World Health Organization Unicef

System design approach to improve the immunization supply chain

A system design approach offers a framework for analysing, designing, and implementing solutions to improve the performance of a vaccine supply chain system. However, with little information available on how the system design approach has been used, making a case for investment can

be challenging. This evidence brief provides government decisionmakers working in public health immunization programmes with a summary of evidence-based case studies from five country governments and one private industry. Each case study highlights the unique context, the catalyst driving the need for change, the key analysis undertaken and the results of the system design process. An overview of a system design approach and questions it can address are also provided.



Credit: Paul Brown

The need for system design analysis

Is it possible to introduce a new vaccine next year with the existing immunization supply chain? What needs to change? What happens to the planned availability of vaccines if, for example, there is an earthquake or other natural disaster? Can the health programme support greater outreach efforts, or do other areas of the supply chain need to be more efficient to support reaching the last mile? These kinds of decisions require data, analysis, and a clear picture of the end-to-end supply chain, including the inherent relationships between storage, distribution, inventory, and presentation.

Underlying each of these questions is whether the current supply chain system is "fit for purpose"; answering these questions is the subject of Supply Chain System Design.

System design offers solutions

A system design approach helps create a blueprint to improve the performance of all components of the immunization supply chain, including programme requirements, distribution network, warehousing and storage, human resources, equipment and its management, planning, monitoring and data. When transitioning to a new supply chain model that can better meet the rapidly changing needs of current immunization programmes, a system design approach is critical for ensuring a successful transition and a sustainable system. Ministries of health must address repeated questions about the performance of the supply chain: Is it efficient and effective? Can it handle increased demands? What types of investments would improve performance? A system design approach helps examine how multiple components in the immunization supply chain influence each other, such as how changes in the distribution network affect the overall availability, potency and efficiency of the immunization supply chain.

A system design approach can be large in scope and involve, for example, a full reorganization of inventory storage locations in a country; or it can focus on a specific issue, such as improving outreach to make access to vaccines more equitable in a particular district. Neither the scope of the analysis nor the particular strategy employed is the defining characteristic of a system design approach; rather, system design is manifested in the analytical approach providing answers to key questions about performance improvement.

In the context of the immunization supply chain, some of the key questions about performance improvement could include:

- + How many vaccine storage locations are needed?
- + Where should storage locations be placed?
- + How much inventory should they hold, and which provinces, districts or health facilities should they serve?
- + How often should they be replenished?
- + What are the cold chain and dry store needs?
- + Can the cold chain be integrated with other health commodities?

Because the answers to each of these questions impact other elements of the supply chain, such as storage needs, transport needs, human needs and data needs, supply chain managers must analyse the system design as a whole.

This approach provides managers and decision-makers with the evidence, engagement and confidence to elevate supply chains as a programme enabler which is continually examined to ensure flexibility and adaptability to changing circumstances.

WHAT IS A SYSTEM DESIGN APPROACH?

A system design approach is a continuous improvement approach that is evidence-based, and measures key performance indicators that are both quantitative (e.g. product availability) and qualitative (e.g. risk, community will).

It encompasses a holistic system approach that incorporates people (stakeholders, decisionmakers and other contributors), activities, processes, products, infrastructure, money, incentives and other related systems in their unique contexts.

It informs decisions in the design or blueprint of a supply chain plan, recognizing the "as-is" and "to-be" states by illustrating trade-offs, using local knowledge, best practices, and curiosity to outline, prioritize, and implement supply chain objectives.

HOW CAN IT HELP?

A system design approach can answer these questions using the following steps:

- 1. Analysis and recommendations
- Advocate and introduce the concepts to stakeholders and decision-makers to clarify scope, interest and opportunities.
- Model, validate and optimize the existing supply chain, potential future needs, and analyse scenarios to highlight improvements.
- + Prepare an action plan that reflects known barriers, stakeholders, funding and risks.
- 2. Phased implementation
- + Implement the recommendations of the plan using a targeted, phased approach.
- + Evaluate the project and decide how to expand the implementation.
- + Expand the implementation, model and optimize a new set of questions.

Ethiopia

Improving performance by analysing and changing distribution patterns.

With a population of 94.1 million, Ethiopia is the second most populous country in Africa. Supplying hospitals, health centres, and health posts with safe supplies for routine immunization of the nearly 3 million infants born each year is a complex endeavour. In response to frequent stock-outs at regional warehouses, and the resulting growing number of inefficient and unplanned stock deliveries, the Ministry of Health analysed its distribution practices to identify opportunities for improvement.



Key analysis

Because of the inefficient distribution practices, the Ministry of Health conducted a network optimization analysis and identified the lowest-cost supply chain network for distribution from regional hubs to *woredas* (districts).

Outcome

An improved performance in distribution freed funds to be allocated to supervision and cold chain equipment maintenance. Health workers have more time to attend to patients rather than focusing on logistics.

Source: From supply chain analysis to action: Delivering vaccines in Ethiopia. Arlington, VA: John Snow Inc.; 2015 (www.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=16235&lid=3).

CASE STUDY 2.

Benin

Computer modelling and simulation highlight ways to address challenges of new vaccine introductions.

An external review of Benin's Expanded Programme on Immunization (EPI) conducted in December 2008, found that at least 15% of children were not receiving the complete set of recommended vaccinations. The introduction of pneumococcal conjugate vaccine in 2010 further strained the system, forcing the Ministry of Health to increase transport capacity. When faced with new vaccine initiatives in 2012, the Ministry of Health decided to comprehensively review the vaccine supply chain.



Logistician entering stock information at a health facility. Credit: AG Partners

Key analysis

The Ministry of Health initiated a system design study to analyse four alternative immunization supply chain scenarios using computer modelling and simulation to analyse storage locations, transport options and routing.

Outcome

The Ministry of Health piloted the following system design interventions: (i) consolidation of commune stores into one health zonal store; and (ii) informed push distribution model and delivery routes for vaccine distribution to health centres.

Following a positive evaluation of the interventions, the Ministry of Health is expanding the system countrywide.

Source: McWhorter R, Dicko H, Kalangwa A. Benin: Simulation study and delivery consolidation for new vaccine introductions. UNICEF; 2016. (www. technet-21.org/iscstrengthening/media/ attachments/2017/02/14/benin-systemdesign-case-study---final-submittedjan-15-2016.pdf).

CASE STUDY 3.

Mozambique

Dedicated logistics system results in vaccine stock-outs of less than 5%.

In Mozambique, the original EPI supply chain was designed around multiple tiers of storage and distribution and, in many circumstances, had become inadequate and underperforming over time. Poor immunization supply chain performance was linked to poor or inequitable vaccine coverage rates, delayed new vaccine introductions, excessive waste of expensive vaccines, and reduced availability of all vaccines at the point of immunization. Following a system design analysis, the government identified bottlenecks showing that the existing immunization supply chain could not accommodate the requirements placed on it.

Key analysis

The Ministry of Health initiated a system design approach to analyse and evaluate alternative supply chains to ease transport and human resources bottlenecks.

Outcome

Interventions included a dedicated logistics system that incorporates transport loops, level jumping, and direct data collection with new provincial logisticians' positions and an improved performance - consistently low vaccine stock-outs of less than 5%.



Last-mile vaccine delivery in Mozambique Credit: VillageReach

Source: Prosser W, Phillips N, McWhorter R, Kalangwa A. System Design approach for comprehensive immunization supply chain strengthening - a case study of the Dedicated Logistics System (DLS) in Mozambique. UNICEF; 2016 (www. technet-21.org/iscstrengthening/media/ attachments/2017/02/14/mozambiquesystem-design-case-study_final-version-byvr-submitted-jan-15-2016.pdf).

Nigeria

New system design for storage gains efficiency and lowers costs.

By 2015, Nigeria had made significant progress towards improving its vaccine supply chain. The average stock availability in local government areas had increased from less than 35% to approximately 80%. However, the demand for vaccines in Nigeria is expected to nearly triple by 2020, owing to the needs of a growing population and the introduction of new vaccines to the national immunization schedule. Faced with the storage gap, the National Primary Healthcare Development Agency (NPHCDA) partnered with donors and multilateral agencies to explore options for additional immunization supply chain capacity while optimizing available capacity so that it could do more; this was approached as a system design intervention.

Key analysis

The NPHCDA engaged in-country partners to review the results of desk-based and Llamasoft's supply chain guru-based modelling analyses. NPHCDA organized a stakeholder consultation to review the results of the analyses and decided to employ the three-hub redesigned model to optimize available capacity.

Outcome

Interventions included a three-hub national vaccine storage architecture which: (i) reduced levels by eliminating the zonal level; (ii) downgraded remaining zonal stores for surge capacity use only; and (iii) assigned each hub to transport directly to states. These resulted in reduced overall storage capacity needs, lower operational costs and more efficient use of available storage.



Source: McWhorter R, Arnot-Kruger M, Mustafa M, Kalangwa A. Making supply chain system design decisions based on stakeholder consultations aided by office based analysis: A case study on the Nigeria vaccine supply chain. UNICEF; 2016 (www.technet-21.org/ iscstrengthening/media/attachments/2017/02/14/nigeria-system-design-case-study---final-submitted-jan-15-2016.pdf).

CASE STUDY 5.

Loblaw Retail, Canada

Refocus on customer experience spurs investment in information technology systems and improved monitoring of performance indicators.

Loblaw is the largest Canadian food and pharmacy retailer, with a network of corporate and independently operated full-service pharmacies and food stores in communities across Canada. The company distributes fresh foods and pharmaceuticals to over 1000 stores. Customer loyalty is a hallmark of its success, and therefore high-quality and safe products that are available at customer request is critical to its business.

After facing problems replenishing its stores and customers' shelves while its major distribution centres were full of inventory, the company undertook a system design analysis to identify bottlenecks and areas for improvement. This study outlined distribution rationalization and information systems as the key drivers for change and included a fresh look at the key performance indicators.



Loading refrigerated food products for distribution. Credit: Loblaw Companies Limited

Key analysis

The senior executive team queried managers and employees to better understand and note their concerns and complaints, identifying gaps in data and performance indicators.

Outcome

Interventions focused on customer experience by investing in an improved information technology system; rationalizing deliveries and measuring/monitoring key performance indicators; and organizing deliveries using multi-temperature trucks. Inventory accuracy is now close to 99%.





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