

Nigeria system design case study final

Making supply chain system design decisions based on stakeholder consultations aided by office based analysis: A case study on the Nigeria vaccine supply chain.

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Date of submission of case study

March 7, 2016

Abstract

By 2015, Nigeria had made significant progress towards improving its vaccine supply chain. The average vaccine stock availability¹ at Local Government Areas (LGAs) had increased from average levels of < 35% to approx. 80%, which had been maintained since July 2014. However, the demand for vaccines in Nigeria would nearly triple by 2020, owing to the needs of a growing population and the introduction of new vaccines to the national immunization schedule yet there was limited capacity to store additional vaccines.

Faced with the capacity gap, the National Primary Health Care Development Agency (NPHCDA) of Nigeria partnered with several donors and multi-lateral agencies to explore options for obtaining additional immunization supply chain capacity required by the country while optimizing available capacity so that it could do more; this was approached as a system design intervention. The following changes were agreed to improve performance of the vaccine supply chain: reducing the number of levels in the vaccine supply chain by eliminating the zonal level; increasing the number of national level warehouses from 1 to 3 through creation of two additional national level hubs besides Abuja - one at Lagos and the other at Kano); downgrading the role of zonal level warehouses such that the four remaining zonal stores would only be used for contingency storage at approx. 25% of their current capacity; and assigning responsibility to transport and deliver vaccines such that each hub transports vaccines directly to the state.

System design resulted into a 3-hub national vaccine storage architecture where centrally located units namely Kano, Abuja and Lagos would serve as national hubs that receive vaccines from manufacturers and transport them directly to states. The hub-to-state allocation reflected the geopolitical set up of Nigeria resulting in a population coverage

¹ Stock availability refers to percentage of LGAs with all antigens present above minimum / buffer levels

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of 39% for Kano, 26% for Abuja and 35% for Lagos. The four remaining zonal stores would only be used as contingency storage at approx. 25% of their current capacity².

We therefore find that system design could help Nigeria meet its immunization targets for the year 2020 through a reduction in overall storage capacity needs, implementing a supply chain with a lower operational cost and more efficient utilization of available warehousing storage than the current system.

Key words

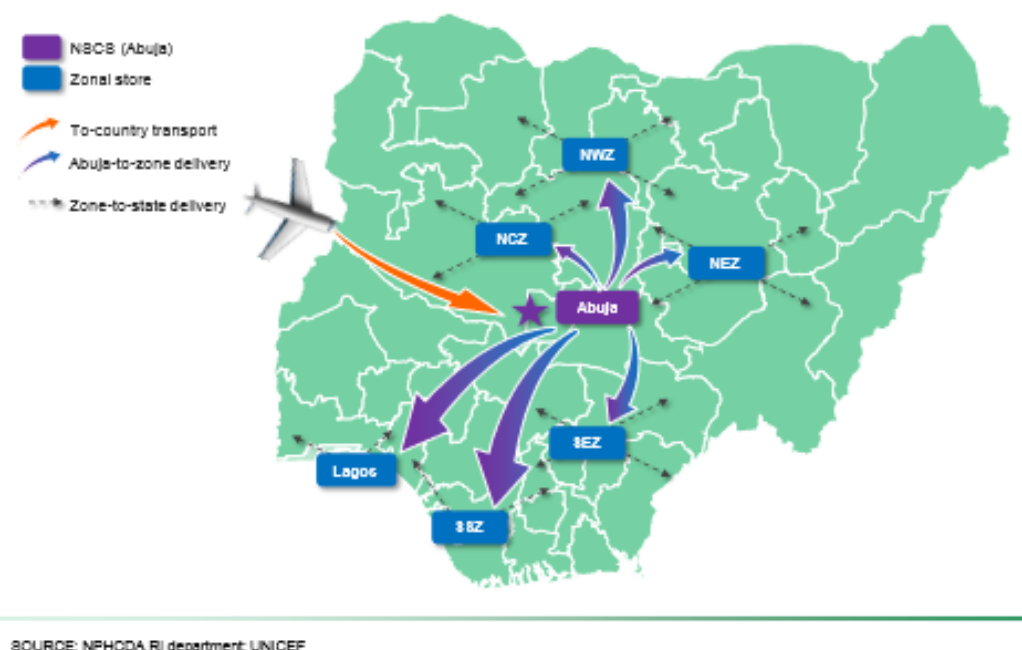
- Commodity
 - Vaccines
- Industry
 - Pharmaceutical
- System Design Strategy
 - Network redesign
- Country- Nigeria
- Partners
 - National Primary Health Care Development Agency
 - UNICEF
- Supply Chain Level
 - National
 - Provincial
 - Sub-regional

1. Background

By the year 2013, Nigeria had many nodes in the national vaccine storage and distribution architecture. All vaccines entered the country by plane through Abuja, where they would be stored at the National Strategic Cold Store (NSCS). The vaccines would then be pushed via ground transport to six zonal stores and stored for an interim period. Thereafter, the vaccines would be transported via ground transport from zonal stores to state stores to be kept pending delivery to the Local Government Areas (LGAs). The figure below illustrates Nigeria's original national vaccine storage architecture.

² Permanent discontinuation of zonal stores is not an immediate option due to geopolitical considerations; instead they shall serve as contingency storage for prepositioning campaign phases and other products.

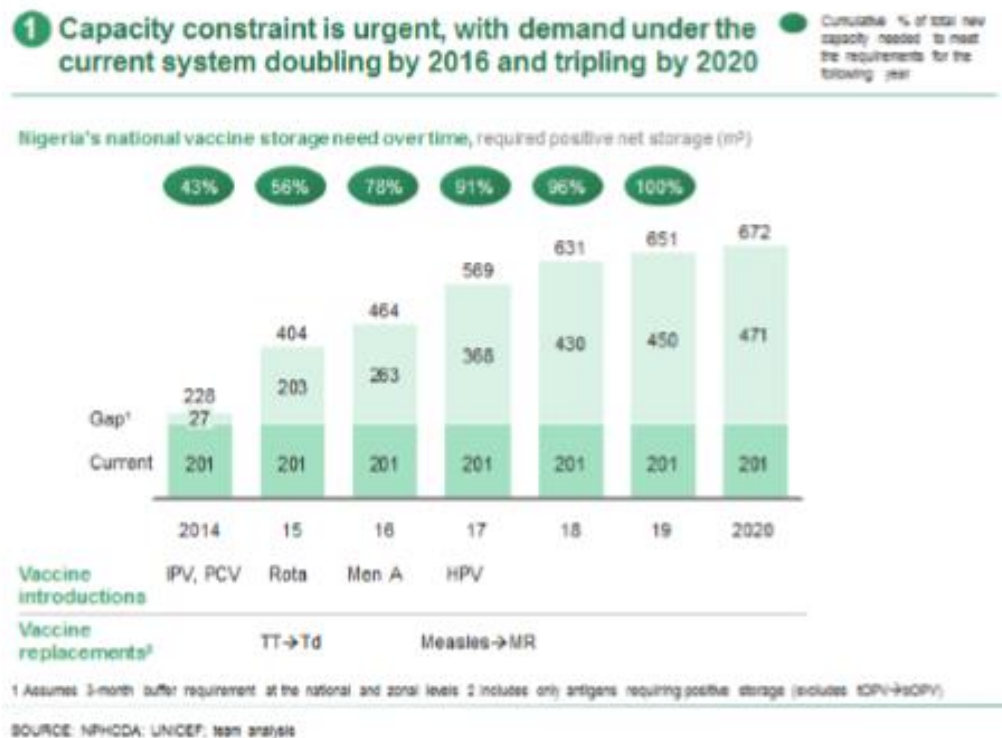
Currently, vaccines enter Nigeria through Abuja and are distributed to states via 6 zonal stores



By 2015, Nigeria had made significant progress towards improving its vaccine supply chain such that the average vaccine stock availability³ at Local Government Areas (LGAs) increased from average levels of < 35% to ~ 80%, which have been maintained since July 2014. However, the demand for vaccines in Nigeria would nearly triple by 2020, owing to the needs of a growing population and the introduction of new vaccines to the national immunization schedule yet there was limited capacity to store additional vaccines. More than two times of capacity available in 2015 was required to meet 2020 storage needs (i.e., current capacity of 201m³ for positive net storage⁴ versus 672m³ needed for 2020, creating a storage gap of 471m³). The need to increase capacity was urgent, as ~ 80% of the additionally required capacity had to be in place by the end of 2016.

³ Stock availability refers to percentage of LGAs with all antigens present above minimum / buffer levels

⁴ Negative storage is primarily used for OPV; its need is expected to decrease significantly after the anticipated eradication of polio in or before 2018. The capacity requirement therefore focused on positive capacity only.



Therefore, to maintain on this path to success, there was an urgent need for Nigeria to expand its national vaccine storage capacity.

Faced with the capacity gap, the National Primary Health Care Development Agency (NPHCDA) of Nigeria partnered with several donors and multi-lateral agencies to explore options for obtaining additional immunization supply chain capacity required by the country while optimizing available capacity so that it could do more; this was approached as a system design intervention.

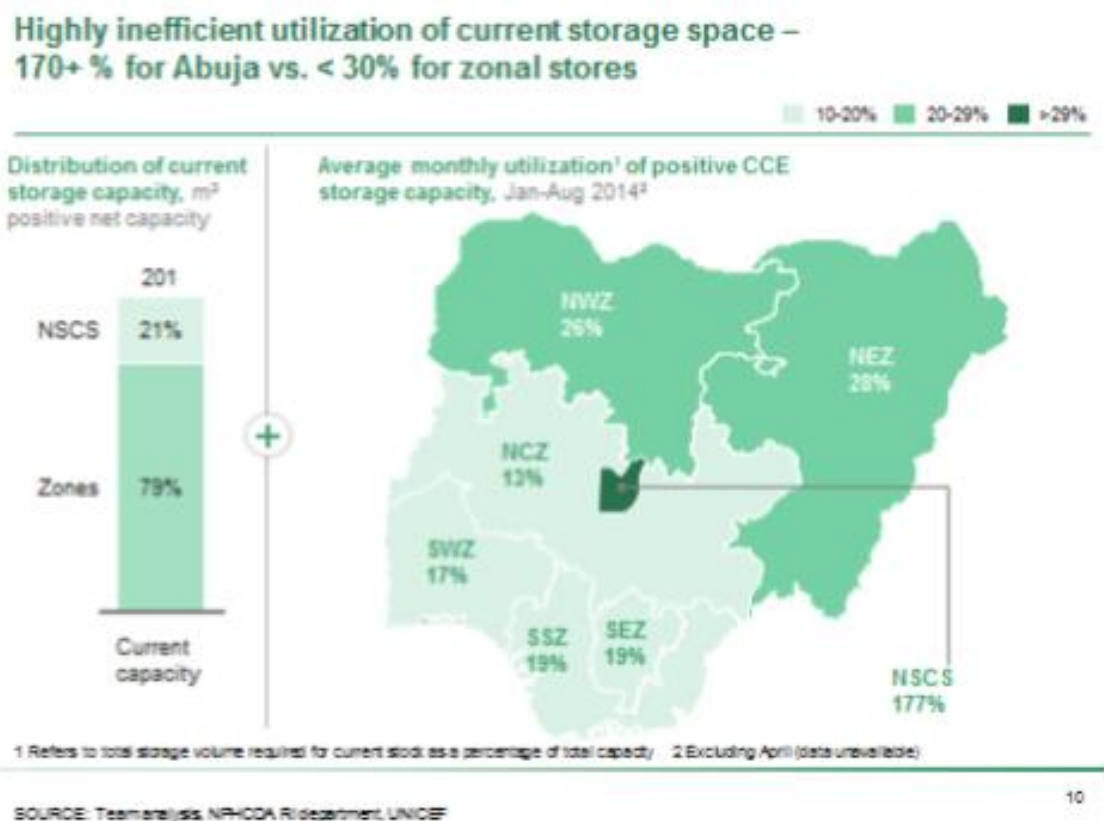
2. System design intervention

Nigeria's vaccine supply chain is established according to national administration structures namely; one national Strategic Cold Store (NSCS); six zonal stores; and various state stores and the Local Government Authorities (LGAs). However, administration structures were not necessarily drawn according to demand of vaccines. A consultative analysis by stakeholders revealed that aligning the supply chain to administrative structures could have led to a mismatch between deployment of supply chain capacity and demand for vaccines resulting in capacity gaps as well as redundancy at different points of the same vaccine supply chain.

For example, the figure below demonstrates that utilization of storage space was inefficient because while zonal stores represented 79% of all national capacity, they

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showed an average positive storage utilization of less than 30%. At the same time, the Abuja NSCS showed an average utilization rate of more than 170%.⁵



The above pattern was found to be consistent over time – even at zonal peak times, zonal stores were utilized up to less than 60% while utilization rate of the Abuja NSCS was above 100%.

NPHCDA commissioned a team to consider options available to improve performance of the vaccine supply chain and match targets set for 2020 within a constraint of available resources. The team which was supported by UNICEF analyzed the vaccine supply chain and came up with an idea of use of hubs. The locations of the hubs were selected more on a pragmatic basis than modelling based on analysis. The team thought that the hubs needed to be in Abuja, Kano & Lagos because these are the major commercial hubs in Nigeria and are also of political significance. Members of the team thought that no other city would have been chosen, even if the model gave a different answer because of the commercial and political considerations that had to be made. The suggestion of three hubs instead of one came about also because there was not sufficient space in Abuja for expansion. At that time, Lagos already acted as the device hub for the country and this plan just formalized it. The other reason for three stores was to spread risk. Nigeria stores

⁵ Utilization refers to stock level over available space; considering averaged monthly data from January to August 2014, excluding April

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large volumes of vaccines and having three hubs was safer from that perspective. The move was also supported because it would get the vaccines closer to the states and reduce delivery times. The team therefore identified the following supply chain changes that had potential to improve performance:

- They reduced the number of levels in the vaccine supply chain by eliminating the zonal level
- Increased the number of national level warehouses from 1 to 3 through creation of two additional national level hubs besides Abuja - one at Lagos and the other at Kano)
- The role of zonal level warehouses was down-graded such that the four remaining zonal stores were only used for contingency storage at ~ 25% of their current capacity.
- The responsibility to transport and deliver vaccines to the state was changed such that each hub transports vaccines directly to the state.

The system design intervention was anticipated to improve performance of the vaccine supply chain through reduction in overall storage capacity requirements to achieve national immunization targets by 2020; reduction in capital expenditure to achieve national immunization targets by 2020; reduction in operational expenditure to achieve national immunization targets by 2020 and operational efficiency demonstrated by the extent of spread of the burden of storage among national level hubs. Ultimately, system design would reduce the need for storage, distribution and Human Resource at the zonal level.

3. Indicators

The system design intervention was verifiable by the following indicators:

- Number of levels in vaccine supply chain (reduced by elimination of zonal level)
- Number of national level warehouses (increased from 1 to 3 through creation of two additional national level hubs besides Abuja - one at Lagos and the other at Kano).
- Role of zonal level warehouse - the 4 remaining zonal stores are only used as contingency storage at approx. 25% of their current capacity.
- Responsibility to transport and deliver vaccines to the state (Each hub transports vaccines directly to the state)

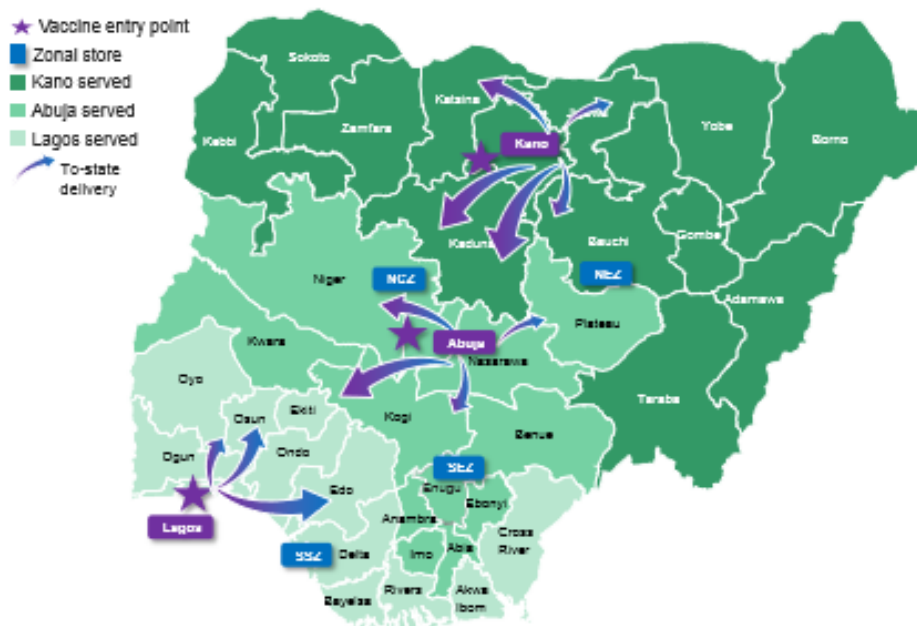
Supply chain performance was assessed by the following indicators:

- Overall storage capacity requirements to achieve national immunization targets by 2020.
- Capital expenditure to achieve national immunization targets by 2020.
- Operational expenditure to achieve national immunization targets by 2020.
- Operational system efficiency to achieve national immunization targets by 2020. Efficiency is determined by the extent of spread of the burden of storage among national level hubs.

4. Results

As a result of the system design intervention, Nigeria agreed on a 3-hub national vaccine storage architecture. This design was chosen from several options based on cost and feasibility trade-offs in which capacity expansion had to take place. In the new architecture, Kano, Abuja and Lagos would serve as national hubs that receive vaccines from manufacturers and transport them directly to states. The hub-to-state allocation reflected the geopolitical set up of Nigeria resulting in a population coverage of 39% for Kano, 26% for Abuja and 35% for Lagos. The four remaining zonal stores would only be used as contingency storage at ~ 25% of their current capacity⁶. The figure below illustrates the proposed architecture.

New 3-hub architecture involves direct transportation of vaccines from hubs to states



SOURCE: NPHCDA RI department; UNICEF, team analysis

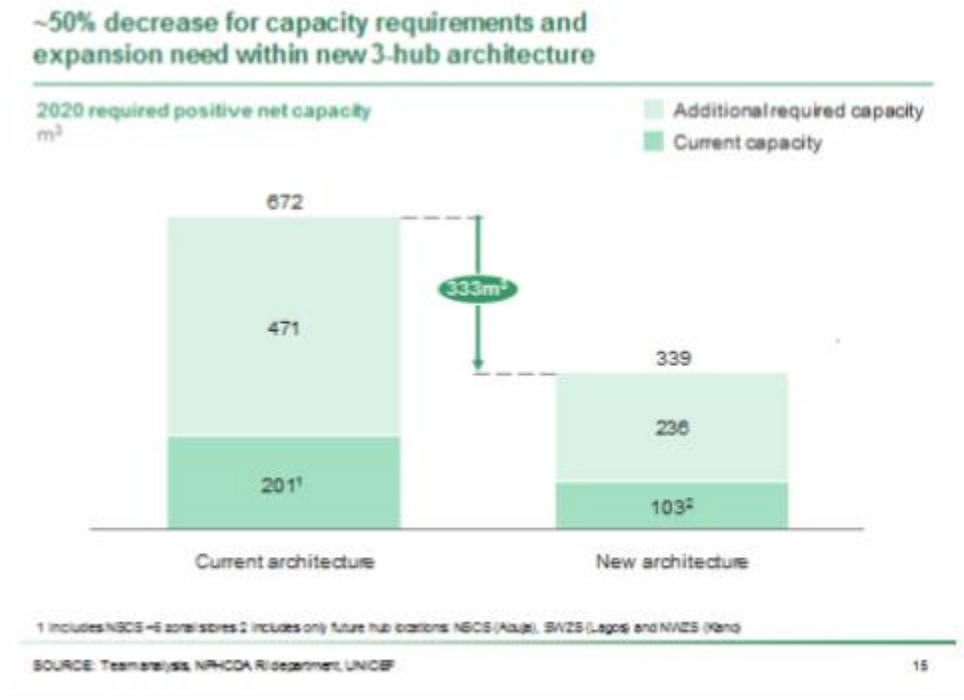
The new architecture has several key advantages over the current system and can be summarized as follows:

- a) **The new architecture reduces the overall required storage capacity by approx. 50%.** By proposing a direct hub-to-state distribution network, the new architecture substantially reduces capacity need at the zonal level. As a result, the overall system capacity needed to meet 2020 requirements is reduced by 333 m³, which is equivalent to a 50% decrease (i.e., from 672 m³ overall 2020 positive net storage required in the

⁶ Permanent discontinuation of zonal stores is not an immediate option due to geopolitical considerations; instead they shall serve as contingency storage for prepositioning campaign phases and other products.

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current system to 339 m³ in the new architecture). This effect is summarized in the figure below:

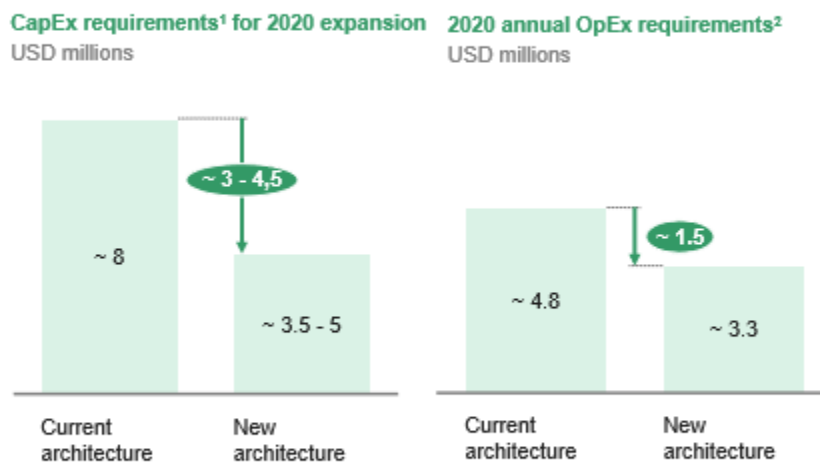


- b) **The new architecture is less costly than the current system.** By removing capacity and operations requirements at the zonal level, the new architecture entails substantial cost savings over the current system: ~ \$ 3 to \$ 4.5 million less in capital expenditures for a 2020 quick-fix expansion (i.e., ~ \$ 8 million required capital investments in the current system versus ~ \$ 3.5 to \$ 5 million in the new system); ~ \$ 1.5 million less in annual 2020 operating expenditures (i.e., ~ \$ 4.8 million in the current system versus ~ \$ 3.3 million in the new system). The figure below summarizes cost savings within the new architecture.

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New architecture is less costly than current system:
~ \$ 3 - 4.5 m less in CapEx, and ~ \$ 1.5 m less in annual OpEx

APPROXIMATIVE



¹ Includes WICR purchase and installation, construction, renovation, technology and purchase of equipment and delivery vehicles ² Includes within-country transportation and warehousing costs. Excludes international freight costs

SOURCE: NPHCDA RI department; UNICEF, team analysis

- c) **The new architecture improves operational system efficiency.** The new architecture facilitates a more efficient utilization of warehousing storage than the current system. The new 3-hub architecture will enforce a more even distribution of storage space utilization as vaccines will directly arrive at their respective hub – thereby reducing the burden on Abuja, while enforcing full utilization for Kano and Lagos hub locations.

5. Next steps

A costed action plan has been agreed to establish the new architecture starting by launching hubs sequentially by the first quarter of 2016. The plan includes short term (until end of 2016) – quick fix expansion; midterm (2016 to 2018) – establishing intermediate solutions; and long term (2019 and beyond) – establishing state-of-the-art hubs.

6. Conclusion

System design could help Nigeria meet its immunization targets for the year 2020 through a reduction in overall storage capacity needs, implementing a supply chain with a lower operational cost and more efficient utilization of available warehousing storage than the current system

7. Lessons Learned

A possible lesson emerging out of this case study is that it may be possible to make supply chain system design decisions by following a stakeholder consensus building process

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aided by office based analysis e.g. MS excel without complicated mathematical and computational models.

Acknowledgements

This study report is a collective output of the authors as specified. Funding and technical support for the case study was provided by UNICEF.