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## PUBLIC-PRIVATE SUPPLY CHAIN INTEGRATION AS A POSSIBLE MEANS TO IMPROVE PUBLIC HEALTH SUPPLY CHAINS

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### ABSTRACT

Struggling health supply chains and poor health outcomes in developing countries, have highlighted the need to improve these supply chains. A number of different methods have been used to improve health supply chains. However, it has been argued that the results are not sufficient and sustainable, neither do they aim to resolve impending challenges. In this paper, we put forward that public-private supply chain integration may be an important tool towards improving public health supply chains. However, further research is required to establish tools that support the determination to improve the supply chains and it. Moreover, research is required to determine whether improvements can be accomplished, as well as what the impact would be on the health supply chains in specific circumstances.

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## 1. INTRODUCTION

Supply chains are an essential component of the health system because they are responsible for providing a continuous supply of quality, affordable products to locations that are accessible to the country's population [1]. In order to effectively prevent, identify and respond to diseases, health supply chains must be able to respond rapidly and reliably when sourcing and distributing medicines, equipment and other health commodities [2]. Health supply chains also provide information regarding the supply and demand of products to planners and policymakers, who in turn ensure that the system has adequate supply and resources [1].

Health supply systems, including procurement, distribution and warehousing, must be able to meet the dynamic public health and security needs and demands [2]. According to Barillas [3], the success of a health system is determined by the availability of pharmaceuticals. Pharmaceuticals are critical to the health system because the expiration of medicines incurs extra costs, while the failure to deliver medicines, delayed deliveries or insufficient stock costs people their lives [4].

However, in many developing countries the problem is not finding methods to prevent or cure the high burden of disease, but to deliver quality health commodities at healthcare facilities on time, in the right quantities, at a reasonable cost to patients who need it [5]. A number of solutions have been applied to improve public health supply chains in developing countries. However, various authors have pointed out that these solutions may not be sustainable, proactive and sufficient [4, 6-8] and that there is a need for innovative solutions [9], not only for current health supply chain problems but also for impending supply chain problems [7, 10].

This paper explores the problems that public health supply chains are currently facing in developing countries, the methods that are being used to improve public health supply chains and some of the key shortcomings of these methods. The paper then suggests a research agenda that may further support the continuous improvement of public health supply chains.

## 2. LITERATURE REVIEW

Poor functioning health supply chains can severely damage the health system and hamper health outcomes [1] and result in higher costs, expiration and wastage of products, redundant efforts, stockouts and subsequently poorer health outcomes [11]. Unfortunately, this is common amongst the majority of developing countries [6]. Many countries lack the required resources to ensure the availability of health products [6]. This includes a poor functioning or absent logistics information system and the lack of transport and storage resources [6].

Reliable and complete data is required for the effective management of health supply chains [4]. This data is used to quantify how much of each product is needed by the population and, therefore ensures that there is adequate stock available at each health facility [4]. However, in many developing countries the lack of, or inadequate data for forecasting and supply planning [1, 4, 11], results in unresponsive supply chains [11], stockouts and supply chain inefficiencies [4].

In many developing countries there is also a lack of trained staff [6]. Often, supply chain tasks are given to workers who are either not trained to perform these tasks, or who do not have the necessary qualifications [4, 6]. Consequently, at the lower levels of the health supply chain, clinical staff have to spend valuable time on supply chain tasks instead of serving and helping patients [6].

Furthermore, health supply chains are strained due to the increasing demand for health services and increasing volumes of products that need to be provided by the public health sector [2, 6, 7]. According to Allain et al. [6], the demand for increased health services in turn increases the complexity of health supply chains, resulting in higher costs. Funding from donors has risen, which further pushes up the volume of products that flow through the supply chains [7].

While health supply chains are trying to meet these needs, consumers, partners and civil society demand greater cost effectiveness and improved performance [7]. Meeting the higher demand for health commodities and services requires more robust regulatory oversight, so that the quality of the increasing number of products can be ensured. Thus, additional pressure is placed on both the public and private sector [2].

Most public health systems have multiple vertical, programme-specific supply chains, each of which receive different levels of attention and funds from donors [6]. Some ministries of health develop these separate vertical supply chains specifically for each health programme. Thus allowing for investments, information and supply chain activities, such as procurement, forecasting and product flow, to be better aligned with specific program outcomes and objectives [6]. In addition, some investors have focused on developing alternative supply chains

to compensate for poor performing supply systems, or to respond to bigger health sector reforms [7]. However, only a handful of public health supply chains are able to accommodate various parallel supply initiatives [6].

Vertical supply chains are often criticised by some health reformists to be counterproductive and inefficient in strengthening the public health system [12]. Moreover, these supply chains are criticised for promoting fragmentation [13]. This fragmenting results in the duplication of resources and effort [14], and increasing the complexity of the supply system [6]. International agencies, such as the World Health Organization, PATH [15], VillageReach [14] and USAID [8], have been involved in projects that aim to merge some, or all, of the vertical programme supply chains. The expectation is that redundancies will be reduced and that performance and efficiencies will improve [6]. Other factors that have been increasing the complexity of public health supply chains are: (i) The fundamental operational changes that some governments are making to the health system [6]; (ii) an increase in the number of decision makers, financing options and stakeholders who have contributed to the decentralisation of government services [7]; and (iii) the poor design of health supply chains, which are often established based on assumptions that are outdated [6].

Other challenges faced by public health supply chains include a lack of adequate transport, limited geographic reach, malfunctioning cold chains, insufficient warehousing and distribution, and frequent stock outs [1, 6, 11]. In summary, public health supply chains do not have the capacity and resources required to supply an ever increasing volume and complexity of products [1].

Numerous international initiatives and donors have saved many lives [10] by providing much-needed funds [6] and facilitating the distribution and purchasing of various medicines, such as HIV, tuberculosis and malaria medication [10]. However, the funding is often uneven, usually allocated for specific diseases or programmes, and resources that are distributed by health programmes may not always be shared effectively. Thus resulting in underutilised resources [6]. The International Finance Corporation [10] argues that it is unclear whether donor funds are a sustainable and sufficient solution in addressing future health problems. Other initiatives have dedicated a lot of effort and investment to addressing these health supply chain challenges, in the form of supply chain strengthening and capacity building [4, 7].

Capacity building is defined as “the development of the ability of individuals and organizations or organizational units to perform functions effectively, efficiently and sustainably” [4, 16]. There have been some successful cases where capacity building and systems strengthening have improved the efficiency [4]. Moreover, the performance of pharmaceutical supply chains also improved, which resulted in an increased availability of health commodities [7]. Examples include countries such as Tanzania, where the Medical Stores Department operates at a level that is better than expected. In addition, Zambia and Rwanda’s pharmaceutical supply chains have also been reported to run efficiently [4]. Nevertheless, capacity-building efforts, aimed at improving supply chain efficiency, have been to a large extent unsuccessful [4]. For example, the Malawian Central Medical Store continuously encounters problems despite receiving fulltime technical assistance from the Global Fund over a period of two years [4]. According to Bornbusch et al. [7], the improvements from capacity building and supply strengthening are “tenuous”<sup>1</sup> and suggest that public health leaders should ask whether current solutions are working as well as they need to, and whether current solutions will be able to solve future challenges. Similarly, [4] argues that the capacity building approach needs to change due to the poor effectiveness of these projects. However, [4] does not state how the approach should change, or how it can be improved.

On the other hand, Bornbusch et al. argue that the core competency of the government is not the operation of supply chains because numerous governments lack the expertise required to operate an efficient supply chain [7]. Moreover, there is no career structures to facilitate high performance in supply chain workers, and thereby enable professionalism [7]. Instead, the government should play a stewardship role where it is responsible for providing the necessary guidance, oversight and vision to ensure that health supply chains achieve results [7]. Within a stewardship role, it is not mandatory for the government to directly control facilities and services. However, it is the government’s responsibility to engage and coordinate various actors in order to collectively achieve common development goals [7].

Currently, health reform seems to favour the implementation of supply chain integration in order to improve the overall health system, as well as the efficiency of health supply chains [12]. In the health sector community, the term ‘supply chain integration’ can refer to two types of integration [17]. The first involves the merging of programme or disease-specific supply chains, which are also referred to as “product integration” [17], or “horizontal integration” [18]. The second involves the “integration of information flows, physical flows, and financial flows between a firm and its supply chain partners” [19]. When speaking about supply chain integration,

<sup>1</sup> Tenuous definition: Very weak or slight; very slender or fine; insubstantial (Oxford dictionary)

it generally refers to the second type of integration. Integrated supply chains have six characteristics, namely: (i) Clarity of roles and responsibilities; (ii) agility; (iii) streamlined processes; (iv) visibility of information; (v) trust and collaboration amongst actors within the supply chain; and (vi) alignment of objectives [20, 21]. While product integration does reduce redundancy, improve efficiency and reduce complexity in the public health system, it does not improve product availability [8, 20]. Supply chain integration improves supply chain performance, reduces costs and improves customer service [8]. However, according to the USAID, the implementation of either product integration or supply chain integration is not sufficient, rather, both and other approaches should be implemented [8]. On the other hand van Olmen et al. [22] argue that although theory may suggest that merging vertical supply chains into a single, central supply chain increases the efficiency, it also creates weak links within the chain in areas such as haphazard ordering systems, stock management and slow distribution. According to van Olmen et al. [22] these weak links could result in the weakening of the entire chain.

Although many health supply chains have been substantially improved through both product and supply chain integration, as illustrated in case studies provided by [20, 21, 23], some questions remain. For example, questions regarding whether supply chain integration will be able to solve future supply chain challenges, considering factors such as the increasing number and volume of products [2, 6, 7], the increasing health service demand [6], demographic changes such as population growth [9] and increases in the burden of disease [9]. Looking at the documents that supply chain integration advocates, such as USAID, WHO, JSI and PATH, provide, there is no indication as to what resources are required for such integration endeavours. The resources required will vary from country to country [21]. However, the case studies by [20, 21, 23] support the notion that substantial financial and physical resources are required to implement supply chain integration. The questions surrounding the resources include: What resources are required and how do developing countries, that already lack financial and physical resources, obtain the necessary resources to implement these approaches? Do they rely on donors and NGOs? If developing countries do manage to integrate their supply chains, how can these supply chains further improve to accommodate increased volumes, populations, diseases?

According to Bornbusch and Bates [12], private sector supply chain research and application suggest that multiplicity in supply systems is the preferred method for improving efficiencies. Multiplicity involves “structuring a supply system to take advantage of multiple supply chains or segments to reduce risk and maintain supply” [12]. Multiplicity has been partially applied in public health supply chains in the sense that the public sector may take advantage of the private sector’s strengths to improve supply chains, usually through public-private initiatives [1, 11]. However, from the existing literature it is clear that the public-private initiatives have not been applied to take advantage of entire supply chains as suggested by [12]. In contrast, public-private initiatives are applied to specific problematic or underperforming supply chain areas [24, 25]. In addition, most public-private initiatives predominantly occur in disease-specific programs [26], due to the increased external funding for vertical disease-specific supply chains and programs. This funding is opposed to the increase in available resources that are at the public sector’s disposal [26]. This means that improvements through public-private initiatives are targeted to specific supply chains and rely on external funding.

In order for the public health system to ensure the availability of health products, while the burden of disease increases and health supply chain face the above mentioned challenges, more efficient supply strategies need to be found [9]. This means that decision makers will need to adopt new frameworks and models [6], as well as innovative delivery systems [9]. According to [9], it is crucial to investigate the private sector’s role in providing increased service levels.

### 3. ALTERNATIVE RESEARCH AGENDA

Given the current context of health supply chains in developing countries, it can be argued that the health sector should take a proactive approach to addressing the supply chain challenges and improving health outcomes. We suggest that an alternative approach may be used to overcome these problems. However, very little research has been conducted with regards to this approach. We argue that the health sector, and academics, investigate an approach involving horizontal supply chain integration and horizontal supply chain collaboration - in public and private health supply chains. This approach may be referred to as ‘public-private supply chain integration’. The meaning of horizontal supply chain integration is briefly discussed, followed by a discussion of horizontal supply chain collaboration along with the benefits of these approaches. Next, a definition of public-private integration is provided, and the reasons for public-private integration are included. Lastly, the final research agenda is presented together with the challenges that this approach may present and how they may be overcome.

### 3.1 Horizontal Supply Chain Integration

There are two types of horizontal integration, namely forward and backward integration [27]. Forward horizontal integration involves the collaboration with other organisations that provide substitute options, for example an organisation can provide road transport in addition to rail transport [27]. On the other hand, backward horizontal integration involves the integration of a company with other similar companies, for example a retailer can work with a second retailer or own a second retailer [27]. However, usually horizontal integration refers to the consolidation of companies [28], either by merging with or acquiring a competitor [27], that is in the same supply chain tier (i.e. manufacturer and manufacturer or distributor and distributor) [28]. Before continuing with horizontal integration, a decision needs to be made regarding what exactly will be integrated and how [18]. There are two options when deciding what should be integrated, namely products or processes [18]. Supply chain functions include procurement, forecasting, transport, information systems, orders, storage and transport [18]. Product integration involves the last two functions, storage and transport, whereas process integration involves the other functions that consist of supply chain management processes [18].

In terms of integration, supply chains can either be fully integrated or integrated via segmentation [18]. Full integration occurs when the multiple supply chains are essentially merged into one supply chain [18]. Segmented integration involves grouping the products according to specific characteristics and delivering according to these characteristics [18]. For instance, products that need to deliver to a specific location may be integrated. The benefits of horizontal supply chain integration include economies of scale, increased flexibility and adaptability, improved efficiency and improved performance [18]. However, it should be noted that these benefits and methods were achieved by integrating parallel public supply chains and not supply chains from stakeholders who are competitors, as we are suggesting.

### 3.2 Horizontal Supply Chain Collaboration

Horizontal supply chain collaboration occurs when “unrelated or competing organisations, producing similar products or different components of a product, form a cooperative association to share resources such as warehouse space and manufacturing capacity” [29, 30]. Many companies optimise and improve their supply chains to a point where further improvement efforts do not yield significant improvements or cost savings [31]. However, when companies participate in horizontal supply chain collaboration far greater improvements are achieved in efficiency and sustainability [31].

Horizontal supply chain collaboration is a relatively new research field [31] and so far the focus has been predominantly on horizontal collaboration in transportation and logistics management [32]. Vanovermeire et al. [31] investigated the viability of implementing horizontal logistics collaborations in supply chains, through the analysis of a case study. In the case study three companies currently deliver their own products. However, 57% of the orders are delivered to a customer that is common to two or all of the companies. Vanovermeire et al. [31] examined the costs of: (i) each company delivering their products individually; (ii) each company delivering the products after internal optimisation has been carried out; and (iii) the cost of the three companies collaborating with one another. It was found that internal optimisation achieved a cost saving of 13.65%, whereas collaboration between the three companies saved up to 25.83% in costs, and the number of trips decreased by 26.58% [31].

In the logistics area of supply chain, horizontal collaboration can improve the efficiency between 10 and 30% [31]. Horizontal supply chain collaboration could lead to the following outcomes [27, 31, 33, 34]: (i) Economies of scale when delivering to customers and decreased logistics costs; (ii) increased service levels, which result in more frequent deliveries and increased throughput; (iii) increased market share, which provides shared opportunities for new customers; (iv) shared investments; (v) sustainable logistics due to the efficient use of transport; and (vi) the exchange of best practices and innovation. An increasing amount of companies are forming horizontal collaborations in the logistics area of supply chains, where orders are consolidated into a common transportation channel [31]. Some companies take collaborations a step further by sharing assets, such as warehouses, collaborating on supply chain decisions according to a shared strategy, and harnessing the additional bargaining power to achieve economies of scale [31]. Ultimately these companies create one large supply chain [31].

According to Björnfot and Torjussen [35], supply chains need to incorporate structural flexibility in order to overcome and manage increased demand and uncertainty in markets. In addition, Björnfot and Torjussen argue that horizontal collaboration improves a supply chain’s structural flexibility and stabilises the market. Shared resources and capabilities enable this flexibility [33].



Horizontal collaboration presents its own challenges [31]. These include the risk of divulging information, cultivating a relationship based on trust, dividing gains amongst partners and absence of IT support as well as case studies [31]. One of the biggest risks of horizontal collaboration, according to academics and experts, is determining how the gains from the collaboration will be shared amongst partners [31]. According to a literature review by Cruijssen et al. [35], barriers to horizontal collaboration include selecting the right partner, negotiations and coordination, and the adoption of information and communication technology. Horizontal collaboration is long-term in nature and requires commitment and trust from all partners [31].

### 3.3 Public-private Supply Chain Integration

The following definition of supply chain integration was created by combining elements from horizontal supply chain integration and collaboration [11, 36-38]: Supply chain integration is defined as two or more autonomous supply chains (in this case public and private pharmaceutical supply chains) that work together. The integration is supposed to (i) improve their collective efficiency and effectiveness; (ii) find synergistic combinations of resources; and (iii) find solutions to problems, that each supply chain may not achieve on its own, by constructively exploring their differences and combining expertise from different organisations within the supply chains.

According to Donato et al. [2], countries that can take advantage of the public and private sector strengths have supply chains that are more adaptable, effective and more immune to disease outbreaks and epidemics. For example, the private health sector in countries of the Organisation for Economic Cooperation and Development (OECD) are leveraged to a much greater extent to accomplish increased effectiveness. On the other hand, the private sector involvement is significantly less in health supply chains in developing countries [1].

In contrast to health supply chains in developing countries, health supply chains in OECD countries largely depend on the private sector to provide services such as distribution, supply and other auxiliary services to complement a predominantly public health sector [1]. These supply systems effectively provide a continuous supply of pharmaceutical products to health facilities [1]. This led to the deliberation of how greater private sector involvement and leveraging, may improve public health supply chains in low- and middle-income countries. Many authors, such as Nishtar, Tennyson, Prybil et al., Kula and Fryatt, have argued that the public and private health sectors cannot address current and emerging health problems individually, but that the two sectors should work together [39-43]. Public-private collaboration is therefore imperative and unavoidable [39].

The private sector needs to be part of the solution if health supply chains are to react responsively to the current dynamic environment [44]. Engaging with private sector providers can improve the effectiveness of supply chains and consequently improve the health system [26]. Private sector initiatives can increase the efficiency and reliability of supply chains among all sectors and improve disadvantaged communities' access to products. Thus, contributing to public supply chain challenges [1]. Private sector initiatives can enhance the efficiency and effectiveness of supply chains, lead to the adoption of private sector best practices and expand the private sector's reach [1].

According to Bornbusch et al. [7], the government needs to recognise that public health supply chains encompass numerous other supply chains that comprise of a multitude of actors, from facilities to distributors of the public and private sector, NGOs and faith-based organisations. This collection of supply chains and actors may be a complex system. However, if the system is adequately understood and managed, Bornbusch et al. [7] argue that the supply chains can be "woven into a rationally integrated system". As a result, governments may have the flexibility and option to reduce or even eliminate distributors, funders, suppliers, procurement arrangements and quality assurance since all actors will be working together to improve health outcomes [7].

The supply chain functions that will remain the government's responsibility include the regulation of pharmaceuticals, policymaking, developing the overall supply system strategy and vision, managing the public sector's expenditures and supervising the health system [7]. This type of supply chain integration is similar to the concept of multiplicity suggested by Bornbusch and Bates [12], who identify the need for research to determine how multiplicity can be built into public health supply chains in order to optimise the performance, cost and risk management. The role of multiplicity in public health supply chains is crucial as it will assist future systems with the ability to handle increasing volumes of products [12]. However, public-private integration does not only have to benefit the public sector. In countries such as Ghana, Tanzania and Kenya, to name a few, the private for-profit sector has saturated their target market of high-income earners [45]. Subsequently, the private sector now aims to provide products and services to lower income groups [45]. Integration can expand the private sector's channels to lower income groups, while simultaneously improving access to health products [1]. It has been established that a number of private sector initiatives generate a profit, which indicates that the private sector has the opportunity to improve the health system while making a profit by engaging with the public sector

[1]. However, the government will need to effectively regulate the private sector in order to manage its profit motive [1].

### 3.4 Research Agenda

The public sector has been involved in numerous engagements with the private sector. However, currently most of the engagements have been created in disease-specific programmes or with the focus of solving specific problems within health supply chains. We argue that the integration of health supply chains, as defined in section 3.3, may be a possible solution to proactively address supply chain issues and improve health outcomes.

Health supply chains from the various sectors may be integrated and the strengths of each sector harnessed to address current and future health and supply chain problems. This potential solution will likely prove to be very complex to implement, for the reasons discussed in section 3.3. Very little research has been done on the integration of end-to-end supply chains, as well as horizontal supply chain collaboration in the health sector. Therefore, we identify crucial areas for further research framed around the following questions:

- Can the public and private sector health supply chains be integrated (as defined in section 3.3) to address supply chain issues?
- Is it a feasible solution for developing countries that lack resources?
- What requirement will be needed to achieve public-private integration?
- What is the implication of public-private supply chain integration?

The suggested research agenda may be ambitious, yet it will undoubtedly be worthwhile investigating if it means that the access, availability and affordability of health products will improve as a result of better functioning supply chains. It may not be feasible from the outset for the supply chains to integrate at all points, there is a need to identify the costs, benefits and risks for integrating different aspects. Starting with limited sections of the supply chain can reduce the complexity somewhat and may provide information about how to go about the integration process in future as well as where these supply chains can or should integrate, including the impacts that integration has for the two supply chains.

## 4. CONCLUSION

The lack of resources along with an increase in the burden of disease, population and volume of health products in developing countries have led to poorly performing health supply chains and low health outcomes. Some solutions have not been as successful as hoped while others focus on disease specific supply chains or specific problems. Although improvements have been made, various authors argue that the solutions are not good, sustainable or proactive enough. There is a need to not only solve current supply chain problems, but also adapt supply chains for future supply challenges that may occur. This paper has suggested that public-private supply chain integration may be a potential solution to the problem. This paper also highlighted the need for further research to determine the feasibility of the solution, the implications of the solution and how it may be implemented. Further research may enable developing countries to deliver much needed improvements in the efficiency and effectiveness of health supply chains and thereby improve health outcomes.

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