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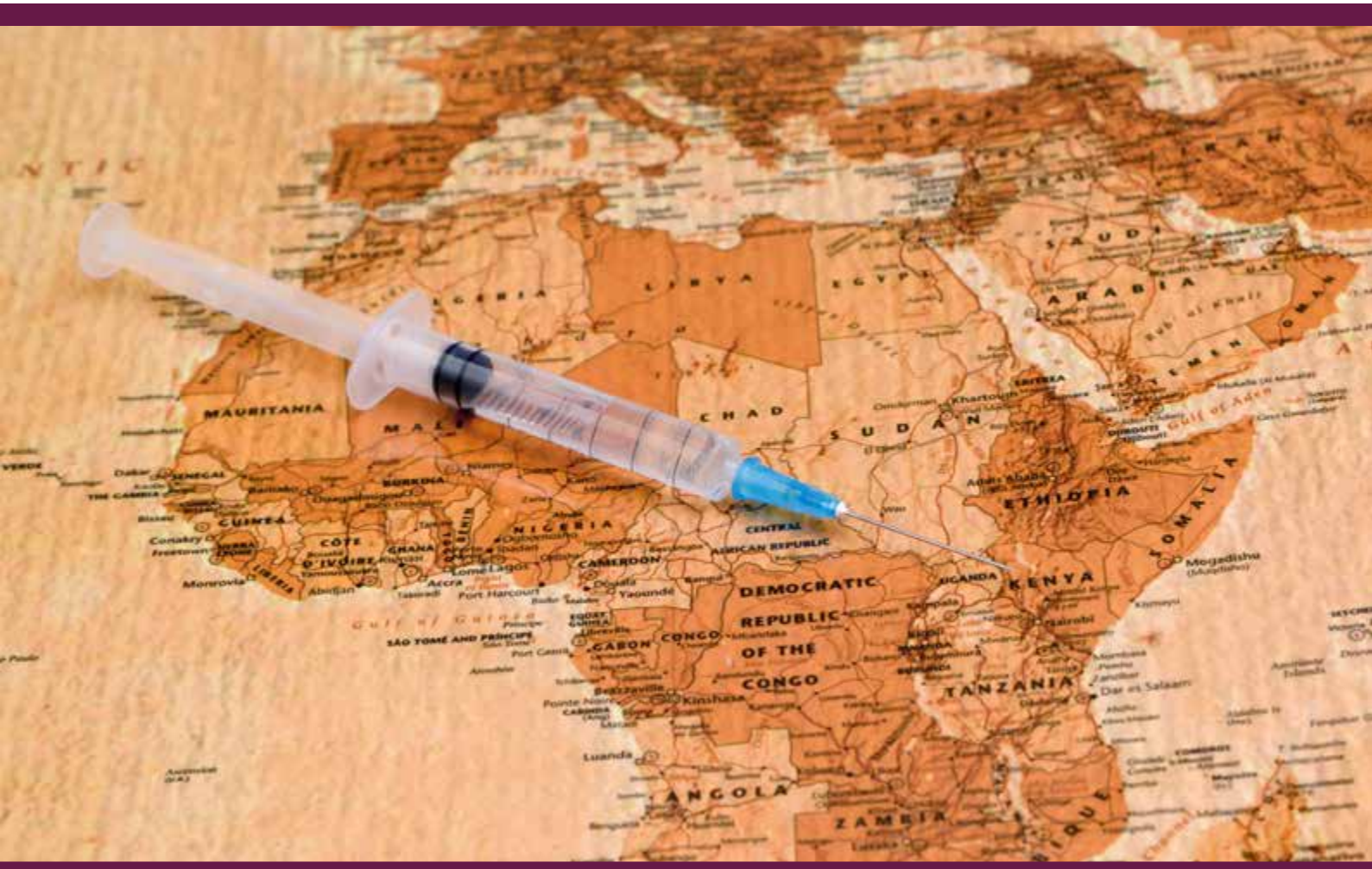

WHITE PAPER

Commercialising vaccines: A methodology to identify potential market opportunities and conduct outline assessments

Case study: South Africa

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Case study: South Africa

Global UNIDO Project:
Strengthening the local production
of essential medicines in developing countries
through advisory and capacity building support

2018

This document has been prepared by Kris Howard, Pharmaceutical Manufacturing Expert, UNIDO, and Martin Nicholson, International Pharmaceutical Expert, UNIDO. It forms part of UNIDO's global project "Strengthening the local production of essential medicines in developing countries through advisory and capacity building support", which is led by Juergen Reinhardt, Senior Industrial Development Officer and Project Manager, assisted by Alastair West, Pharmaceutical Manufacturing Plan for Africa Business Plan Coordinator.

The project is funded by Germany's Federal Ministry for Economic Cooperation and Development (BMZ).

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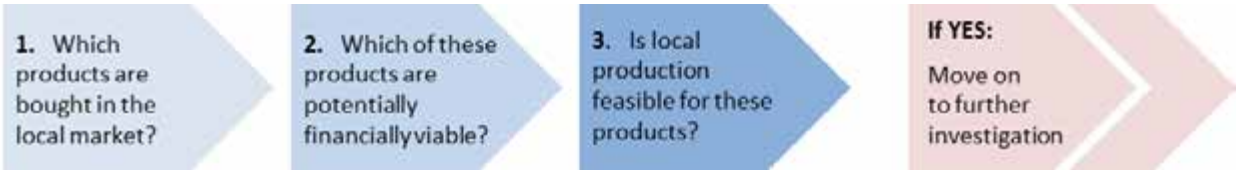
Executive Summary

This paper describes a methodology to perform an initial evaluation to decide which vaccines, if any, may be worth manufacturing for a particular market. These methods do not constitute a comprehensive market analysis but instead form part of an initial concept level business case analysis.

This stepwise approach is demonstrated using a real life example, South Africa, as a country case study.

The evaluation is carried out in three steps:



The document outlines each of these three stepwise phases which collectively comprise the methodology, and also details the next steps that would need to be taken to validate a business case.

Publicly available information on the existing South African vaccine manufacturer indicate that the conclusions drawn by this document relating to the South African market do in fact identify the key market opportunities there. This indicates that the methodology has delivered a valid assessment result in this particular case study, thus endorsing the approach taken. The results of the analysis may even provide insight as to why certain strategic decisions were made by the existing South African manufacturer, however further discussion on this point is beyond the remit and focus of this study.

The document supports and expands upon the white paper "Establishing Manufacturing Capabilities for Human Vaccines"[1] published in 2017 and assumes the reader is familiar with the concepts introduced therein. This white paper was designed to give a basic overview of the vaccines industry and summarize key cost drivers and factors to consider when planning the establishment of a vaccine production facility.

The objective of the current paper is to demonstrate how a person endowed with knowledge of the vaccine industry and basic market data can determine the high level feasibility of potential commercial vaccine opportunities in a market.

[1] https://www.unido.org/sites/default/files/files/2017-12/Establishing-Manufacturing-Capabilities-for-Human-Vaccines-ebook.pdf

Introduction

This paper introduces a high level methodology that can be used to identify potential commercial opportunities in the vaccines market and to systematically pare them down to the opportunities with the highest potential. It then seeks to determine if, from this list of opportunities, either the entirety or a sub-set of it constitute a financially viable opportunity to produce vaccines locally for a given market or region. The methodology follows three steps:

1. **Understand the local market for vaccines** – determine which vaccines are currently being supplied to the market, who purchases them (private citizens or insurance schemes, NGOs or the government), the basic procurement information for these vaccines (manufacturer, quantity purchased, purchase price) and how all of these details may change over the coming years.
2. **Identify financially viable candidates for local production** – determine if a compelling case can be made for these local purchasers to buy from a newly proposed organization. In many cases, the largest purchasers will be NGOs or the local governments so an opportunity to support local industry or generate procurement or forex savings may feature highly on their list of priorities.
3. **Assess feasibility of local production** – determine if local production of certain high potential vaccines presents a commercially attractive proposition for a new entity, local market purchasers and a technology transfer partner who currently makes these or similar vaccines. Issues such as facility operating and investment costs and the ability to achieve a certain facility capacity utilization will begin to factor into this decision.

This methodology should not be seen simply as a recipe for evaluating these types of scenarios around the world. Market data availability and format as well as local conditions will vary widely from market to market and must be evaluated on a case by case basis. So, whilst the basic approach depicted here is still a valid one, it may require experts with specific knowledge of the local market and the inner workings of the pharmaceutical industry to complete a similar assessment in other markets. Furthermore, it should be noted that the output from such a methodology should be considered as an initial high level analysis that needs to be further developed and expanded prior to making any investment decisions.

Lastly, this methodology has made one very large assumption, namely that the localization of vaccine production will occur via a technology transfer from another company. Whilst development of a novel and unique vaccine by a firm that is new to the vaccines industry is certainly possible (in other words, developing a product from scratch in a new company), the results of doing so vary widely in terms of duration, cost and probability of a successful product development program, and thus have not been accounted for here. The technology transfer-based route is consequently the predominant industry approach in the majority of cases like this, since it is more predictable in terms of duration, cost and probability of success.

Local market for the case study: South Africa

For the purposes of demonstrating the application of the methodology, South Africa was chosen as a suitable case study because of the relative ease with which data could be accessed. South Africa self-procures (i.e. is not GAVI supported) a substantial amount of vaccines every year for its EPI (Expanded Program on Immunization) through a local vaccines company, Biovac.

This analysis treats the South African market as a hypothetical example for the purposes of demonstrating the methodology. Importantly, it considers the country as if it were a 'clean slate', i.e. without consideration of the current manufacturing capacity present there. Whilst this is not actually the case in this country, given the presence of one local vaccine manufacturer, the analytical methods demonstrated can be used to assess feasibility for any market.

First Phase: Understanding the local market for vaccines

The South African EPI immunizes approximately 90% of the targeted EPI population (i.e. children under 12 years of age) free of charge, making the South African government the largest purchaser of vaccines in the country by far. Due to this, the analysis is focused on the public EPI vaccines market rather than the smaller, more fragmented private market. When discussing the local production of vaccines, the largest commercial opportunities for new market entrants are almost exclusively found within the public market. South Africa is not a GAVI eligible country and actually donates to the GAVI fund. It is important to note that:

- **GAVI eligible countries have their vaccines bought by UNICEF at what can be assumed to be close to COGs (Cost Of Goods) prices** - typically making the commercial potential of these markets lower than Non-GAVI funded countries**.**
- **Not all GAVI eligible countries should be discounted as places where local production is not viable.** In some circumstances, countries that will soon graduate from GAVI support can be good candidates for local production.

South Africa purchases all of its vaccines on the open market, including EPI products and those purchased for other uses by the government (vaccination of armed forces, healthcare workers, and so on). The vaccines bought by the SA government and the prices paid can be seen by examining publicly available tender data. This does not include operational and administrative costs. See the Appendix for more information on this.

By comparing the purchasing data from the tenders with the PAHO/UNICEF data, the following information can be extracted:

Table 1: Overview of South Africa Vaccine Purchase 2014-2016

Generic Vaccine Product Description	Part of EPI? (y/n)	Brand	Manufacturer	SA Price/ dose (ZAR)	SA Price/ dose (USD)	Quantity	Total Cost (USD)	% Budget
Hepatitis B	n	HEBERBIOVAC B AMD	CGEB *	29.50	2.22	264,477	587,461	0.2%
Rotavirus	y	ROTARIX	GSK	82.09	6.18	4,555,587	28,158,131	8.4%
BCG Intradermal	y	BCG SSI ID	SSI**	2.26	0.17	721,301	2,459,191	0.7%
BCG Intradermal	y	BCG Cipla/SII	Cipla	2.54	0.19	721,301	2,756,270	0.8%
Diphtheria Tetanus	y	DIFTAVAX	Sanofi Aventis	11.41	0.86	455,559	3,914,837	1.2%
Diptheria, Pertussis,Tetanus, Polio, HIB, HepB	y	HEXAXIM ***	Sanofi Pasteur	228.44	17.20	-	-	0.0%
Diptheria, Pertussis,Tetanus, Polio, Haemophilus	y	PENTAXIM	Sanofi Pasteur	186.35	14.03	9,111,175	127,841,839	38.1%
Hepatitis B	y	HEBERBIOVAC B PMD	CGEB *	7.99	0.60	927,387	5,577,869	1.7%
Human Papilloma	y	CERVARIX	GSK	108.60	8.18	2,000,000	16,354,190	4.9%
Influenza	n	Vaxigrip 2013	Sanofi Pasteur	55.94	4.21	3,000,000	12,636,097	3.8%
Measles	y	ROUVAX	Sanofi Pasteur	8.82	0.66	961,735	6,383,325	1.9%
Measles	y	Measbio	Biofarma Indonesia	11.11	0.84	961,735	8,045,959	2.4%
Meningococcal Meningitis A and C Single Dose	n	Menomune	Sanofi Pasteur	109.43	8.24	27,400	225,765	0.1%
Pneumococcal	y	PREVENAR	Pfizer	184.90	13.92	6,833,381	95,135,317	28.3%
Pneumococcal, Polyvalent	n	Pneumovax	MSD	101.85	7.67	24,200	185,586	0.1%
Polio Oral Trivalent	y	POLIORAL	Sanofi Pasteur	2.62	0.20	400,000	1,576,387	0.5%
Polio Oral Trivalent	y	POLIORAL	Sanofi Pasteur	3.45	0.26	865,562	2,247,163	0.7%
Rabies (embryo cells cultured)	n	Rabipor	Novartis	165.62	12.47	660,000	8,230,495	2.4%
Rabies (vero cell cultured)	n	Verorab	Sanofi Pasteur	158.83	11.96	660,000	7,893,065	2.3%
Tetanus Toxoid	y	TETAVAX	Sanofi Pasteur	8.42	0.63	865,562	5,486,259	1.6%
Yellow Fever	n	Stamaril	Sanofi Pasteur	216.21	16.28	15,100	245,823	0.1%
						Total	**335.9**	**USD ($ M)**
							4,461.6	**Rand (ZAR M)**

* Center for Genetic Engineering and Biotechnology

** Statens Serum Institute

*** South Africa is transitioning from a combination of Pentaxim + Hep B vaccine to Hexaxim, which is an all in one covering the same six antigens - this is why Hexaxim is currently shown at 0% of the budget.

Second Phase: Identifying financially viable candidates for local production

When identifying potential candidates for local production, the question to answer is “Can a compelling case be made for the local government to buy from you?”. Of course, things such as the safety and efficacy of the product will factor into the government’s decision to buy from a new supplier, but here we will begin with a financial assessment. Below are the guidelines used to carry out a quick and relatively straight forward assessment of the financial viability of local production for the products SA is purchasing:

- **UNICEF/PAHO prices**
  As discussed in the previous white paper, the UNICEF price is generally the lowest price for which a vaccine will be sold, and for many products is at or close to the cost of goods and therefore includes only a relatively small margin. The PAHO price for a vaccine indicates the “open-market” price for middle income countries and is generally higher than the UNICEF price for most products. In the case of South Africa, PAHO prices are relevant given its status as a middle income country.

- **Difference between purchase price and PAHO/UNICEF price**
  The greater the difference between the tender purchase price and the PAHO/UNICEF prices, the more likely it is that the South African government wishes to reduce it, and the greater the opportunity for savings.

  A small difference between PAHO and UNICEF prices most likely indicates a high degree of competitive price pressure has been placed on the product. Even in the case where the PAHO

and UNICEF prices are the same or similar, a case can still be made for local production if the South African government is paying above PAHO/UNICEF prices.

- **Purchase volume**
  Even if the difference in purchase prices and UNICEF prices is high, if the overall volume purchased is small, there is less pressure to reduce the price. Conversely, even a small saving of a high purchase volume product makes sense to pursue.

  Secondly, due to the high initial investment required, it is not financially viable to build a local facility to produce low volumes of a product. Further information about this point is available in the white paper "Establishing Manufacturing Capabilities for Human Vaccines" (UNIDO, 2017).

  If a country's total vaccine purchases are too low to make local production feasible, several countries in a region may need to be assessed together in an effort to increase the target market volume.

- **Percentage of total budget**
  The more the South African government spends on a given vaccine as a percentage of its total budget, the more likely it is to want to reduce that expenditure.

Most of this information will be easily available, however pricing for certain products can be hard to find. For example, since Hexaxim is not purchased by UNICEF, it may be difficult to estimate the total savings that could be invoked through local manufacturing. See Appendix 1 for further information regarding the compilation of the tables from the raw data.

Table 2: Assessment of Potential Financial Viability for Locally Produced Vaccines

Viability	Brand	Manufacturer	SA Price/ dose, 2015 (USD)	UNICEF Price/ dose (USD)	PAHO Price/ dose (USD)	Annual savings if bought at UNICEF price (USD)	Annual savings if bought at PAHO price (USD)	% Budget	Total Cost, 2015 (USD)	Number of Annual Units (single or multi-dose)
High	ROTARIX	GSK	6.18	1.99	6.50	9,546,256.40	(726,592)	8.4%	28,158,131	2,277,794
	HEXAXIM	Sanofi Pasteur	17.20	2.35	18.65	-	-	43.6%	156,716,875	4,555,588
	PREVENAR	Pfizer	13.92	10.30	15.68	12,375,746.42	(6,006,048)	28.3%	95,135,317	3,416,691
Medium	CERVARIX	GSK	8.18	4.60	8.50	3,577,095.10	(322,905)	4.9%	16,354,190	1,000,000
	Measbio	Biofarma Indonesia	0.84	0.23	1.85	5,882,054.83	(9,746,139)	4.8%	11,764,100	961,735
	Rabipor	Novartis	12.47	8.00	10.50	1,475,247.35	650,247	2.4%	8,230,495	330,000
	Verorab	Sanofi Pasteur	11.96	8.00	11.00	1,306,532.64	316,533	2.3%	7,893,065	330,000
	TETAVAX	Sanofi Pasteur	0.63	0.13	0.15	2,180,514.33	2,115,597	1.6%	5,486,259	432,781
Low	HEBERBIOVAC B AMD	CGEB *	2.22	0.38	0.30	243,479.94	254,059	0.2%	587,461	132,239
	BCG SSI ID	SSI **	0.17	0.16	0.16	194,305.38	165,453	0.7%	2,459,191	721,301
	BCG Cipla/SII	Cipla	0.19	0.16	0.16	491,385.15	462,533	0.8%	2,756,270	721,301
	DIFTAVAX	Sanofi Aventis	0.86	0.10	-	172,963.89	195,742	1.2%	3,914,837	227,780
	Menomune	Sanofi Pasteur	8.24	1.22	26.00	96,168.39	(243,318)	0.1%	225,765	13,700
	Pneumovax	MSD	7.67	N/A	7.62	-	591	0.1%	185,586	12,100
	POLIORAL	Sanofi Pasteur	0.20	0.14	0.14	228,193.66	218,594	0.5%	1,576,387	200,000
	POLIORAL	Sanofi Pasteur	0.26	0.21	0.14	236,380.67	507,302	0.7%	2,247,163	432,781
	Stamaril	Sanofi Pasteur	16.28	1.17	1.09	114,100.49	114,682	0.1%	245,823	7,550

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Notes

Dollar prices quoted for the SA price/dose are converted from Rand; this can shift considerably depending on the exchange rate at time of conversion.

It should be noted that the SA price reflects the fully loaded delivery price to the vaccinating facility, whereas PAHO and UNICEF prices reflect only the ex-factory price.

This table shows that South Africa is getting a good price for most of its vaccines compared to the PAHO prices. **However, there are several products where significant savings could be made by**

lowering the purchase price closer to the UNICEF price:

- **High Viability:** Rotarix, Hexaxim and Prevenar, together making up 80.3% of South Africa's total vaccine budget, are bought in large volumes, and have enough difference between the SA purchase price and UNICEF price (which is approximately equal to COGs), that local production could be financially viable. One or more high viability products should be the main production focus of a new local facility.
- **Medium Viability:** Products that have sufficient difference between the SA purchase price and UNICEF price but currently constitute relatively modest amounts of the vaccines budget may be worth pursuing. Medium viability products can be used to fill up capacity in a facility. The choice of medium viability products to focus on is likely to depend on several factors, such as how easy it is to find a technology transfer partner, and if these products can be produced in the same facility as the high viability products.

Competitors and technology transfer partners

The ability to produce a vaccine is heavily reliant on finding a suitable technology transfer partner from amongst the other vaccine manufacturers, who are also competitors. Any savings made from bringing prices down closer to cost of goods must be split between the technology transfer partner, local partner and the government.

In most cases, large numbers of manufacturers for a particular vaccine drive the price down and make anything but large-scale manufacturing unfeasible. Small numbers of competitors - or a single one - can either make a technology transfer deal very easy, as they move to lock other competitors out of a market, or very difficult, if they prefer to keep their technology to themselves. There is no way to accurately assess this without talking directly with potential technology transfer partners.

Many technology transfer partners are drawn to the right to sell exclusively to a market that has a sizeable volume and decent price point (i.e. a large chunk of guaranteed and predictable income).

Third Phase: Assessing feasibility of local production

Here the feasibility of performing formulation/filling (form/fill) and packaging locally for the high and medium viability products will be analyzed. This is the most likely outcome for a new facility (or at least the first stage in production localization), and is discussed in more detail in UNIDO's 2017 white paper "Establishing Manufacturing Capabilities for Human Vaccines".

- Form/fill technology transfers offer a relatively high value proposition to all parties, and are more common than technology transfers including bulk antigen production.
- Even if the local partner moves on to bulk antigen production at a later date, the form/fill stage must be mastered first.
- Bulk antigen production for multiple antigens requires significantly more space/equipment than form/fill.

What can be made in the same facility?

Live virus and inactivated products cannot be made in the same facility. A separate facility with separate equipment would be required for each type of product.

What can be made with the same equipment?

Focusing production on vaccines that can use much of the same equipment allows output to increase while keeping initial investments lower.

Live virus: At first glance, the live virus products would need different filling (plastic tubes/vials) equipment, and one requires a lyophilizer. Lyophilizers are not only expensive, but notoriously difficult to do a technology transfer for.

Inactivated products: Four of the inactivated products (including two products accounting for 70% of the total vaccine budget) could feasibly be made using much of the same equipment. One key difference that may arise in the equipment needs is due to each of these products being suspensions, which may require unique homogeneity processes for each product.

The other two inactivated products are also lyophilised products, which run into the same issues mentioned above, although they could potentially use the same filling machines.

Table 3: Product Information for a Form/Fill Facility*

Facility Type	Product	Administration Type	Presentation	Primary Container	Annual Volume	Total Facility Volume
Live Virus	Rotarix	Administered Orally	Liquid	Plastic Tube	2,277,794	2,277,794
	Measbio	Reconstituted for Injection	Lyophilized	Vial	961,735	961,735
Inactivated	Hexaxim	Suspension for Injection	Liquid	Vial or Syringe	4,555,588	9,405,060
	Prevenar	Suspension for Injection	Liquid	Vial or Syringe	3,416,691	
	Cervarix	Suspension for Injection	Liquid	Vial or Syringe	1,000,000	
	Tetavax	Suspension for Injection	Liquid	Vial or Syringe	432,781	
	Rabipur	Reconstituted for Injection	Lyophilized	Vial	330,000	660,000
	Verorab	Reconstituted for Injection	Lyophilized	Vial	330,000	
Diluent	Measbio, Rabipur, Verorab, BCG					2,343,036

* All products are refrigerated; storage 2-8^{o}C

What is the annual output?

Live virus: The total output of live virus products is approximately 3M units. This would be a very small facility, with all the technology transfer work of a larger facility but much lower financial viability. Of these, only approximately 1M units are lyophilised products, meaning the lyophilizer would be unused for much of the year. As well as being a poor return on initial investment, there is a risk that personnel would forget how to use it correctly between batches.

Inactivated products: The lyophilized products, with a combined annual output of approximately 660K units, run into the same problems introduced above. However, the two most lucrative liquid products, Hexaxim and Prevenar, have an annual output of approximately 8M units, which is feasible for a small facility while keeping it fairly well utilized year round. Making Cervarix and Tetavax in the same facility brings the total output up to approximately 10M units. Furthermore, the addition of export sales (pending deal terms with the TT (tech transfer) partner), sterile pharmaceuticals and/or diluents for lyophilised products are another option to better utilize the facility's capacity.

All the above conclusions assume that single dose vials or syringes would be used for the production of these volumes. All things being equal, the use of multi-dose vials would result in lower overall utilization of the facility and equipment as they can typically be produced more quickly than a single dose product.

In conclusion, due to the small relative financial gain of both the live virus and lyophilized products, it makes the most sense to build a facility for the four liquid suspension inactivated products, anchored by the production of Hexaxim and/or Prevenar.

Could a local facility be financially viable?

A small form/fill facility capable of handling approximately 10M doses a year would cost in the range of $14-$29M and take 2.5-5 years to build (see the previous white paper for a detailed breakdown of which costs are included and excluded from this estimate).

This theoretical facility would involve up to four technology transfers (see Table 4 below), and it is very unlikely that these would all be carried out in parallel. Even taking the upper boundary of that estimate, the timeline is extremely optimistic. These costs do not anticipate completely different formulation and filling processes, however, so more extensive analyses of the manufacturing methods and costs need to be carried out.

After factoring in any extra facility costs and COGs, any savings made from producing locally rather than buying at the current purchase price needs to be split in three ways:

- The local government, who will most likely expect a discount on the new product/s
- The technology transfer partner, who will not want to sell at too low a cost
- The local partner, who needs to recoup (at least) the facility costs

The percentage that each party would get in this split would be a matter of negotiation, and there are many caveats. For example, the local government may be willing to forgo their share of the

profits to help establish a new, skilled industry. However, nothing should be assumed or taken for granted before the negotiations start.

The potential savings from local production are summarized in Table 4 below. The main takeaway and conclusion is that that the annual savings to be split and the facility cost are of the same order of magnitude (i.e. tens of millions of dollars) - and that this scenario has the potential therefore to be financially viable.

Table 4: Maximum Potential Savings Using Local Production

Product	SA Price/dose, 2015 (USD)	UNICEF Price/dose (USD)	Total Cost, 2015 (USD)	Number of Annual Units (single or multi-dose)	Maximum Potential Annual Savings (if bought at UNICEF price)
HEXAXIM*	17.20	2.35	156,716,875	4,555,588	**$67,652,807**
PREVENAR	13.92	10.30	95,135,317	3,416,691	**$12,375,746**
CERVARIX	8.18	4.60	16,354,190	1,000,000	**$3,577,095**
TETAVAX	0.63	0.13	5,486,259	432,781	**$2,180,514**
				Total	**$85,786,163**

Note: While the maximum potential savings for Prevenar, Cervarix and Tetavax are within the correct order of magnitude, UNICEF do not buy Hexaxim - the UNICEF price is for a similar, but older and less complex vaccine. The true maximum annual savings for Hexaxim could still realistically be in the $10-20M range. While the exact figures are uncertain, it is clear there is a financial opportunity.

Summary

Using publically available data from the South African Department of Health, it was possible to determine the types, quantities and purchase price of vaccines that the department is currently procuring.

Since approximately 90% of the vaccines in the market are procured and administered by the government free of charge, it was prudent to focus mainly on this segment of the market for the analysis. Knowing the South African government may be interested in seeking to lower the amount of money it currently spends on vaccines, it was decided to seek out products the government was currently paying a premium for compared to other large global investors. To do this, current South African purchase prices were compared to publically available prices paid by UNICEF and PAHO. Knowing that the best way to gain access to similar prices is through local manufacturing, a high level production facility scope and costing exercise was conducted to determine which of these products of interest could be manufactured in a financially viable manner.

While the costing exercise was carried out on a high-level order of magnitude basis, it did show that local production of vaccines could be viable if the producers of one or two key products, specifically Hexaxim and Prevenar, would agree to perform a technology transfer to a local entity.

As proof of the power of this methodology, the outcomes determined here actually mirror the current plans for the localization of manufacturing of these same products in South Africa.

Conclusion and Next Steps

This paper outlines an approach to perform a top line analysis in order to determine potential vaccine market opportunities within a given territory or region, using a country case study of South Africa as an example.

In order to perform such an analysis, there is a need to have access to country (or regional) market data. In the case where the government or an NGO is the main purchaser of vaccines in the country, this information should be publically available, especially in the case of NGO donated vaccines. In the case where government data is more opaque or there is no single majority purchaser in a market, an experienced individual must employ other means of market data collection. However, due to the limited number of global vaccine manufacturers and products, this is a more straightforward exercise than it would be analyzing the pharmaceuticals market in a country.

Whilst it cannot be concluded from a top level analysis, such as the one above, that a project is investment worthy, the data suggests that there is enough potential to move onto the next stage of project planning. The UNIDO/WHO White Paper "Establishing Manufacturing Capabilities for Human Vaccines" (2017) outlines further points to be considered in the sections "Other Considerations" and "Next Steps". There are, however, further aspects which require specialist expertise to assess in addition to those highlighted on in this document, therefore it does not present an exhaustive set of considerations.

The next analytical steps are pursued when the initial evaluation indicates the potential for a valid business case, that is, it shows favorable alignment between costs and financial benefit as depicted here. These next steps focus on the following:

- **Detailed talks with the government**
  Determine with the local government what support or pledges they could offer to the project, whether money related (land, cheap financing, tax concessions, exclusivity for certain services or ring fenced markets, etc.) or influence related (policy coherence, continuity to the next government, influence with trade partners to win export tenders, and so on).
- **Talks with potential technology transfer partners**
  Examine which manufacturers around the world are making the products and see which may be interested in localizing products. Even manufacturers who are no longer making products may be persuaded to divest. At this stage, technology transfer partners should be brought on board or at least show strong interest.
- **Fine tune of cost/revenue calculations**
  More detailed analysis of facility initial capital required and operating costs, especially when the technology transfer partner's specifications are known. Research other activities that could be used to boost revenue of the facility (importation, packaging, release testing, exporting, production of non-vaccine product, and so on) as well as how other technology transfer deals for vaccines have been structured elsewhere in the region or around the world.

Appendix 1: Compiling Data

The main sources used to gather the data analysed in this case study are:

- **South African Department of Health: Master Procurement Catalogue**, available at: http://www.health.gov.za/index.php/medicine?download=1233:master-procurement-catalogue-8-march-2016-updated&start=20
- **UNICEF: Vaccine Price Data**, available at: https://www.unicef.org/supply/index_57476.html
- **PAHO Revolving Fund: Vaccine Price List 2015**, available at http://www2.paho.org/hq/index.php?option=com_docman&task=doc_download&gid=29591&Itemid=270&lang=en

While most of the data is relatively easy to compile in the format used in this case study, there are some important points to consider:

Products without UNICEF/PAHO prices

Some products in the case study do not have listed UNICEF/PAHO prices. This could be due to the fact that it is a new product on the market, due to low production volumes, or for several other reasons. In these cases, similar products can be used as a substitute for a price estimate, however be aware that this method inherently has a high margin of error. A vaccine expert may need to be consulted at this point to choose an appropriate substitute.

Multi-dose Products

UNICEF and PAHO prices are given as price per dose, however some vaccine products (in the case study, Heberbiovac, Diftavax and Polioral) are purchased as multi-dose vials. If during your analysis a vaccine price seems off by an order of magnitude, it is likely to be a multi-dose product.

Transition years

Years where the local government are transitioning from one product to another (in the case study, Pentaxim and HepB to Hexaxim, Rouvax to Measbio) may make the quantities of vaccine purchased and total purchase costs difficult to estimate accurately.

Appendix 2: Acknowledgements

This paper is a result of an ongoing collaboration between UNIDO, WHO and AVMI. The authors wish to thank Martin Friede, Coordinator, Initiative for Vaccine Research, WHO, and the African Vaccine Manufacturing Initiative, AVMI, for their involvement in, and contribution to, the concept, development and finalization of this document.

AVMI is focused on promoting the establishment of sustainable human vaccine manufacturing capacity in Africa. The organization conducts high level advocacy towards this goal, and encourages partnerships between African manufacturers of vaccines and biologicals and other interested stakeholders who have a vision of Africa producing its own vaccines. Further work entails attracting and securing the necessary skills and financial resources for establishing vaccine manufacturing capacity on the continent, as well as promoting the scientific and technical capacity building of Africa's vaccine manufacturers in all aspects of production and distribution of vaccines and other biological products. More information on AVMI can be found at www.avmi-africa.org.

The authors also wish to thank Cecile Lanfranchi for editing this paper.

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