

PRINCIPLES FOR FORECASTING DEMAND
FOR
GLOBAL HEALTH PRODUCTS

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“Forecasting is a process not a number”

Introduction

Demand forecasting is the ability to predict the future. The simplest forecasts occur in stable environments with plenty of good data. They depend on the future resembling the past; the closer the resemblance, the more accurate the forecast.

When the future does not resemble the past, demand forecasting becomes especially critical. The process of forecasting becomes the vehicle to quantify the rate of change from the current state of supply and demand to another state of supply and demand. The change from one state to another state depends on human action and reaction to the possibility of change and hence is difficult if not impossible to simply calculate. The level of demand is based on a wide range of demand drivers, and understanding the impact of each of these drivers on total demand is complicated. Forecasting in these conditions is as much an art as a science and requires wisdom as well as data.

Demand forecasting is inherently a customer focused activity. At the global level, the purpose of forecasting demand is to influence the supply of medicines and health products. This means that suppliers, who are expected to make investment decisions based on these forecasts, are important customers of forecasts. Ensuring the appropriate availability of drugs at an optimal price requires demand forecasting that has sufficient certainty around funding and timing of orders to allow suppliers to confidently invest in production capacity. Other important customers are global and national health programs and Product Development Partnerships (PDPs) who require demand forecasts to size and design their supply chains, and to design and implement strategies to stimulate demand for new and existing products. National and international technical agencies and funders also use demand forecasts to make budget, program and market segmentation decisions, and to procure health products.

Demand forecasting is an iterative process and a critical part of the supply chain that links supply to demand so that consumers and service providers have products available when and where they need them.

Defining Demand

Before outlining key principles for demand forecasting, it is useful to define what demand forecasting is and perhaps more importantly, what it is not. The classic economics definition of ‘demand’ is straightforward – it states that from the perspective of sovereign consumers, demand defines the quantity of a given product they are willing to buy at a given price. It assumes that consumers have the money to purchase the product. The term “***demand forecasting***” is applied by the global health community to define a wide range of forecasts which do not measure true *demand* for health products. For example:

- Within international agencies, it is often used to mean “needs forecasting” – e.g. the number of people affected by a disease based on epidemiological data and the proportion of those requiring treatment.
- Funders use it to mean “resource forecasting” to project needs for future financing, usually from the donor community.
- For country programs and buyers, it can range from describing short term budget needs to achieving ambitious government targets.
- In global health programs, it is often used synonymously with “demand creation” to really mean *generating* demand for products that can be used to address public health challenges.

While all of the above will influence demand for products, they do not define true demand forecasting. The term *demand forecasting* goes beyond the forecasting of needs or funds to focus on *expressed demand* expected in the market (i.e. product needs for which there is purchasing power). It is also different than demand creation,

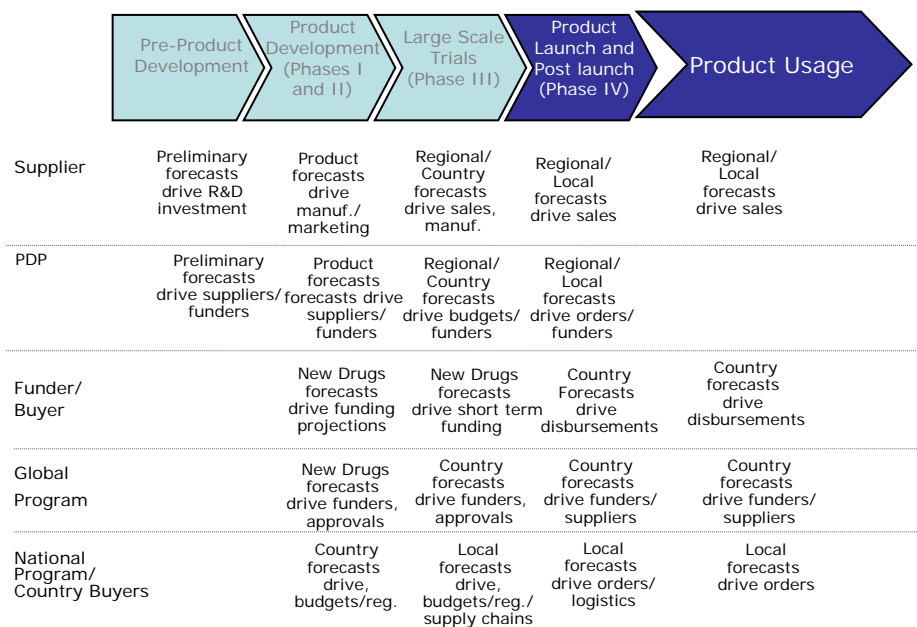
which in the private sector would be called marketing. Of course, expressed demand will be influenced by demand creation activities, and the process of demand forecasting attempts to capture these potential impacts in a defensible and transparent way.

Demand Forecasting Within the Context of the Global Health Value Chain

Demand forecasting is essentially a management analytic tool that will assist each participant in the health products supply chain to make key decisions. The forecasting process is a distinct activity but does not stand alone. It is an important component of the global health value chain. In the most basic terms, a health need can often be satisfied by the purchase and supply of medicines. This may be the simple procurement, manufacturing and distribution of antibiotics for common infections or the development of a new vaccine for a currently untreatable disease.

Whatever the solution to the health need, the provision of products to meet that need usually follows a similar process. At a high level the process includes the following stages (see Figure 1): **Pre-Product Development** when suppliers determine the investment they will make in R&D for potential new products; **Product Development** (Phases I and II) when the product is developed and tested for clinical efficacy and safety in order to determine whether the drug is safe and effective enough to put on the market and make the much larger investments required for Phase III trials; **Large-Scale Product Trials** (Phase III) in which clinical trials are expanded to increasingly larger populations, leading up to registration; **Product Launch and Post Launch** (Phase IV) when the product is offered for sale on the market and real data on health outcomes, usage and uptake are gathered; and finally **Product Usage** when the product is purchased and delivered to service providers and consumers on a routine basis.

Figure 1: Forecasts in the Product Development Life Cycle



Forecasts will be in continual refinement during this product life-cycle and will be used for different purposes by each player in the supply chain. The process is iterative with feedback loops between forecasting and other areas within the organization and the external environment reflecting changes as they occur. Table 1 shows how different customers use demand forecasts to meet their objectives at each stage in the Product Life Cycle.

Table 1: Types of Demand Forecasts: Contributions and Uses by Customers

	Supplier	PDP	Funder	Global Health Program	National Health Program/ Country Buyer
<p>Pre Product Development</p> <p>(10-15 years before launch)</p>	<p>Guides investment in R&D for new product development. Future scenarios built on basic epidemiology and assumptions regarding price, financing, and acceptability to determine size of potential market taking into account target drug profiles. These inform decisions on how or whether to proceed with product development.</p>	<p>Guides investment in R&D for new product development. Future scenarios built on basic epidemiology and assumptions regarding price, financing, and acceptability to determine size of potential market taking into account target drug profiles. Used to advocate for funding and encourage suppliers to invest in product development.</p>	<p>Not generally done.</p>	<p>Not generally done.</p>	<p>Not generally done.</p>
<p>Product Development</p> <p>Drug isolated, and shown effective and safe in humans. Being tested for efficacy in larger populations (Phases I and II)</p> <p>(5-10 years before launch)</p>	<p>Guides investment in infrastructure (e.g. plants, marketing). Based on historical data, analogs and expected market share based on drug profile. Guides market positioning and pricing. Usually more ambitious and less conservative to ensure adequate supply capabilities.</p>	<p>Guides funders and suppliers by providing more detailed market information and evaluating alternative health investments. Provides information on price, financing and uptake rates for suppliers.</p>	<p>Drives potential funding projections by identifying new drugs that may be on markets.</p>	<p>Guides funders and international agencies by anticipating long term funding needs to achieve public health outcomes, drive policy discussion on how products should be delivered (public/private sectors) and identify legal, regulatory, capacity constraints to achieving these outcomes. Also reflects and guides treatment guidelines, approval processes and policies for potential new products in pipeline, and assesses impact on current products</p>	<p>Provides input into global health programs investment forecasts. Drives investments in infrastructure, supply chain and service delivery capabilities. Identifies adoption intentions, timing. Guides registration and approval processes in-country.</p>

Supplier		PDP	Funder	Global Health Program	National Health Program/ Country Buyer
<p>Large Scale Product Trials Drug in wide scale trials being tested for safety (Phase III)</p> <p>(2-5 years before launch)</p>	<p>Drives production and sales projections, marketing plans, pricing. Shifts focus to regions and countries for more specific forecasting. Based on historical extrapolation, funding availability. Adjusted for distribution inefficiencies and waste.</p>	<p>Drives supplier launch plans, marketing efforts and funding. Creates country specific forecasts for launch.</p>	<p>Drives mid term funding, in as much detail as possible e.g. needs by country.</p>	<p>Guides funders and international agencies by creating treatment guidelines, guiding international approval processes, essential drugs lists etc. Assesses impact on current products. Guides supply chain investments across countries.</p>	<p>Drives investments in infrastructure, supply chain and service delivery capabilities. Identifies timing of adoption. Drives registration and approval processes in- country.</p>
<p>Product Launch (and post launch)</p> <p>(Phase IV)</p>	<p>Drives regional/country sales forecasts with feedback loop to manufacturing. Guides raw material purchases and production schedules. Tests health outcomes and makes and make decisions re value against other products. Provides real data on uptake and usage of product.</p>	<p>Role to be determined.</p>	<p>Drives short term funding needs and disbursements.</p>	<p>Some programs may wait until data is gathered during this period to decide whether the drug should be on essential drug lists. Drives aggregate procurement and distribution processes. Guides funding, tendering strategy, tenders, contracts and orders.</p>	<p>Drives local ordering, tenders and distribution. Guides ongoing service delivery needs.</p>
<p>Product Usage</p>	<p>Drives regional/country sales forecasts with feedback loop to manufacturing. Guides raw material purchases and production schedules. Provides real data on uptake and usage of product.</p>	<p>Role to be determined</p>	<p>Drives short term funding needs and disbursements.</p>	<p>Drives aggregate procurement and distribution processes. Guides funding, tendering strategy, tenders, contracts and orders.</p>	<p>Drives local ordering, tenders and distribution. Guides ongoing service delivery needs.</p>

Demand forecasting is critical to all phases of the global health value chain. When its importance is not understood, or it is not developed using robust analyses and appropriate methodologies, the value chain breaks down: patients and clients suffer adverse health outcomes when they do not have access to the right products when and where needed, manufacturers lose money when they invest inappropriately in product development or manufacturing capacity, programs and buyers lose credibility and money when there are shortages or overstocks, and funders lose credibility when their investments don't generate the desired outcomes.

While each customer has varying uses for demand forecasts, they will all benefit from the application of transparent, sound forecasting principles.

What are Demand Forecasting Principles?

The diversity of organizations involved in the supply chain (from funders, to PDPs, to ministries of health, procurement organizations, commercial manufacturers, etc.) across numerous countries, covering various stages of a product's lifecycle, using different methodologies, with different base data sets, makes it very difficult to provide one answer on "how to forecast." It is not possible, nor arguably desirable, to strive for a single or limited set of methods and sources for forecasting. It is, however, possible and necessary to reduce the variation in forecast outputs and increase the confidence of all players in the market with the accuracy of the forecasts produced.

This paper presents a set of ten key Demand Forecasting Principles for projecting demand for global health products. These principles are adapted from a much longer list of "Standards and Practices for Forecasting,"¹ which have been tested in a variety of industries over the past decades.

These Demand Forecasting Principles represent a set of basic rules to be used to guide organizations in their approach to developing and using demand forecasts. These fundamental rules are not a description of *how* to forecast; instead they are intended to assist in the design and management of good *forecasting processes*.

As such, these forecasting principles are applicable to forecasts at all stages of the supply chain. They will also apply for forecasts done at any stage of the client-care cycle (e.g. prevention, cure, prolonged treatment) and the health program life cycle (e.g. planning, launch, expansion, scale-up, maintenance, re-supply, and graduation).

While principles in and of themselves will not solve all the challenges of producing demand forecasts, they should provide a context and environment in which forecasting can occur and serve as a compass to guide both forecasters and their customers.

Why Have Principles?

Functional global health markets are based on a level of trust and information that permits all players to independently act in accordance with the messages given by the market. Outlining transparent and evidence-based principles for creating demand forecasts can help to reduce overall risk and uncertainty in the market and increase the chances that supply better matches demand. Ultimately, a consistent adoption of principles can contribute to saving lives by helping to ensure that more products get to the right people at the right time at the right price.

Specifically, these principles are intended to:

¹ J. Scott Armstrong (ed.). "Standards and Practices for Forecasting." *Principles of Forecasting: A Handbook for Researchers and Practitioners*; Norwell, MA: Kluwer Academic Publishers, 2001

1. **Increase market understanding and credibility:** Assuring the customers of forecasts that standard and transparent practices are being used to develop forecasts can increase credibility in the forecasting process. Adopting a principles-based approach to forecasting can also improve consistency across organizations in the supply chain, increasing the likelihood that all players in the market will take appropriate actions based on the demand forecasts.
2. **Increase accuracy and reduce variation.** Adopting these principles can improve the accuracy of forecasts and, as important, reduce variation in forecasts across different organizations.
3. **Better understand and mitigate system-wide risk.** Reduced variation and increase credibility can reduce overall system risk – i.e. market wide and supply chain risks. These risks can then be better understood and shared between buyers, suppliers, and funders.
4. **Increase value for money.** A more confident market can make investment decisions in R&D, manufacturing plants, and distribution that are more likely to result in products closer to the quantity/price optima. In economic terms this should help in improving *allocative* efficiency.

What Do the Principles Cover?

The forecasting principles cover some of the most fundamental aspects of forecasting demand. They are deliberately high-level and non-technical, as they are meant to shape the forecasting process rather than perform the actual functions of forecasting. These principles are not intended to represent a comprehensive set of rules to follow when forecasting; there are doubtless other basic principles that could be considered in such a document, but the list has been deliberately kept to 10 key principles for focus and manageability.

The demand forecasting principles are divided into three basic categories:

1. ***Customer Focused Principles*** which identify how to ensure that the forecast will meet the needs of its customers and have the greatest impact on the decisions it is intended to inform.
 - *Identify the principal customers/ decision makers of the forecast and clearly understand their needs.*
 - *Understand and clearly communicate the purpose of the forecast and the decisions that it will affect.*
 - *Create a forecasting process that is independent of planning and target setting.*
 - *Protect the forecasting process from political interference and ensure it is transparent.*
2. ***Process and Context Focused Principles*** which identify how to create a credible forecasting process and to develop, present, and understand the forecast in relation to the overall market situation and public policy environment.
 - *Embed the forecast into the broader environment taking into account market conditions, public policy, competitive forces, regulatory changes, health program guidelines.*
 - *Create a dynamic forecasting process that continually incorporates and reflects changes in the market, public policy and health program capabilities.*
3. ***Methodology and Data Focused Principles*** which identify how to select the right methods for the nature of the forecast being developed and effectively incorporate qualitative and quantitative information. These principles do not cover the specific method to use in each situation, the statistical nature of certain methodologies or specific data requirements.
 - *Choose the methodologies most appropriate to the data and market environment. Obtain customers/ decision makers' agreement on the methodologies.*
 - *Keep the methodologies simple and appropriate to the situation. Don't introduce too much complexity, but include sufficient detail to address the level of investment risk and accuracy required.*
 - *Make forecast assumptions clear and explicit.*

- *Understand data and their limitations. Use creativity and intelligence in gathering and introducing data into forecasts.*

Who is the Audience for Forecasting Principles?

These principles are intended for those institutions that are responsible for creating demand forecasts for global health products, including: ministries of health, global and national health programs, funders, procurement agencies, PDPs and suppliers.

Within these organizations, these principles may be adopted by senior staff who will have a strategic interest in understanding and applying the key concepts, as well as by those who have an operational and logistical interest in using the principles themselves.

The principles are equally relevant for public programs and private organizations. However they may be applied uniquely by different organizations. National and global health programs, for example, are integrated organizations in which demand forecasting is one part of the many activities that the program undertakes to generate and meet demand for health products. Though demand forecasting should be a separate and distinct activity in these programs, it will be clearly affected by the overall program, including its policies, budgets, stakeholders, priorities, infrastructure, management and administrative systems, staffing, catchment areas, and client needs and behaviors. The forecast will reflect the program's requirements and capabilities and these will serve as inputs. As these capabilities change, the forecast will change, providing an important feedback loop to health program managers.

How Should the Principles Be Used?

Before beginning to use these principles it is necessary to ensure that adequate skilled resources are available in the organization to perform demand forecasting. This is a particular challenge in health programs, where functions are integrated and disease experts are expected to create forecasts. Demand forecasting requires training and expertise and is not an activity that can be performed simply by those with strong domain experience. While demand forecasters will need to work collaboratively with experts in the disease or product area to ensure that forecasts are valid and have real life applicability, forecasting requires separate and specialized technical skills.

There is also a minimum amount of time, collaboration, data, technology and financing that is necessary to produce a result which will meet customers' needs. It is necessary to examine the context in which a forecast is to be developed and discuss resource limitations directly with customers to agree on what can be done with the current resources and what more is needed to achieve the required outputs.

Once these resources are in place, as a statement of good practice, it is hoped that these principles will be shared openly and adopted widely.

Forecasting Principles

The principles below are grouped by the three categories listed above. Under each principle is a description of the principle and its purpose, and a section on application of the principle. Examples of how the principles have been used in practice are provided in separate text boxes. A checklist for forecasters is provided at the end of this document.

I. Customer Focused

1. Identify the principal customers/ decision-makers of the forecast and clearly understand their needs.

Description and Purpose: Identifying the key customers and understanding how they will use the forecast is an important first step in the forecasting process. If the purpose of the demand forecast is to estimate the appropriate supply of products, then suppliers will be important customers of the forecast. It is therefore important to understand the needs of the suppliers and the environment in which they are making production and investment decisions. If the purpose of the forecast is for procurement or distribution key customers will be health program managers, procurement agents, supply chain managers, and funders. It is important to understand their needs, time horizons and at which stage they will be making certain decisions.

Application: Meet with key decision-makers (those within your organization and the ultimate customers) to jointly define the forecasting problem, and understand what purposes the forecast will serve. Determine the time frame for which the forecast is intended; for example, is it a short-term forecast for supply chain/ordering decisions, a long term product development forecast, or a forecast to inform mid-range investment decisions? Obtain agreement on the level of engagement that customers/decision-makers would like in the process.

In some cases, different customers will require forecasts for very different purposes with varying time horizons and levels of accuracy. This requires separate forecasts and forecasting processes. Each of these forecasts should be independently specified with customers and their needs clearly defined.

Good practice suggests that discussions take place in face to face meetings with the users of the forecast to probe their needs in detail. These should be explicitly confirmed in writing before the forecasting process begins.

2. Understand and clearly communicate the purpose of the forecast and the decisions that it will affect.

Description and Purpose: Forecasts are only necessary if they can affect decision making. If decisions won't change as a result of the forecast, there is no economic justification for forecasting. Understanding the specific decisions that will be affected by the forecast and the timing of these decisions is critical if the forecast is to have any real impact.

Application: Meet with decision-makers to agree on which decisions will be affected, how the forecast will inform these decisions, and the specific circumstances under which they will change their decision based on the forecast. Understand their detailed needs, including interrelationships with other decisions, level of aggregation required, time frames, important geographies on which to focus, and analogous forecasts that should be considered.

One approach is to present forecasts under different possible conditions to produce distinct options for decision makers. For example, “*if the facility is built at a capacity of Q, the price would have to be P, and we forecast that demand at that price is significantly lower than Q, which means a build-up of inventory, so we shouldn't make the investment; however, if the facility is built to a larger capacity and efficiencies permit us to charge a lower unit price, and we forecast that demand at the lower price matches the higher capacity, we should consider making the capital investment.*”

Document all decision parameters in writing.

3. Create a forecasting process that is independent of planning and target setting.

Description and Purpose: Forecasts are not plans and they are not targets. A forecast is how the future is likely to look, whereas plans and targets are how we would want it to look. Credibility and trust in the forecast and the forecasting process are compromised if it is based on plans, goals and targets. However, plans will serve as inputs to forecasts and will also be influenced by them. While there is a mutually reinforcing feedback loop between planning/marketing/distribution and forecasting, these should be considered distinct processes.

Application: This can be a difficult principle to implement in practice because of the necessary interdependence between planning, marketing, goal setting, and demand forecasting. As a rule of thumb, forecasts should drive planning to a greater extent than the other way around.

Within an organization separating the demand forecasting process from planning processes, and having different people perform these functions is a good way structurally to ensure greater independence. At the same time, ongoing and explicit feedback and data loops between these functions must be built into the structure.

One method for addressing management’s desire to accommodate plans, sales goals and targets into forecasts is to generate separate forecasts for alternative plans or targets and present these in concert with plans. For example, “*if we achieve 80% of the target, demand for this ACT is likely to be 160,000; if we achieve 90% it is likely to be 200,000. The likelihood that we will achieve 80% of the target is 70%, whereas achieving 90% of the target has only a 50% chance.*” This allows decision-makers to understand and balance their risks in the context of other priorities. It will also allow procurers to decide how much risk they are willing to take in their orders.

All ‘adjustments’ to forecasts should be based on evidence of justified opinion, and always supported by documented rationale.

4. Protect the forecasting process from political interference and ensure it is transparent.

Description and Purpose: Political issues surrounding forecasts are often difficult to disentangle from the need for demand forecasts in the first place. Some may argue that because markets for global health products function within and are influenced by global, regional and national politics, public sector programs, and lobbying, politics is inherent to the process of forecasting for these products and should not be disassociated.

Clearly the political and policy environment influences the demand for health products either directly or indirectly and therefore its impact must be considered. While these factors should be explicitly taken into account as process drivers or assumptions in *developing* the forecast, political considerations should not be used to *change the results* of the forecast. Adjustments or “fudges” should not be made to forecasts simply because the results of the forecast do not meet political objectives (e.g. what our Minister say the demand “should” be or what the sales department wants demand to be).

If the purpose of the forecast is to give customers as objective a sense as possible of future demand then its credibility is compromised if they believe the forecast is serving political objectives, providing a tool for advocacy, or trying to generate additional resources.

Application: To deal with political considerations, it is helpful to map the political issues surrounding the forecast and the forecasting process, and develop a strategy to manage these. Explicitly documenting political pressure to influence inputs or final forecasts and identifying the likely impacts of these inputs is also useful to protect the integrity and transparency of the forecasting process.

Changes and inputs should be rationally justified, supported by evidence (quantitative or qualitative), agreed upon and documented.

II. Process and Context Focused

5. Embed the forecast into the broader environment taking into account market conditions, public policy, competitive forces, regulatory changes, health program guidelines.

Description and Purpose: Forecasts should be an expression of market knowledge and as such whenever a forecast is presented, the audience should gain a clear understanding of the wider market context. The quality of the forecast is more dependent on the extent to which forecasting is carried out as part of a broader analytical process rather than complex models and methodologies. When a forecast is developed with insightful market understanding this will be apparent and the results communicated and understood by a wide audience.

Application: While it is a distinct process, forecasting should not be carried out in isolation from other functions. A cross functional matrix team approach should be adopted to optimize efficiency. The individual responsible for developing or updating a forecast should work in collaboration with those responsible for other analytical activities including those active in market and policy development.

In the case of a PDP for example which has several products under development that may compete with each other, creating forecasts for a single product launch should include managing the entire product portfolio strategically by modeling the impact of different demand scenarios of these products together, including potential timing of introduction, price points, and other product characteristics.

6. Create a dynamic forecasting process that continually incorporates and reflects changes in the market, public policy and program capabilities.

Description and Purpose: Demand forecasting is an iterative process that is influenced by external drivers and changes in the capabilities and requirements of health programs. Forecasts are an important input into the decision-making process and should change as the environment changes. Identifying key market, policy and capacity drivers and as they change ensuring that the forecasting process incorporates these changes on a continuous, agreed upon schedule is an important component of forecasting. For this to happen efficiently the critical drivers and assumptions should be highlighted and monitored closely.

Application: The use of rolling forecasts (e.g. updating forecasts for the next 18 month period) is standard practice. The most important demand drivers should be identified and monitored and reported to reflect changing market conditions and new information. Strategic forecasts are frequently updated annually or more often depending on need. Operational forecasts can be updated monthly, quarterly or more frequently as needed.

A governance process for forecasts should be defined. It is also important to incorporate an ongoing evaluation process to measure the accuracy of forecasts against actual results. This analysis should identify key causes of errors so that the process and variables used in producing the forecast can be continually refined. A commonly used practice, particularly closer to product launch when risk is high, is to seek external validation and have an outside agency (e.g. market research firm or econometric group) repeat the forecast to ensure consistent results.

For health programs, forecasting processes will be tightly and iteratively linked to distribution strategies; as the forecast changes the distribution strategies should change to reflect this and vice versa. If these processes are out of sync, shortages and expirations at point of patient care are likely to occur even with an adequate supply of product.

Coordination of Demand Forecasting at the Country Level

In Zambia, there has been a concerted effort to improve coordination of forecasting at all levels. Implementing partners of the HIV/AIDS programs jointly agreed to create a national forecast for anti-retroviral therapy (ARVs). This forecast provided the basis for discussions with the various funding sources to ensure that there was sufficient funding to cover forecast needs. The partners also reported information on their issues to facilities, their stock on hand, and their planned shipments. This provided a picture of the national stock situation. All partners are using procurement management software, PipeLine, to facilitate the timely sharing of key information, including months of supply by product. By sharing information, the partners can enhance their coordination and take concrete actions to ensure product availability. For example, one partner had 50 months of Efavirenz, 50mg, almost guaranteeing expiration and waste, while another partner was stocked out. The partners were able to transfer stock, which allowed the stocked-out partner to meet the demand for Efavirenz, 50mg, and to cancel future shipments until the stock within the country was used, thereby lessening the chance of expiration. (USAID/Deliver. Delivering HIV/AIDS Products to Customers: Lessons in Supply Chain Management. Virginia. May 2006.)

III. Methodology and Data Focused

7. Choose the methodologies most appropriate to the data and market environment. Obtain decision-makers agreement on the methodologies to be used.

Description and Purpose: Different forecasting methods are appropriate under different circumstances. If the environment has sufficient cross sectional and time series quantitative data and the environment is stable, then a variety of quantitative analytical tools can be used. If large changes are anticipated, historical data will need to be augmented with causal models and expert analyses. In many cases, in the current global health environment, quantitative data are limited and large changes are expected in funding or policy. In these cases it is necessary to collect and analyze qualitative or 'judgmental' data using a variety of methods such as Delphi, prediction markets, role playing, structured analogies and game theory.² Applying these methodologies requires considerable knowledge and skill; these are best used by those with training in gathering and understanding these types of data and forecasting methodologies.

In many cases, several methodologies will be appropriate for the forecasting problem. It is useful to develop forecasts using several different methods to improve forecasting accuracy.

Gaining acceptance of forecasts requires that decision-makers understand the methodologies selected and their limitations and strengths.

² For a comprehensive description of forecasting methods see J. Scott Armstrong's *Principles of Forecasting: A Handbook for Researchers and Practitioners*.

Application: List the important selection criteria before selecting the methods for forecasting. Perhaps ask unbiased experts to rate the methods. In new product markets, creating market analogs which look at other products with similar characteristics to understand uptake speed and switching rate from existing products is a commonly used technique. Analogs can be based on products launched in similar therapeutic classes, with similar orders of entry, and by companies with similar promotion budgets. Analogs can also be used to identify sub-markets, and regions or countries that may behave similarly.

Describe how the forecast will be made to decision-makers in understandable terms and obtain agreement on how you will approach the forecasting process and the methods that will be acceptable to them.

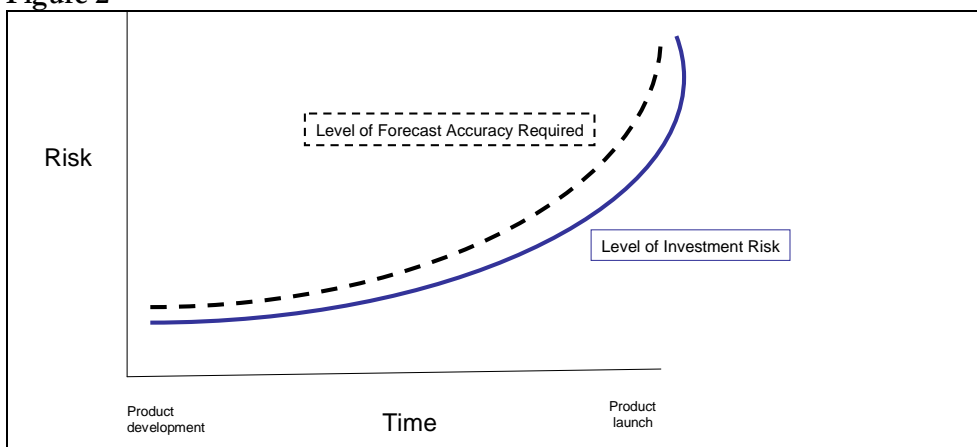
The Use of Banding in Immunization Forecasts

In projecting immunization demand, the WHO Global Immunization Program grouped countries into bands by size and wealth focusing on the rate of adoption of a global program within each band. Initially, it was assumed that larger and wealthier countries would adopt more quickly and smaller and poorer countries would adopt later. These initial groups were modified as the program progressed so that banding became more accurate with time and was based on a variety of characteristics beyond simply size and income level. When using the banding strategy to determine rate of adoption, it was useful to consider India, China, and South America separately. These countries/regions are influenced by global programs but usually act based on local data and may choose a variation of the global program. The Global Immunization Program has created several models which all show that even with a good infrastructure in place and few funding problems a 70% take up requires about 8 years. However immunization is a preventive strategy rather than a curative strategy. People may be more motivated when they are sick or threatened immediately, for example, meningitis vaccination can achieve levels of 50% coverage from 0% within a matter of weeks during an epidemic.

- 8. **Keep the methodology simple and appropriate to the situation. Don't introduce too much complexity, but include sufficient detail to address the investment risk and level of accuracy required.**

Description and Purpose: *"It is better to be broadly right than precisely wrong."* The level of accuracy needed in forecasts increases as the time horizon shortens. The level of confidence in the forecast is proportionate to the investment decisions and associated risks; for example, ordering forecasts will require a much higher level of accuracy and certainty than strategic long term forecasts (as shown in figure 2).

Figure 2



When producing strategic forecasts, understanding the level of uncertainty is critical. These types of forecasts are ‘best guesses’ of how the future will look in 10-20 years and giving a false sense of accuracy can be misleading and counter-productive, actually decreasing customers’ confidence in the forecast.

Application: Make sure the forecast is appropriate to the level of investment risk being undertaken and the decisions that will be made based on the forecast. For example, a strategic forecast might involve interviewing 50 stakeholders; while a short term purchasing forecast might involve interviewing hundreds of stakeholders to get precise information on timing of orders, demand and price considerations.

Clearly identify the confidence level of the forecast and provide explicit confidence intervals if possible. If qualitative judgments are being used in which it is difficult to provide statistical intervals, simple low, medium and high estimates may be necessary. However, even in these cases it is important to try to estimate the likelihood of achieving each of these estimates (e.g. there is a 50% chance that we will hit the medium forecast but a 90% chance that will hit the low estimate). In early stages of a product life cycle, for example, forecasters may decide to use the lower deciles in the confidence range of forecasts as the baseline, rather than the mid range forecast, as making conservative assumptions in these cases will give greater credibility to forecasts. However, very conservative estimates all along the supply chain can lead to shortages, which can have serious public health consequences. Manufacturing investment forecasts, for example may need to use the higher estimates.

It is important to be explicit about the level of uncertainty in the forecast so that those who use the forecast understand how much they can realistically discount it (or not). Higher levels of uncertainty will require increased levels of flexibility across entire supply chains including procurement, distribution, manufacturing and sales processes.

In situations of high uncertainty or very small or large numbers, the forecasting problem might be decomposed into its component parts and each part may be forecast separately with the results combined at the end. One way to do this is geographically for example, in the early uptake of a new product, it is better to build bottom-up forecasts on a country-by-country basis and aggregate these to determine the global forecast rather than looking at aggregate trends.

Regular monitoring and evaluation is also very important: the more uncertain the forecast, the more often it should be checked against actual demand and the more frequently it should be revised.

Demand Forecasting in Health Programs

Typically a demand forecast will start with scan or assessment of the program situation, and an appraisal of the current conditions and performance. This will include consideration of products, distribution channels, and an assessment of a health program’s political and technical elements that are necessary pre-requisites for changes in use of products and supplies. The assessment should also provide a realistic assessment of the characteristics of products – their stability, shelf life, turn over rate, side effects, controversies around use, ease of manufacture, simplicity in re-supply, etc. Data on implementation plans, targets, objectives and goals can then be fed into the equation to assess likely changes from historical trends. In addition to providing the key inputs into the forecast, these factors will inform the frequency and horizon of the demand forecasting process.

9. Make forecast assumptions clear and explicit.

Description and Purpose: To ensure acceptance of forecasts, it is important that decision-makers understand the basis for the forecasts as well as the key drivers and risks to which the forecast is particularly sensitive. Forecasts should provide an accurate representation of the current situation and should continually change as these conditions change.

Application: Explicitly identify key drivers of the forecasts by using theory and domain expertise to define causal links and risks. In specifying key drivers, limit irrelevant variables and don't select variables simply based on statistical techniques such as step wise regression or data mining. These techniques can yield spurious relationships between variables that do not have face validity.

Funding flows and the timing of these flows will often be key drivers in forecasts for global health products. Capacity constraints, human resources, available instruments and plans and policies of various agencies are also relevant. The forecasting process should recognize which drivers are most critical at a particular point in the life cycle of the product and the program, and continually update and refine the drivers and their inputs. For example, early in a health program, the amount and timing of funds may have a more critical impact on the forecast, while later in the program, availability of human capacity may be the most significant driver.

Test with key contributors and users of the forecasts that all relevant players have the same understanding of the key assumptions and their implication for the forecasting process and output. Particularly in global forecasts, language and culture can create serious misunderstandings in assumptions and their impact.

Ensure that each new forecast has clear and documented statements on the changes in assumptions compared to previous forecasts and explicitly quantify the impact of these changes. Date stamp all forecasts.

International AIDS Vaccine Initiative (IAVI) Determining Drivers

IAVI started its forecasting project by identifying the key determinants or drivers of demand. Some of these drivers are largely independent of disease area and can be used by any health program.

- *Need: Potential Recipient Populations*
- *Vaccine Profile: Vaccine Characteristics Specification*
- *Political Will & Access: Regulatory Hurdles, Health System Capacity & Effectiveness*
- *Attitude: Vaccine Acceptability*
- *Funding: Government & Donor Budgetary Constraints*
- *Targeting: Vaccination Strategy*

10. Understand data and their limitations. Use creativity and intelligence in gathering and introducing data into forecasts. Incorporate qualitative inputs rigorously and systematically.

Description and Purpose: The data do not always 'speak for themselves' or if they do, it is sometimes hard to know what they are saying. Understanding which data to collect and how to use these data form the underpinning of good forecasts. Using theory and research to decide which key data elements to collect are the first stage. For example, short term demand forecasts that will influence sales are often based on market size, ability to purchase, and underlying need. These may be the most critical variables on which to focus first; measures such as income, availability and price can be added to refine forecasts.

It is also important to understand the sources of data and the particular biases of each source. Identify these biases before analyzing the data, particularly in health care where those who collect data may intend to impact policy and funding based on their information. Data collected for advocacy purposes to emphasize the importance of a disease and secure more funding for its treatment may be subject to biases that will need to be clearly addressed when applying these numbers to demand forecasts.

Application: If it is difficult to find unbiased sources for core data, it is best to find multiple and diverse sources with differing biases. For example, in looking at epidemiological data, it is useful to get data from

a variety of sources with different estimates. While it can be difficult to deal with conflicting data, forecasts will be more accurate if data from a range of sources are combined, giving a better estimate of the actual prevalence and incidence of the disease. Although this may seem counter-intuitive, averaging and combining can be powerful statistical tools if they are appropriately applied. If forecasts are to be used for decisions requiring high levels of investment, primary market research will be required.

Explicitly reference the sources of data, their context and limitations. Check data for face validity by having impartial experts independently review the data and outputs to see if they are relevant and appropriate.

Continual Updating of Data and Assumptions

In Zambia, in the absence of data, consultation with experienced providers for the provision of first line ART (anti-retroviral therapy) informed the estimated uptake of ART and the breakdown of patients by first line regimen. Because assumptions were based on providers' experience, the forecast for first line ARV drugs was relatively accurate. However, because the program was relatively new, the providers' experience with second line treatment was limited. Thus, the assumptions were less informed by experience and relied more on expectations, thus leading to an overestimate in forecasting consumption for second line ARV drugs. Procurement planning was based on those assumptions—weak as they were—because of the lack of any kind of data. Fortunately, as a result of careful monitoring of consumption, a second line drug shipment due in six months was postponed, preventing a number of expensive, second line ARV drugs from expiring in the warehouse. Frequent reviews and adjustments to a quantification, which are based on actual consumption, allow programs to respond to rapidly changing environments. (USAID/Deliver. Delivering HIV/AIDS Products to Customers: Lessons in Supply Chain Management. Virginia. May 2006.

Checklist of the Ten Principles
(To be completed for each Forecast)

- Have I identified the principal customers/decision-makers of the forecast and do I clearly understand their needs?
- Have I understood and clearly communicated the purpose of the forecast and the decisions that will be affected by the forecast?
- Have I created a forecasting process that is independent of plans and targets?
- Have I understood the political considerations and taken measures to protect the process from political interference? Is my process transparent?
- Have I understood the broader environment in which the forecasting process is occurring? Have I created the forecast in the context of market and policy trends, portfolio of investments, and new product developments by suppliers? Have I clearly communicated this context?
- Have I created a dynamic forecasting process that incorporates and will reflect changes in the market and in public policy as they occur?
- Have I selected the methods that are most appropriate for the forecast problem and data available? Do I understand how to apply the various methods that are most suitable? Have I obtained decision-makers' agreement on the methods?
- Does my methodology reflect the appropriate level of accuracy and detail that is needed for the forecast? Have I explicitly identified confidence intervals in the forecast?
- Have I made my forecast assumptions clear and explicitly defined them for those who will use the forecast?
- Do I understand the data and their limitations? Have I searched for data from multiple sources and gathered both qualitative and quantitative data? Am I using these different types of data appropriately?