordination; otherwise the performance of vaccine supply chains could suffer. Given the varying characteristics required for warehousing and distributing vaccines as compared to many other health products (cold chain, resupply intervals, scheduled vaccination cohorts, etc.) it is evident that integrating vaccines with other health products into a single supply chain could lead to mediocre effectiveness.

Global policy makers and national immunization program managers face ambiguity as to whether or not supply chains for vaccines should be integrated with other supply chains, and whether the proposed benefits outweigh the costs. Decisions regarding which supply chains to integrate and as well as which stages of the process to synchronize can be dauntingly complex. Products such as malaria medicines have a less predictable and more seasonal demand schedule that require different operating rules than vaccines, which are distributed according to a pre-specified schedule or based on birth-cohort enrollment. Another important consideration is that products with cold or cool chain requirements necessitate stricter stocking, transport, and resupply intervals than essential medicines or other health products. Furthermore, the service delivery points to which the product has to be supplied also impacts its resupply interval.

This paper provides National Immunization Program managers, their technical support staff, policy makers in Ministries of Health, and global agencies involved in vaccine and health product supply chains with a better understanding of the benefits and potential risks of integrating vaccine supply chains with other health commodity supply chains. Admittedly, understanding the benefits of integration requires NIP managers to systematically capture distribution costs and performance metrics related to supply chain effectiveness. In the absence of these it is hard to generate rigorous evidence on the benefits of integration. This paper presents a simple framework for exploring this issue.

2. Methodology

Existing published literature on supply chain integration both in the context of public health supply chains, vaccine supply chains, and in the commercial sector were reviewed. EBSCO was searched for “supply chain integration”, “supply chain segmentation”, “logistics integration” with time ranges 1990-present. In addition, non-peer reviewed literature from multiple sources was obtained. The literature review was used to develop a comprehensive understanding of the benefits, costs and challenges associated with integration of supply chain functions in public health supply chains. A desk review of background technical documents, including previous technical documents on supply chain integration developed by Project Optimize (a WHO and PATH collaboration on immunization supply chain systems for the future) and an earlier literature review [10] were used to complement the literature search.

Integration of family planning programs into other health services has been pursued by many countries in Latin America, Asia and Africa, and the USAID/Deliver project has successfully captured the key lessons learned from such integration initiatives [11–13]. These were used to understand integration and associated challenges from other public health fields.

Findings from a large sample questionnaire conducted by Project Optimize in 2011 to assess the extent of supply chain integration currently being pursued by different NIPs was used to validate assessments of the ease of integrating specific functions within the supply chain.

In depth case studies from Senegal and Tunisia, two countries that were pursuing a vaccine supply chain integration project in collaboration with Project Optimize were used to understand the barriers to integration. Meetings and telephone interviews were then conducted with key stakeholders involved in vaccine supply chains at the global level.

3. Horizontal vs. vertical integration

Traditionally, a firm is considered vertically integrated when it operates at successive levels in the value chain whereas when a firm operates at the same level of the value chain but in different industries it is horizontally integrated. There are a number of different definitions and interpretations for the term integration used in the global public health supply chain community [14,34]. In many instances supply chain integration refers to the integration of physical and information flows between the different levels and functions within a supply chain [15]. While this definition is important and often such integration can be a source of significant performance improvement, this paper focuses on horizontal supply chain integration i.e. the merging of more than one vertical supply chains for specified programs or product categories.

4. Horizontal supply chain integration in commercial sector

The commercial sector has developed and operates effective and efficient supply chains for a variety of products. Many argue that the high availability of consumer products at retail outlets in the most remote areas of the world is indicative of the effectiveness and efficiency of commercial sector supply chains. While there are significant differences between the strategic objectives and operating rules of commercial sector supply chains as compared to vaccine and essential medicine supply chains [16] it is worth understanding the extent to which supply chains in the for profit commercial sector are integrated across product categories. As mentioned earlier, integration in the commercial sector is used more often to refer to integration across functions within a supply chain for a single product category and less for supply chains integrated for different product categories. A large majority of research and trade literature deals with vertical supply chain alliances in which partnerships are created between firms operating at different levels of the supply chain [17]. However, some studies have captured the extent of supply chain integration across product categories within a company [18–20] and also horizontal collaboration across firms in the same industry [21,22]. Analysis of such studies reveals that leading commercial companies tailor their supply chains to serve different products to different customer segments through different supply chain configurations. They seldom use a single supply chain to serve all product categories and customer segments as this would result in a supply chain strategy mismatch [23]. They rely on effective segmentation of product categories based on carefully analysis of

Please cite this article in press as: Yadav P, et al. Integration of vaccine supply chains with other health commodity supply chains: A framework for decision making. Vaccine (2014), http://dx.doi.org/10.1016/j.vaccine.2014.10.001