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STRATEGIES TO STRENGTHEN COUNTRY VACCINE FORECASTING CAPACITY

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Contents

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Acronyms

ACRONYM	DEFINITION
EPI	Expanded Programme on Immunization
KPI	Key Performance Indicator
MOH	Ministry of Health
NLWG	National Logistics Working Group
OIAI	Office of Internal Audit and Investigations
SOP	Standard Operating Procedure
TOR	Terms of Reference

Definition of terms

Data triangulation: The process of comparing data points from multiple sources or multiple approaches to improve data analysis results and increase reliability in the forecasting output.

Equity vaccine forecasting: A vaccine forecasting process that uses disaggregated health and logistics data to more accurately predict vaccine demand and improve immunization coverage for traditionally underserved populations such as urban poor, remote rural and conflict-affected populations.

Forecasting: The process used to estimate the quantity of doses of each vaccine that will be consumed or utilized for a specific period of time in the future. Projected vaccine demand is based on observed trends or patterns from historical, adjusted and/or predictive health service and logistics data. The output of this process is the demand forecast.

Forecast accuracy: The variance between the estimated quantity of doses of a vaccine expected to be consumed or utilized for a given period of time and the quantity of doses of the same vaccine actually consumed for that period.

Logistics: The operations related to the receipt, issue and inventory management of commodities within a supply chain.

National Logistics Working Group (NLWG): The committee or team responsible for coordinating national immunization logistics and supply chain activities as well as supply chain investments made by government agencies and development partners. The NLWG provides guidance, expertise and technical assistance on all matters concerning supply chain operations and improvement initiatives.

Quality data: Data that is accurate, timely, consistent, reliable and complete.

Quality procedure: Documented procedures for a task or activity where the goals, owners, the sequence of task steps, resources, implementation/review cycles and other related elements are clearly documented.

Standard Operating Procedure (SOP): An operational document that provides step-by-step instructions on how to execute a process, activity or task. An SOP aims to reduce variability on how a process is executed and is officially endorsed by an organization.

Supply planning: The process used to determine when, where and how many doses of each vaccine should be delivered to ensure adequate stock levels are maintained throughout the supply chain. The supply planning process is used to estimate the total vaccine requirements and costs based on the forecast generated from the demand forecasting stage.

Total vaccine requirements: The quantity of each vaccine needed to meet the forecasted consumption and ensure that adequate stock levels within the supply chain are maintained to ensure continuous vaccine supply at the immunization service level.

Introduction

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Immunization is a highly effective intervention for the reduction, control and elimination of life-threatening infectious diseases. It is estimated that 2–3 million deaths around the world are averted each year through national immunization programmes.[1] By protecting children from deadly and disabling diseases, childhood vaccines play an important role in advancing national and global health outcomes.[2]

Vaccine forecasting is a continuous, data-driven process to estimate the total vaccine requirements and costs for a specific period of time in the future for a given country immunization programme. Effective vaccine forecasting helps prevent the risk of national vaccine stockouts, expirations and overstocks. By identifying national vaccine needs, forecasts inform and guide the development of national vaccine budgets and procurement plans, while also

1 World Health Organization, www.who.int/topics/immunization/en/, accessed 14 June 2021.

2 Vaccines are a global health "best buy." It is estimated that for every dollar invested in vaccine interventions a total of US$16 are saved in health care costs, lost wages and lost productivity due to illness and death, www.gavi.org/vaccineswork/value-vaccination/cost-effective, accessed 14 June 2021.

supporting supplier price negotiations and production planning processes. Vaccine forecasting therefore plays an important role in ensuring that adequate financial resources and vaccine stocks will be available to meet national vaccination goals.

The challenges related to vaccine forecasting vary from country to country. Data governance, the standardization and institutionalization of forecasting processes, as well as the capacity of national forecasting teams are among the various factors that can positively or negatively influence forecast accuracy. Given all the various factors and conditions required to produce accurate forecasts, a systems perspective must be adopted, whereby the various data management, partner coordination, and planning systems must be understood, continuously strengthened, and integrated as a part of the forecast development process.

The objective of this document is to provide strategic guidance on strengthening the vaccine forecasting process at the country level. It provides five high-level strategies to guide the design, planning and implementation of interventions to strengthen country forecasting. The target audiences for this guidance document are national Expanded Programme on Immunization (EPI) teams, national ministry of health teams, UNICEF country office teams and international donors, as well as other national and international vaccine stakeholders.

This guidance document is both an agreed action from a UNICEF Office of Internal Audit and Investigations (OIAI) audit in 2018 and part of a larger initiative by the UNICEF Supply Division, Programme Division and regional offices to more effectively support countries in their continuous efforts to improve national capacities for the production of more accurate and reliable vaccine forecasts.

What is vaccine forecasting?

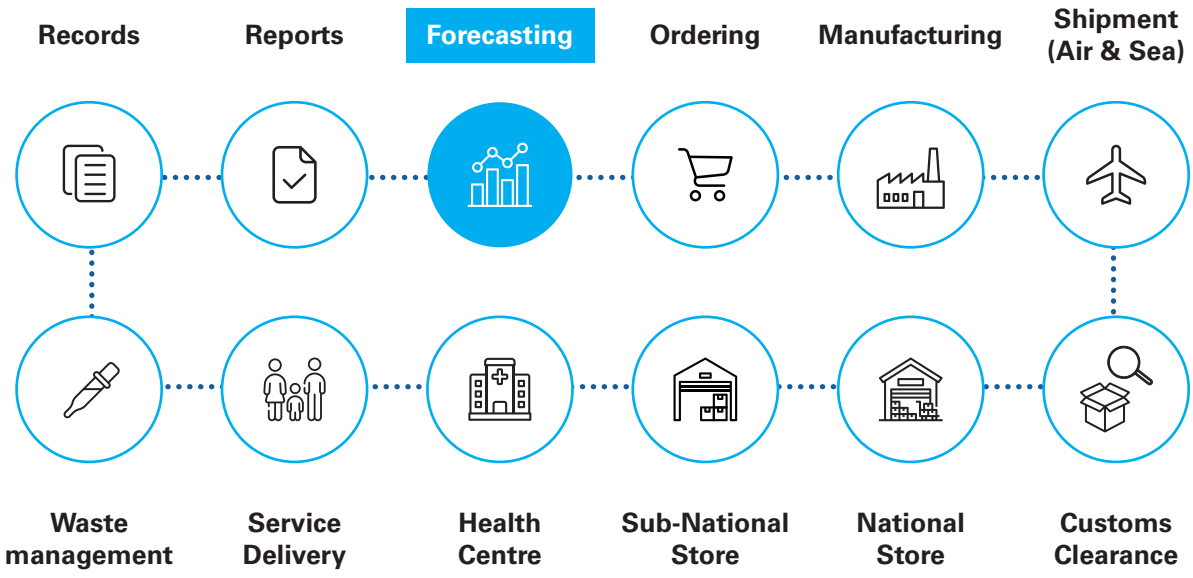
Overview of vaccine forecasting

Forecasting is the initial activity in the continuum of supply chain processes and activities (Figure 1) implemented to ensure that vaccines are available to children and the communities that need them. A data-driven exercise, it initiates the planning process by estimating how many vaccine doses are required for a set period of time in the future. The forecasting process determines when, where and how many doses of each vaccine need to be delivered to maintain adequate stock levels throughout the supply chain (Figure 3).

The estimation of future vaccine demand is developed through the aggregation and analysis of a combination of health and logistics-related data. These projections are informed by anticipated increases or decreases in demand caused by various factors, such as service capacity levels, demographic trends and health policy goals.

Once established, the projected quantities are analysed and presented in a vaccine demand forecast. This forecast informs and guides the development of total vaccine requirements and costs during the supply and procurement planning stages of the forecasting exercise, and subsequently the development of vaccine budgets. As an activity in the supply chain management cycle, vaccine forecasting specifically attempts to answer the question: **"How much vaccine, in terms of quantity and cost, is required to meet the health demand of a population for a given period of time in the future?"**

Figure 1: Supply chain management process and product flow



What data elements are required for vaccine forecasting?

The primary data inputs required for vaccine forecasting can be broadly categorized as health-related data[3] or logistics-related data[4]. Health-related data includes the target population, facility service levels and morbidity data. Immunization targets, dosing changes and other health or clinical policy-related decisions that may impact future demand also fall into this category.

Logistics-related data includes data points related to the actual and/or anticipated vaccine stock levels, consumption (utilization) and the national movement or reallocation of stock. Logistics targets such as storage maximum and minimum rates, wastage rates and buffer stock targets are also included under logistics data. Inventory performance-related data, such as expiration rates, stockout and stock shortage-related data also belong to this second category.

In practice, vaccine forecasts are made up of a combination of these two data categories. It is important to use and compare multiple types of vaccine forecasting methodology, using both health and logistics data to forecast vaccine demand. It is often the case that the various data elements are not available, reliable, up-to-date or complete. As a result, forecasting teams must be able to build and justify informed forecasting assumptions based on previously observed trends, expected changes in services, mandated policies or targets, and other factors that might affect estimated future demand.

Vaccine forecasting planning process

The national vaccine forecasting exercise is led by EPI representatives from the Ministry of Health (MOH). Forecasting teams are made up of various vaccine programme stakeholders who meet formally or informally during the course of the year to collect, review and analyse forecasting data to update or develop national vaccine forecasts. Given UNICEF's technical expertise, role as a reliable procurement agent and historic partnership with EPI programmes, UNICEF country offices often serve as the support secretariat for forecasting activities in many countries.

Forecasting planning activities can be organized into three levels: strategic, tactical and operational (Figure 2). The activities at each of these levels occur in parallel, reinforce each other and are differentiated by their frequency. They can also be categorized by their planning horizon as well as by their impact: short, medium or long term.

Strategic

Forecasting activities in this category address long-term forecasting planning issues, for at least a year or more. Activities

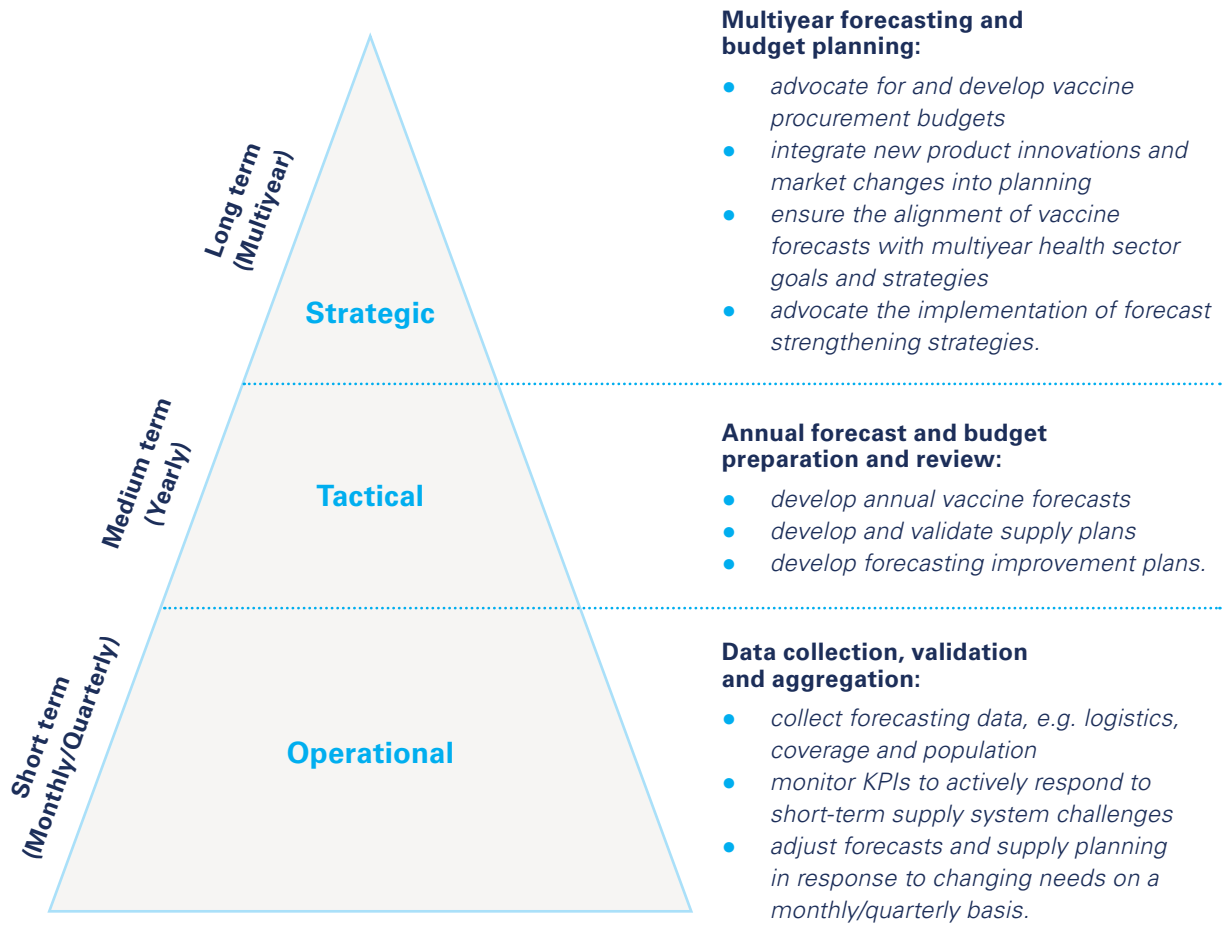
3 Health-related data sources include immunization registries, other facility records, District Health Information System 2, population census reports, etc.

4 Logistics-related data sources include facility stock cards, stock reports, warehouse inventory records, Logistics Management Information Systems, etc.

at this planning level include developing annual or multiyear forecasts, supply plans, budgets and other vaccine budget-related advocacy. Planning related to the establishment of a self-financing vaccine mechanism, once a country transitions out of Gavi funding, is also executed at this strategic level. Other examples of strategic planning activities include planning to introduce new vaccines into an EPI programme or, inversely, to phase out a product, both of which can be implemented over a longer planning horizon.

The alignment of vaccine forecasts and plans with long-term health supply chain strengthening initiatives and goals also belongs to this strategic level of planning. This could include, for example, adjusting forecasting assumptions related to vaccine storage in response to plans to create new facilities or storage warehouses in the next few years. Similarly, updating forecasting processes based on the planned roll-out of a national vaccine logistics management system would also be considered a long-term, strategic forecasting activity.

Figure 2: Country forecasting planning triangle



Tactical

Tactical, or medium term, forecasting planning activities occur on a quarterly, semiannual or annual basis. Activities or tasks at this planning level support long-term strategic goals and/or aim to mitigate potential medium-term risks that may be a challenge over the coming months or year. The goals of tactical plans are more narrowly focused and can be adjusted based on changing circumstances or evidence.

Examples of these medium-term activities include updating annual forecasts and supply plans based on the confirmation of vaccine deliveries, distribution delays or anticipated short supply of vaccines. The design and planning of forecast system strengthening activities also takes place on this tactical level. The planning of meetings and work sessions to update forecasting assumptions, the development of forecasting guidance documents, like SOPs, or the implementation of forecasting method trainings are also examples of tactical forecasting activities. Unlike strategic forecasting planning activities, these activities are meant to address more medium-term challenges with a narrower scope, based on emerging trends that can be identified over the course of a few months.

Operational

Forecast planning activities at the operational level focus on monthly, or even weekly, activities related to the forecasting process. These activities include the routine collection of health and logistics data and their aggregation into an existing forecasting database or data management systems. Other forecasting-related activities with a short-term impact include following up on monthly reports, cleaning and validating datasets, and investigating any data quality concerns. Updating supply plans due to changing procurement, order fulfilment and delivery schedules also belongs to the operational level of forecast planning.

The activities at this level are critical in supporting the day-to-day management of forecasting data and serve as the foundation for medium- and long-term planning activities. Activities at this operational level can often be 'firefighting' in nature, in that they address immediate problems as they arise. While operational activities are short term in character, it is important to note that they are implemented in parallel with strategic and tactical activities (see above), which are ultimately designed to mitigate the need for these firefighting activities.

Vaccine forecasting is a data-driven, continuous improvement process

Demand forecasting estimates the quantity of doses of each vaccine that will be consumed for a specific period of time in the future. To ensure a continuous supply of vaccines and maintain adequate stock levels, supply planning determines when, where and how many doses of each vaccine should be delivered. Optimal vaccine supply planning entails coordinating the timing of funding disbursements from different funding sources with procurement lead times and supplier delivery schedules. It also involves balancing material and capacity constraints against the demand forecasts and enables efficient demand

prioritization to ensure an uninterrupted vaccine supply. Demand forecasts of higher accuracy result in more effective supply plans that allow for cost-efficient vaccine budgeting and the implementation of more effective vaccine procurement processes.

The barriers to effective forecasting include poor data quality, the misalignment of various planning processes, and unforeseen events, which can include a change in funding support, supply disruptions and disease outbreaks. As a result, forecasting is often considered more of an art than an exact science, in which multiple constantly changing factors must be continually considered and assessed based on available data, experience and the application of a critical perspective.

Forecasting should therefore be seen as a process of continuous improvement. The goal is to build upon what has been learned and improve the accuracy and reliability of projections and plans with each forecasting exercise. Improved forecast accuracy and optimal vaccine supply planning help to ensure that the total vaccine requirements and costs can be robustly defended and confidently presented to vaccine stakeholders for budget and procurement planning. Effective forecasting requires quality data, clear data governance processes and quality procedures. In addition, the sound and informed judgement of forecasting teams and vaccine forecasting stakeholders is a critical factor in achieving improved forecasting performance.

Five strategies to strengthen country vaccine forecasting systems and capacity

The development of timely and accurate vaccine forecasts requires skilled and knowledgeable staff, as well as the establishment and implementation of efficient and effective management systems. To sustain forecasting performance, gaps in forecasting capacity need to be addressed and systems continuously strengthened. With this in mind, and given the limited availability of resources (time, funding, staff, etc.), the UNICEF team has identified five key strategies to ensure that forecasting system and capacity building interventions are targeted and have the greatest possible impact.

The country forecasting capacity-building strategies presented in this document were informed by lessons learned from an April 2020 UNICEF assessment of eight countries that routinely demonstrated a high degree of forecast accuracy. They also drew on a review of best practices collected from various global health supply chain technical literature.

The five strategies are:

Strategy #1: *Ensure government-led forecasting teams are established and institutionalized to coordinate forecasting activities and promote the sustainability of forecasting performance.*

Strategy #2: *Establish quality forecasting processes to more effectively harmonize forecasting activities and budget development timelines.*

Strategy #3: *Standardize forecasting methods and ensure data quality to improve the accuracy of demand forecasts.*

Strategy #4: *Institutionalize key performance indicators for forecasting to monitor and manage forecast accuracy and performance improvements.*

Strategy #5: *Invest in staff capacity building in forecasting principles and technical competencies to improve and sustain forecasting performance.*

The rationale, impact and intended goal of each strategy will be explored in more detail in this document. Although the five strategies are linked and designed to complement each other, given the varied forecasting country contexts, they can also be implemented independently based on a country's capacity strengthening needs, resources and competing priorities.

This strategy document presents a high-level framework to support countries to identify focus areas for capacity building. It is not intended to provide in-depth technical guidance on forecasting principles or provide instruction on how to develop a forecast. Technical guidance on forecasting can be found in the documents listed in the reference section of this document. As part of its overall vaccine forecast strengthening initiative, UNICEF will collaborate with partners to develop vaccine forecasting-specific technical guidance documents, templates and tools to more effectively support the strategies recommended in this document.

Strategy #1: Ensure government-led forecasting teams are established and institutionalized to coordinate forecasting activities and promote the sustainability of forecasting performance

Summary

Under the leadership of the EPI or other responsible unit of the MOH, national forecasting teams provide technical expertise and coordinate activities related to vaccine demand forecasting and supply planning. The teams comprise various vaccine country stakeholders with diverse skill sets and health system-related responsibilities, and they are led directly by government representatives. In some countries, partner organisations like UNICEF serve as the secretariat and coordinate various national vaccine forecasting activities with stakeholders.

Forecasting teams collect, validate and analyse health and logistics data to develop and update national vaccine forecast and supply plans.[5] These teams help to develop more informed assumptions during the forecasting process and serve to project confidence and reliability in the forecasting outputs. They are thus able to more effectively campaign for, and obtain, budgetary approval for total vaccine requirements and costs. To ensure the effectiveness of the team, individual roles and responsibilities should be standardized and documented. As a result of their forecasting expertise and knowledge of the country's health and supply chain data (as well as the service delivery context), vaccine forecasting teams play an important role in supporting broader forecasting and efforts to continuously improve the health system. Moreover, they ensure continuity of forecasting knowledge.

Establish a multidisciplinary team of stakeholders

A national vaccine forecasting team ideally comprises vaccine programme stakeholders with various technical backgrounds. These teams should have a sound background in immunization

5 Quarterly updates are generally considered the most ideal and effective to more easily identify trends and changes in health and logistics data.

programming, health information systems, logistics management, procurement and supply chain management, among other areas. Costing, financial planning and budgeting are also key capacities. The members of national vaccine forecasting teams or committees should, ideally, also have competencies in data management and statistical modelling and analysis.

In addition to technical expertise, members of a forecasting team should include senior health system decision makers, or those with effective working relationships with government ministries and able to advance priorities in a health system. To better understand and analyse the health and logistics data inputs required, a forecasting team's members should also ideally have experience at different levels of the health delivery system (health facility, provincial and central). This experience will provide the team with a more comprehensive perspective on data quality and immunization programme assumptions at each level of the health system.

Build consensus on and formalize forecasting committee goals, scope and responsibilities

The goals, scope of activities, and member roles of a forecasting team should be clearly defined to ensure the effectiveness of the committee. The process of collectively developing a terms of reference (TOR) document helps to better identify the forecasting team's tasks and activities. TORs build shared agreement on team priorities and goals and can also outline individual committee member roles and responsibilities, as required. As members of forecasting committees are likely to also hold other health system responsibilities with their respective organizations, detailed team roles and responsibilities will also help team members to better manage their time and contributions, thus ensuring that forecasting team or committee activities are adequately supported. In addition, the development of a team TOR helps to better align the expectations of external partners and institutionalize forecasting committee goals, priorities and activities within a health system.

Build on existing forecasting competencies and explore opportunities to coordinate forecasts across programme commodities

In many countries the forecasting of health commodities is conducted across various programme commodities. For example, the MOH in countries like Nigeria and Uganda have established teams that lead the development of forecasts across health programme commodities, such as HIV, tuberculosis and malaria[6]. The mandate of the team in Nigeria, known as the Harmonization Quantification Monitoring Committee, includes developing three- to five-year consolidated forecasts and funded supply plans. It also plays an important

6 Management Sciences for Health, 'The Quantification and Procurement Planning Unit (QPPU): improving resource mobilization and utilization through monitoring commodities and sharing information', 20 July 2020, www.msh.org/news-events/stories/the-quantification-and-procurement-planning-unit-qppu-improving-resource, accessed 14 June 2021.

role in promoting the transparency of health commodity funding and availability. Including members who are representatives of, or have experience in, other programme areas, such as HIV, malaria and family planning, will allow national forecasting teams to build on existing forecasting capacity and expertise. Countries that have established National Logistics Working Groups (NLWGs) can also integrate forecasting and supply planning roles and responsibilities into the overall mandate of these groups.

Proactively share health and supply insights learned from the forecasting process to advocate for health system continuous improvement efforts

The analysis of health and vaccine supply data and the identification of trends is a core activity of forecasting teams. Forecasting teams should prioritize the sharing of findings and insights gained from their data reviews, analysis and updates. While forecasts are generally quantitative in nature, they should also be accompanied by written narratives so key findings and insights can be better elaborated on and more easily shared with health system stakeholders. As a best practice, when a large amount of forecasting data or information is presented, visual aids such as graphs, tables and infographics should be used to help communicate key points and findings.

The analysis of health and supply logistics data through the forecasting process yields important health system performance information. The identification of health system underperformance, such as not meeting immunization targets in certain regions, or the unexpected spoilage of vaccine due to cold chain challenges, provides vital, data-driven evidence to support system improvements. By proactively and routinely sharing the insights they gain through forecasting data, forecasting teams and committees play an important role in strengthening evidence-based supply chain decision-making and vaccine programme continuous improvement efforts.

Strategy #2: Establish quality forecasting processes to more effectively harmonize forecasting activities and budget development timelines

Summary

The development of annual or multiyear vaccine forecasts requires the performance or completion of several activities or exercises. While the categorization, sequencing and timeline of activities varies from country to country, the three phases of the forecasting process should be organized in the same way: preparation, demand forecasting and supply planning. The activities and tasks related to these phases include data collection, estimating future consumption, costing vaccine requirements and developing supply plans (Figure 2).

Forecasting SOPs, job aids and other process guidance documents should be developed to standardize and build consensus on forecasting steps and requirements. The benefits of standardizing procedures include ensuring clarity in process steps, consistency in approach and outputs, and the institutionalization of committee learning and knowledge. As noted in the previous strategy, in certain countries forecasting exercises are conducted across various health supply categories, making it necessary to harmonize forecasting processes across national health programmes. As vaccine and health commodity forecasts provide critical input for national health budgets, aligning forecasting processes with budgeting timelines should be a prioritized goal in the standardization of forecasting processes.

Figure 3: Generic vaccine forecasting process

PREPARATION

- *collect and aggregate health and logistics data*
- *clean and prepare data for analysis.*

DEMAND FORECASTING

- *adjust data and build forecasting assumptions*
- *analyse data and calculate future vaccine needs.*

SUPPLY PLANNING

- *estimate total vaccine costs and coordinate funding commitments and suppliers*
- *develop country supply plans.*

Establish and standardize forecasting processes and develop SOPs, job aids and other guidance documents

Standardized procedures provide a process 'baseline', which can serve to harmonize and streamline forecasting activities and planning timelines as needed. The exact specifics of this overall forecasting process, such as the roles responsible for each activity, the resources required and target completion dates will vary from country to country. In addition, the individual sequence and the degree to which some of these activities overlap, or occur in parallel, will also depend on the process established in the country.

Forecasting processes are documented through SOPs, work instructions or other written documentation. To ensure their accuracy, it is important that the SOPs are developed in collaboration with those responsible for, or contributing to, the forecasting process. Quality procedures should be established for the entire forecasting process so that necessary tasks are more effectively completed and goals achieved. Procedures are defined, and should ideally answer the following questions:

- *What is the goal of the process?*
- *Who is/are the process owner(s)?*
- *What are the individual steps of that process?*
- *Who is responsible or contributes to that step?*
- *What data, inputs or resources are required?*
- *What are the tools or materials needed to complete it?*
- *How long does the process take?*
- *When should the process start/end?*
- *How will the performance of the process be measured?*
- *How frequently will the process be reviewed and updated?*

In addition to identifying the process owners, someone (or group of persons) must also be identified as the owner of the actual SOP or guidance documentation itself. It must be noted that the owner(s) of the SOP may or may not be the same person or groups of persons who perform the actual process. The SOP owner(s) is responsible for maintaining and sharing the guidance material and for collecting relevant lessons learned and organizing stakeholders to update the SOP document on a periodic basis. It is recommended that SOPs are reviewed and updated at least every two to three years.

Harmonize forecasting activities to align with the national budget development cycle

The principal goal of the vaccine forecasting process is to calculate total vaccine requirements and costs for supply and procurement planning and budgetary approval. Once the annual or multiyear forecast is developed and approved by the forecasting stakeholder group, EPI leadership or other MOH representatives, it is then submitted to the MOH and/or Ministry of Finance as an input for the development of an approved national

vaccine budget. As a result, the timing of when the forecasting process is finalized is critical as government staff responsible for developing national vaccine budgets need estimates of projected vaccine costs so they have sufficient time to assess them against other health commodity or other sectoral budget requests. In the event that future budgets are expected to be inadequate for vaccines, the timely submission of costing data will allow budget decision makers to seek additional funding from other health sector budget line items or other external sources such as donors.

As a result of the critical role forecasting plays in budgeting, the forecasting process should be continuously aligned and harmonized with the government budgeting process. However, as reflected in the country forecasting planning triangle (Figure 2), this type of harmonization of activities might need to be established over a long-term planning horizon. To help achieve harmonization, forecasting activity milestones and clear timelines should be established. This will help forecasting teams more effectively manage their time and resources so that the final vaccine forecast, and related budget projections, are submitted to the relevant authorities on time for their review and approval.

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Strategy #3: Standardize forecasting methods and ensure data quality to improve the accuracy of demand forecasts

Summary

The activities and tasks related to forecasting can be executed using different approaches and methods. However, just as the steps of the forecasting process should be standardized, the methods used in forecasting-related activities should be formalized and consistent. Forecasting methods that should be agreed upon, documented and consistently applied include the selection of data inclusion criteria, the tools used to aggregate and analyse data, and the development of the formulas used to project future demand. The methods used to develop a demand forecast should be standardized in SOPs and other guidance documents to help stakeholders better understand identified increases or decreases in vaccine demand: whether these can be attributed to a change in forecasting approach or are reflective of actual changes in a country's vaccine demand.

Quality data is an essential input for developing accurate vaccine forecasts. Under the World Health Organization Data Quality Review (DQR) methodology, quality data is defined as data that is **accurate**, **timely**, **consistent**, **reliable** and **complete**.[7] Methods and approaches used to prepare forecasting data and develop demand forecasts should rely on and advance the availability and use of quality data. While no projection of future demand is 100 per cent accurate, given the complexity of factors involved, the use of quality data in vaccine forecasting helps to reduce the uncertainty in future projections and so helps to build confidence in the forecasting process and future vaccine need projections.

Document, standardize and build consensus on vaccine demand forecasting methods, assumptions and targets

Identifying evolving trends in vaccine demand is among the principal objectives of the vaccine forecasting exercise.

7 World Health Organization, 'Data Quality Review: A toolkit for facility data quality assessment. Module 1. Framework and metrics', WHO, Geneva, 2017, https://apps.who.int/iris/bitstream/handle/10665/259224/9789241512725-eng.pdf, accessed 14 June 2021.

Increases or decreases in vaccine demand are impacted by data changes related to various population, clinical or health service delivery factors.[8] However, observed changes in demand trends might also be attributed to the methods and assumptions used to develop a forecast. For example, improvements in facility data record keeping, such as the implementation of an electronic medical records system or a logistics management information system, will be likely to improve the timeliness and completeness of forecasting data. In scenarios where health or logistics data points are incomplete, out of date or simply not available, certain forecasting assumptions will need to be made by forecasters, which also could impact observed changes in vaccine demand.

The methods and assumptions used in forecasting should be documented. The objective of documenting how a forecast, or an element of a forecast was done, is to allow others to understand the thinking and circumstances behind the forecast outcomes. Among the information that should be recorded are the data sources, the formulas used in the calculations and how other inputs into the forecast were managed. The process of adjusting and filling in data gaps during the demand forecasting exercise is known as 'forecasting assumptions building'. The process should be consistent, documented, formalized and collectively agreed upon by forecasting stakeholders through a consensus-based process. A forecasting workshop or meeting is an effective forum for achieving such consensus when developing these assumptions.

Identify data quality challenges by implementing data triangulation analytic techniques and methods

With reference to the World Health Organization's definition of quality data, the following questions should be asked to better understand the quality of forecasting data:

- *Is the data relevant?*
- *Is the data factually correct?*
- *Is there more current data available?*
- *Is the calculated data consistent with how it was calculated in the past?*
- *Is the data available on a routine cycle or on an ad-hoc basis?*
- *Is the data set complete for the given time period, geographic area, product category or demographic group?*

Poor data governance, an insufficient number of dedicated data staff, as well as labour-intensive paper-based record keeping systems are all potential barriers to the availability of quality data. These conditions can result in data gaps, outdated or unusable data, or even the risk of incorrect data. As it is unlikely that forecasting teams will have consistent access to quality data at all times, they

8 These can include changes in birth trends, targeted immunization or disease eradication campaigns, or the expansion of health services to previously underserved regions.

will need to support the establishment of data management systems and analysis methodologies that can better manage and mitigate the impact of poor data quality on the accuracy of forecasts.

The population target-based method and the consumption-based method are the two major vaccine demand forecasting methods. The target population method uses demographic data (e.g. total population, specific population groups), applicable population rates and programme targets to estimate future vaccine demand, while the consumption method uses data based on past vaccine utilization (adjusted for stockouts). The quality of the data used in these two methods will likely vary from country to country. In forecasting scenarios where the quality of data is inconsistent, forecasting teams can deploy data triangulation techniques to mitigate those inconsistencies. The objective of data triangulation is to address data quality issues by making analytic comparisons between related data points to produce the most accurate forecast possible.

Disaggregate data to produce equity forecasts that more effectively support immunization planning, to help ensure vaccines reach the most vulnerable populations

Country governments should be aware of the significant impact vaccine forecasting has on improving access to vaccines and should see it as a potentially important exercise for improving immunization equity. Where applicable, more accurate and disaggregated population data, including data on remote rural, marginalized or conflict-affected populations, should be used to help develop tailored forecasting assumptions and produce **equity forecasts**. Adapting vaccine stock policy (e.g. area-specific buffer stocks, area-specific maximum and minimum stock levels) to the targeted areas and contexts should be seen as another important method of improving vaccine equity in forecasting.

Strategy #4: Institutionalize forecasting key performance indicators to monitor and manage forecast accuracy and performance improvements

Summary

The implementation of vaccine forecasting key performance indicators (KPIs) is critical to understanding the effectiveness of national forecasting exercises. Forecast accuracy is the most commonly reported on forecasting performance indicator. By measuring how closely projected vaccine demand matches the actual quantities of vaccines consumed and/or utilized, forecasting stakeholders are able to better understand and test the effectiveness of forecasting assumptions and approaches. This understanding allows forecasting teams to adjust their assumptions or forecasting methods to further improve the accuracy of their forecasts.

In addition to the demand forecasting KPIs (e.g. the forecast accuracy indicator), it is important to identify and regularly monitor supply-related forecasting KPIs to ensure that the vaccine supply plan is appropriately monitored and that timely corrective measures are being taken. In order for forecasting KPIs to be impactful, they must be institutionalized and an integral part of the forecasting process. This institutionalization is achieved by standardizing and documenting how the indicators are calculated and developed, establishing routine review cycles and proactively sharing the results and conclusions of forecasting KPIs with a broader group of stakeholders.

Define and standardize the performance indicator data collection, calculation and analysis procedures and methodologies

Vaccine forecasting KPIs should be standardized and documented. The definition of the indicator, along with the method of how data is collected, calculated and analysed, should be consistent and not vary from forecast to forecast. This standardization provides transparency and allows comparison across forecasting exercises. It also, ultimately, more effectively builds confidence and ownership in the performance results. Vaccine forecasting indicators should be documented in indicator reference sheets, which can be stand-alone or included in a manual or similar. Indicator elements that should be defined include:

- *purpose of indicator*
- *definition of indicator*

- *calculation of indicator*
- *indicator data sources*
- *indicator time period*
- *data collection methodology*
- *indicator owner*
- *indicator review period.*

It is important to note that an increased number of indicators requires more time and effort in terms of data collection, analysis and reporting. This can unnecessarily tax limited forecasting team resources and also draw attention away from the more impactful KPIs, such as forecast accuracy, or the accuracy of forecasted procurement costs. It is therefore recommended to limit the number of KPIs to those that are essential for understanding performance and that the team can manage, both in terms of calculating and acting upon.

Vaccine stakeholders conduct periodic and timely reviews of forecasting performance to better identify opportunities to improve forecasting, budgeting and procurement management processes

It is important to review forecasting indicators on a routine and periodic basis. This review period should coincide with the time period the indicator was designed to cover. For example, if an indicator is designed to measure forecast accuracy over the period of a quarter (three months), then the indicator should be assessed each quarter. If the reporting period for an indicator is a year, then performance results related to it should be reviewed annually.

It is critical to implement midterm reviews of performance indicators, particularly those with annual or biannual review cycles. For example, forecasting accuracy might be officially reviewed and reported annually, but should be calculated and reviewed at the six-month mark. In situations where there is an increase or decrease in demand, or if there is an unexpected delay in the delivery of a vaccine for example, implementing midterm reviews can allow corrections in the forecasting and the supply planning data to be made in advance of the official annual review cycle (see the tactical layer of the country forecasting triangle in Figure 2). The updates to forecasting data should then be documented in case they have an impact on how the indicator will be measured at the end of the official cycle.

Ultimately, the purpose of reviewing forecasting performance data is to prompt action to improve actual supply chain performance. During these review sessions, vaccine stakeholders are given the opportunity to discuss the factors that might be positively or negatively contributing to performance results. It is therefore important that stakeholders meet regularly and continuously review data to ensure no new problems arise, regardless of the duration of officially designated indicator review cycles.

Communicate forecasting performance results to data submitters at sub-national level to broaden ownership in forecast performance monitoring and create a performance 'feedback loop'

In addition to being shared with vaccine forecasting stakeholders, forecasting indicator results should be shared with those submitting the input data at the sub-national levels. While it may not be feasible to share these results with everyone that may have contributed data to a forecast, such as every reporting hospital, clinic or storage depot, they should at least be shared with health and logistics data management leadership at these sub-national levels. An awareness of forecasting performance results will help data contributors better understand the importance of their role in planning for, and meeting, national vaccine demand, thus promoting a broader ownership of the forecasting process.

Utilize forecasting performance results to advocate for increased vaccine budgetary resources from government or other donor funds

Among the main reasons for low vaccine forecast accuracy is the limited availability of funds. The calculated gap between the quantity of vaccines required and what is actually funded by budgets can be a powerful advocacy tool for the reallocation or reprioritization of funding by budget holders in future cycles. Increases or decreases in forecast accuracy, if driven by funding issues, can both motivate budget holders to increase or maintain current funding. However, for this advocacy to be most impactful, there must be a widely shared confidence in vaccine forecasting data and in the forecasting process (and related indicators), further highlighting the need for standardized and institutionalized forecasting systems.

Strategy #5: Invest in staff capacity-building in forecasting principles and technical competencies to improve and sustain forecasting performance

Summary

Health system professionals and staff that are knowledgeable, skilled and experienced are the foundation of an effective vaccine forecasting team. The ability to manage data, visualize it and develop analysis that is supported by evidence are skills that members of the team should possess. Data modelling, budgeting, and an in-depth understanding of the national health system are other knowledge areas that are important for forecasting. The ability to manage complex project activities, promote systems improvements and be an advocate of vaccine needs to stakeholders are also among the critical competencies and success factors for an effective national forecasting team.

Gaps in national vaccine demand forecasting and supply planning knowledge should be identified through a formal evaluation or survey. Capacity building plans and trainings should then be developed and implemented to address these gaps. In an ideal scenario, training in forecasting and other supply chain-related skills should be integrated into the pre-service training of national health service workers, such as nurses, pharmacists and other medical professionals. The inclusion of a forecasting module in the curricula of national health training programmes will expand the number of health professionals formally trained in forecasting and will ensure the sustainability of these critical skills in the country.

In addition to formal training, in countries where there is a high level of forecasting competency, mentoring, peer-to-peer or on-the-job learning approaches should be considered to further strengthen and more sustainably build country forecasting skills and capacity. Continued learning activities help sustain a high level of forecasting practice as they play an important role in closing skills gaps and increase the professionalization of forecasting as a discipline. Where applicable, government institutions should also integrate vaccine forecasting capacity building initiatives into their quarterly or annual work plans to strengthen the effectiveness of forecasting activities and to sustain or improve current forecasting performance.

Identify the relevant vaccine forecasting team skills and competencies and current team gaps

The vaccine forecasting committee TOR document (see Strategy #1) outlines the goals, scope of activities and responsibilities of the committee. However, high-level documents such as TORs may not always detail the skills and competencies required for each team or committee member. As a result, job or task descriptions should also be developed for key forecasting roles (e.g. Data Collector/Analyst, Country Forecasting Team Leader) and reviewed by stakeholders to achieve consensus on what skills, knowledge and experiences are required for each role contributing to the vaccine forecasting process. A formal or informal review process can then be implemented to identify where current skills and competency gaps exist within the current team. The gaps that are the most common on the forecasting team or have the greatest negative impact on the forecasting process should then be prioritized in current or planned capacity building or training efforts.

Integrate forecasting and related supply chain competencies into national pre-service training curricula to ensure the sustainability of skills in the national work force

Once the gaps in forecasting skills and knowledge have been identified through a formal evaluative process, ideally, a formal training strategy and programme would then be developed. A more formal approach to training ensures that learning goals, topics and methods are appropriate and consistent in content and approach. The ultimate goal of a more formalized approach to training is to ensure that learning outcomes are standardized and that all those who complete the training develop the same skills and knowledge required to successfully execute forecasting tasks.

In practice, demand forecasting and other related supply management responsibilities are often undertaken by health professionals, in addition to their other duties. To more effectively prepare health professionals for these tasks, forecasting and other supply management-related training should be integrated into a country's institutional pre-service training of nurses, pharmacists, medical doctors and other health service workers. The ability to design and manage databases, model and interpret data, and the capacity to visualize and effectively communicate data are among the various forecasting-related skills that should be strengthened under such pre-service training. Budget and advocacy skills, as well as an in-depth understanding of health delivery systems and priorities, are other learning areas that should be included in the formal training of health professionals. The amount of training will vary by health service role, but a formalized, structured training approach through a country's national health pre-service programmes will serve to 'professionalize' forecasting as a skilled responsibility and help ensure that a baseline national capacity in these skills is established.

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References

Gandhi, Gian, 'Forecasting the Global Demand for Preventive HIV Vaccines', Policy Research Working Paper No. 15, International AIDS Vaccine Initiative, New York, October 2007, https://www.iavi.org/phocadownload/IAVI_Forecasting%20the%20Global%20Demand%20for%20Preventive%20HIV%20Vaccines.pdf, accessed 14 June 2021.

International Organization for Standardization, 'The Process Approach in ISO 9001:2015', ISO, Geneva, n.d., https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/iso9001-2015-process-appr.pdf, accessed 14 June 2021.

Leab, Dorothy, et al., 'National logistics working groups: A landscape analysis study' *Vaccine*, vol. 35, issue 17, 19 April 2017, pp. 2233–2242, https://doi.org/10.1016/j.vaccine.2017.02.033, accessed 14 June 2021.

Management Sciences for Health, *MDS-3: Managing access to medicines and health technologies*, Arlington, Va., 2012, www.msh.org/resources/mds-3-managing-access-to-medicines-and-health-technologies, accessed 14 June 2021.

Management Sciences for Health, 'Quantifying Pharmaceutical Requirements', ch. 20 in *MDS-3: Managing access to medicines and health technologies*, Arlington, Va., 2012, https://www.msh.org/sites/msh.org/files/mds3-ch20-quantifying-mar2012.pdf, accessed 14 June 2021.

Systems for Improved Access to Pharmaceuticals and Services (SIAPS) Program, 'Quantification: Forecasting and supply planning', Promising Practices in Supply Chain Management Series, Management Sciences for Health, Arlington, Va., 2014, http://siapsprogram.org/wp-content/uploads/2014/07/1_Quantification-final.pdf, accessed 14 June 2021.

United States Agency for International Development (USAID), Deliver Project, Task Order 1, 'Guidelines for Managing the Laboratory Supply Chain: Version 2', USAID, Arlington, Va., 2008, https://publications.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=11109&lid=3, accessed 14 June 2021.

United States Agency for International Development (USAID), Deliver Project, Task Order 1, 'Quantification of Health Commodities: A guide to forecasting and supply planning for procurement', USAID, Arlington, Va., 2008, http://1rqxbs47ujl4rdy6q3nzf554.wpengine.netdna-cdn.com/wp-content/uploads/2016/07/Quantification-of-HealthCommodities.pdf, accessed 14 June 2021.

United States Agency for International Development (USAID), Deliver Project, Task Order 1, 'Supervision and On-the-Job Training for Supply Chain Management at the Health Facility', USAID, Arlington, Va., 2011, https://publications.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=15572&lid=3, accessed 14 June 2021.

World Health Organization, 'Data Quality Review: A toolkit for facility data quality assessment. Module 1. Framework and metrics', WHO, Geneva, 2017, https://apps.who.int/iris/bitstream/handle/10665/259224/9789241512725-eng.pdf, accessed 14 June 2021.

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