Last mile vaccine distribution to rural health centres

Faheem Merchant
VillageReach

Abstract
This paper will discuss improving vaccine distribution and coverage rates in rural areas of sub-Saharan Africa. This paper will focus on influencing logistics processes to improve the vaccination rates of children, reducing mortality rates of children under 5 and reversing the incidence of major diseases. VillageReach was founded to improve the supply chain and distribution of vaccines to rural villages and health centers in conjunction with the Ministry of Health in Mozambique. Prior to 2002, vaccination coverage rates in the provinces of Cabo Delgado and Nampula were less than 30% and since then have been improved to more than 80%.

Keywords: vaccine, logistics, VillageReach, immunization, distribution, Mozambique

Introduction
In terms of vaccine distribution, not many in the western world understand how the medicines that their governments have promised to donate to developing countries are actually distributed. Western countries have contracts with pharmaceutical companies to purchase a certain quantity of vaccines. These get distributed to a developing country and stored in the warehouses of the national government. This is where the western world ends its engagement and expects the developing nation to deliver the vaccines to all its citizens. However, just like in an emergency or disaster situation where most developing countries are not well versed in humanitarian logistics or distribution of food and water, the developing country is also not prepared for the distribution of vaccines to all the urban and rural residents of the country. This paper deals with the vaccine distribution improvements and methodology utilized by VillageReach in northern Mozambique as well as the forward looking strategies that vaccine logistics organizations should undertake to stay ahead of future medical discoveries.

Method
To demonstrate the previous distribution system, consider Mozambique as having several provinces and each province having a couple of districts. Each district having one central warehouse and 30 health centres using this district warehouse as the central source of supplies. Imagine also that the district warehouse was not aware of exactly when the supplies from the national warehouse would arrive or when the health worker would arrive to restock for their respective health centres. Imagine having a district warehouse that was never able to predict demands for vaccines or supplies as there would always be an uncoordinated vaccine demand at the district warehouse by the many health centres in the district at various times of the day.

Now imagine that each health centre has only one worker, so if there is ever a stock out of vaccines the health centre has to be shut down so that the worker can travel to the district warehouse to pick up the supplies. Every time a health centre had a stock out of a particular vaccine, syringe, safety box or gas the health worker would travel from the health clinic to the district warehouse for restocking. Imagine also that as the health centre could possibly run out of supplies during business hours, villagers who had travelled many kilometres to get vaccinated at the health facility would be turned away because the health centre would be closed. Also imagine a mother walking for tens of kilometres may return once or twice more to have their children vaccinated but with further closures the clinic’s reliability would be lost and mothers would not return. Also imagine that the health facility’s vehicle that is used for restocking the vaccine supplies also acts as the ambulance for the village, the ambulance would not available in case of emergencies when it was being used to restock supplies. It is noteworthy that vaccines are temperature controlled supplies and need to be stored and transported at temperatures between 2 and 6 degrees Celsius. Imagine the vehicle used as the ambulance which was not a cold storage unit, being used to transport vaccines from the district to the health centre. The vaccines would inevitably get damaged, spoiled or lost during transport. The health clinics also faced problems of their own. Frequently plagued with stock outs of vaccines and refrigerator failures, the vaccines could not reliably be stored for long periods of time. In just the same way as the stock outs resulted in villagers being turned away, the refrigerator breakdown resulted in vaccines being spoiled and losing their potency. Those spoiled and expired vaccines could not be administered resulting in fewer vaccines at the health centre.

When VillageReach was initially conducting a feasibility study of vaccine delivery it recognized that prior to any real deliveries taking place the infrastructure would require some upgrades to handle the influx of vaccines. Firstly, VidaGas was created to provide critical propane fuel services to rural health centres operated by the Ministry of Health in Mozambique. Prior to VidaGas, kerosene-burning refrigerators and lamps were the norm in health centres which were inefficient and required constant maintenance. VillageReach also installed refrigerators at the health clinics to prevent spoilage of vaccines and propane powered lights. VidaGas also provides a safe and reliable energy alternative to burning charcoal and wood in households and now acts an independent private company which sells propane to households, small businesses, industry and the health services sector.
After the energy infrastructure was in place with the creation of VidaGas, VillageReach then changed the vaccine distribution from a collection based model to a delivery based system.

Every quarter the ministry would fly in the vaccines for tuberculosis, measles, diphtheria and other diseases to the province who would distribute the vaccines to the district cold store warehouses. No longer were health centres responsible for picking up vaccines from the district warehouses. Instead, VillageReach instituted a fleet of six Toyota Land Cruisers that would pick up the vaccines and distribute them in temperature controlled cold boxes to the rural clinics. A rigorous scheme was implemented to ensure that refrigeration equipment failures would be reported immediately and then repaired as soon as possible. The health workers would no longer be required to close down the health facilities and villagers would not be turned away due to a vaccine stock out or equipment failure. This distribution model also avoided the pitfalls of utilizing the health centre ambulances to pick up vaccines from the district. Instead the ambulance could continue to be used to administer vaccines to those who were far from the health facility.

In addition VillageReach instituted a meticulous and painstaking scheme of supportive supervision. An individual would travel with the driver of the Toyota Land Cruiser to speak with health workers about improving the first expired, first out methodology of utilizing vaccines and increasing the coverage rate of the population. They also looked for equipment problems and ways to reduce stockouts and wastage of vaccines. The supportive supervision was the main method of collecting data for reporting and also for checking for anomalies at a health centre compared to neighbouring health centres.

Improvments

The new model that was instituted by VillageReach can be described as a circular methodology. In the previous collection based model the concentration is on a single district warehouse. So if all the health centres for a district were mapped the routing for each delivery truck would be between each of the health centres and the district warehouse. In the new delivery based model, there would be one circular route starting at the district warehouse, travelling to each of the individual health centres once and then returning back to the district warehouse. Although a significant improvement from before, the current system utilized by VillageReach is still a push based system where the health clinics fridges are topped up with vaccines. In a push based distribution, a single central authority makes decisions about what supplies should be distributed at each location. The better method would be to change to a pull pull system where the vaccines are distributed according to the number of administrations of a particular vaccine in a particular health centre. In this way a health centre is not pushed to accept vaccines that it doesn’t require, but instead the health centre only pulls those supplies it has used up or it plans to use up in the near future. Although this transition from a push based to pull based system has not fully been completed this is another major improvement that VillageReach has been working on in the last year. These types of improvements that VillageReach has been proactively trying to introduce prove its continued creativity and initiative.

The VillageReach organizational structure is broken down into programs, social business and technology. The overlap of these three groups provides fresh initiatives and ideas to pursue in vaccine logistics for the last mile. It is important to note that although many organizations do concern themselves with humanitarian distribution, VillageReach stands out as a pioneering example in last mile logistics. As mentioned earlier the vaccine distribution model was changed to a delivery based model with a circular loop starting and finishing at the district warehouse. This distribution model is similar to a milk run scheme. At the tail end of this circular truck route it is apparent that the truck is almost empty if not empty. This empty space can be utilized to transport goods from the last few villages in the route to distribute at the district centre. Agricultural goods were one type of good that were being examined for this return trip from the health centre to the district level. If successful this would improve the load levels of the trucks on the return trip and improve the fuel efficiency of the trucks. Farmers might consider this as a viable option to transport edible goods from their villages to the town. Still in the design stages and not yet implemented this is one type of social business that looks at development not simply from one perspective but consider a holistic approach of improving lives. The niche market that VillageReach has established itself in is the last mile distribution of these goods which other NGOs have not yet fully exploited.

VillageReach has also started to look at the issue of the technology pile-up without being prompted by external agencies or the national governments. Technology pile-up is the issue where future vaccines for malaria and antiretrovirals for HIV/AIDS are expected to be much bulkier and more expensive than current measles, TB and polio vaccines and VillageReach has started an investigation to determine whether these vaccines can be supported by the current distribution system. As these future vaccines are expected to be more expensive, simply inserting them into the current distribution would be detrimental. Unlike vaccines for measles, the future malaria vaccine will be more expensive, this means that the demand will have to be accounted for in distribution. A pull methodology instead of the current push methodology will have to be implemented. The fact that HIV antiretrovirals are expected to be bulkier means that the capacity of the entire cold chain from storing to distributing to administering will have to be re-examined. If the current capacity of the trucks is minimal, introducing these antiretrovirals could create a major bottleneck at the transport layer. A management information system is being developed to account for these types of bottlenecks and provide a better feedback loop for preventative maintenance and repairs of broken refrigeration equipment and trucks. The information system has to be developed with enough flexibility to accommodate distribution in diverse countries of sub Saharan Africa and Asia that have different organizational structures and reporting mechanisms. These are all considerations the VillageReach has acknowledged and is working feverishly to stay well ahead of competition but more importantly to stay ahead of the introduction of the next vaccine discovery. It is important to recognize that delivering to the national level is much easier than delivering to local villages.
Acknowledgements

I would like to take this opportunity to thank my family for their support in allowing me the opportunity to pursue my dream of poverty alleviation. I want to thank all my colleagues at VillageReach who made my time there most rewarding. Last but not least, I would like to thank Yasmin Moolani for her continued support in this endeavour.

References

There are several individual donors who have played a significant role in the implementation of this project; the most obvious has been the sincere dedication of VillageReach and the Foundation for Community Development (FDC) which was started by a Mozambican and Nelson Mandela’s wife, Graca Machel.

There were many philanthropic and voluntary organizations that acted as donors to the project such as the United Nations Children’s Fund (UNICEF) that provided funding. Vaccines were provided by the Global Alliance for Vaccines and Immunizations (GAVI) whose main motivation was to save children’s lives in Mozambique and improve health care access by providing immunization. The Program for Appropriate Technology in Health also provided funding support for the vaccine distribution, their main motivation was to increase coverage rates across the country, the World Bank provided approximately $250,000 and the Gates Foundation provided $3.3 million which was its largest contribution ever at the time.