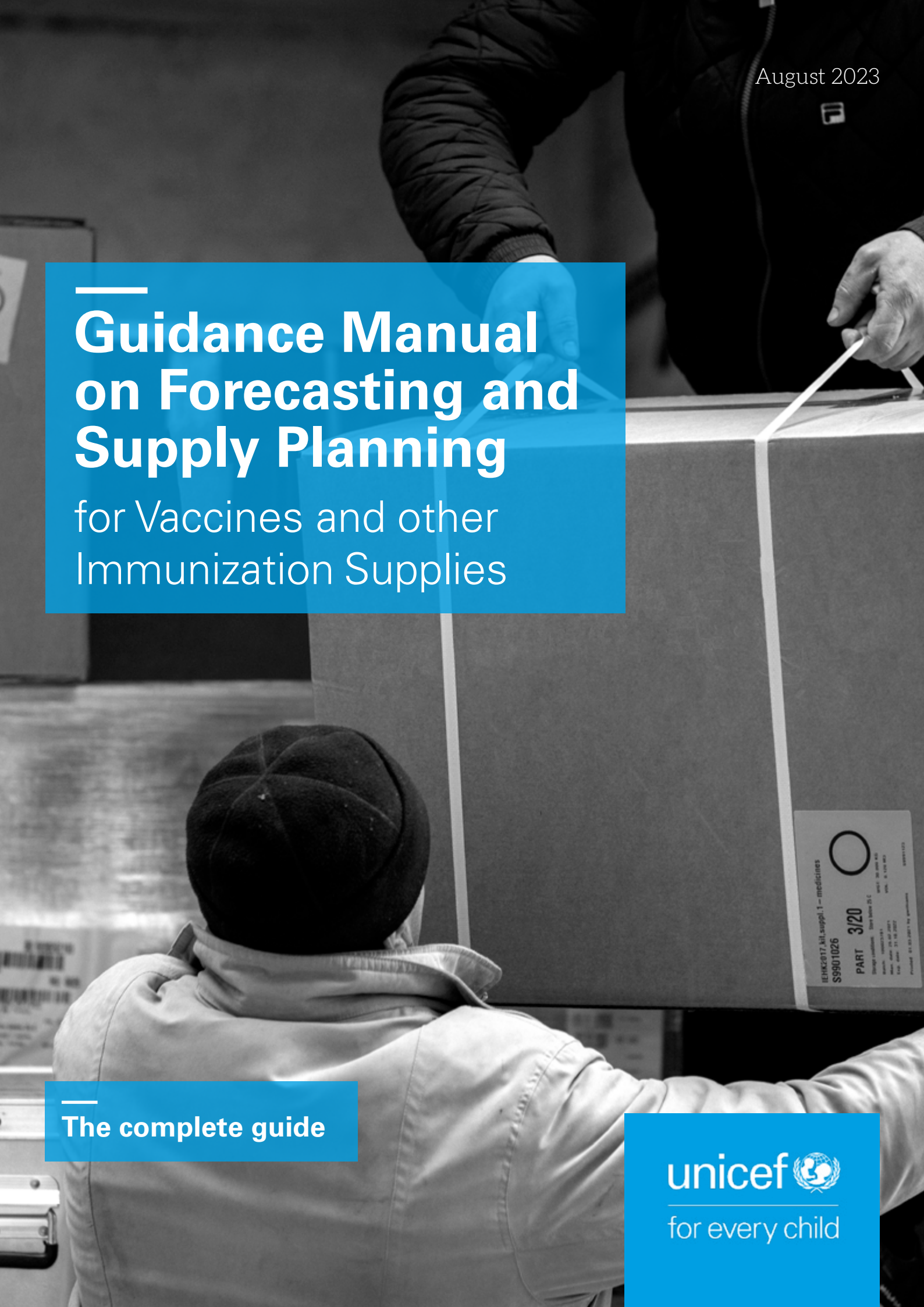
August 2023

Guidance Manual on Forecasting and Supply Planning

for Vaccines and other Immunization Supplies



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Acknowledgements

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Introduction

Who should use this guidance manual

The target audience for this guidance manual is **immunization programme managers and technical officers** involved in forecasting and supply planning (FSP) at the national level. This includes **government officials and staff of implementing partners and donor agencies**. We also anticipate that individuals interested in learning more about FSP for vaccines and immunization supplies will find this guidance document useful.

Purpose of this guidance manual

This guidance manual is developed in response to the need to strengthen national-level FSP processes with particular emphasis on achieving equity and reaching zero-dose children. By following and adapting the principles discussed in this guidance, countries will improve the accuracy of their forecast and supply plan, thereby ensuring the timely availability of quality products where they are needed. The guidance manual outlines the step-by-step approach for FSP. More specifically, it aims to:

- Explain **fundamental FSP concepts** with emphasis on vaccines and immunization supplies
- Outline the **step-by-step approach** involved in conducting FSP at the national level, including continuous quality improvement
- Discuss the critical **programmatic considerations** necessary for the effective conduct, operationalization and monitoring of FSP
- **Provide links to additional FSP-related resources** and tools, including their contextual application
- Offer **strategic guidance to national-level level decision makers** on how to proceed with the design and implementation of FSP-strengthening interventions

Although our focus throughout the document is on vaccines and immunization supplies, most of the concepts discussed also apply to other health commodities. Also, we purposefully avoid using technical jargon where possible to cater to the need of diverse audiences.

This guidance manual should be seen as a live document, and will be updated periodically as new evidence emerges, and as the approaches for conducting FSP evolve.

How to use the guidance manual

This guidance manual was developed primarily to guide FSP for vaccines and immunization supplies at the national level, while considering programme implementation realities across all supply chain levels. The use of this guidance manual will vary with the country's goal(s) and the user's expertise. For example, some countries may want to set up standardized processes to conduct, implement, and continuously improve FSP. In contrast, others may only want to strengthen specific aspects of these supply chain functional areas. Similarly, while some users may be entirely new to FSP, others may be more interested in addressing specific capacity gaps. Our approach ensures that all countries and individuals will find this guidance manual helpful, irrespective of goals and level of expertise. Depending on the identified need(s), this guidance manual can be consulted in order to:

- Gain a holistic understanding of FSP
- Obtain information to address specific needs, including:
  - Establishing and institutionalization of an FSP team
  - Planning for FSP
  - Conducting FSP, including the selection of appropriate methodology
  - Monitoring of FSP performance
  - Assessing forecasting and supplying and developing a continuous improvement plan

To cater to the needs expressed above, each chapter contains sufficient information to address the overarching concept it was intended to cover. Depending on the user's need, each chapter can be consulted in part, or in conjunction with other chapters.

This operational guidance manual builds on an earlier strategy document – 'Strategies to Strengthen Country Vaccine Forecasting Capacity' – also developed by UNICEF to strengthen countries' FSP capacity.

Layout of the guidance manual chapters

The general layout of each chapter is described below.

Chapter layout	Description
Introduction	Provides an overview of the topics covered in the chapter
Section table	Briefly describes each topic area (section) and provides the applicable page number
Sections	Discusses each topic area (section) in detail
Key takeaways	Summarizes the key messages from the chapter

Acronyms

Acronym	Definition
AMC	Average monthly consumption
ARIMA	Autoregressive integrated moving average
cMYP	Comprehensive multi-year strategic plan
DHIS2	District Health Information System 2
DQA	Data quality assessment
EPI	Expanded Programme on Immunization
EVMA	Effective vaccine management assessment
FDR	Forecast demand ratio
FIP	Fully immunized person
FSP	Forecasting and supply planning
FSPAT	Forecasting and supply planning assessment tool
GIS	Geographic information system
KPI	Key performance indicator
LMIS	Logistics management information system
MICS/NICS	Multiple indicator cluster survey/national immunization coverage survey
MOH	Ministry of Health
NLWG	National logistics working group
PCV	Pneumococcal conjugate vaccine
PSM TWG	Procurement and supply management technical working group
QA	Quality assurance
RED/REC	Reaching every district/reaching every child
SCM	Supply chain management
SMART	Specific, measurable, achievable, realistic, time-bound
SMART	Standardized monitoring and assessment of relief and transitions
SMT	Stock Management Tool
SOPs	Standard operating procedures
UN	United Nations
WHO	World Health Organization
WUENIC	WHO and UNICEF estimates of national infant immunization coverage

Definition of terms

Term	Definition
Assessor	An individual tasked with the responsibility of administering the assessment tool following pre-established protocol.
Average monthly consumption (AMC)	The average quantity of product administered to the end users over a defined period (≥3 months), including reasonable waste that will be experienced during service delivery for vaccines.
Budgeting	The process of earmarking a specific amount for a purpose, such as procurement of health commodities.
Buffer	The additional quantity of the stock (other than forecasted consumption) needed to prevent stock-out, and covering stock required when deliveries are awaited and during other fluctuations in demand. Buffer stock can also be referred to as safety stock.
Commodity forecast or Forecast	The quantity of doses of each vaccine that will be consumed or utilized for a specific period in the future.
Commodity requirements	The quantity of each commodity needed to meet the forecasted consumption and ensure that adequate stock levels within the supply chain are maintained to ensure continuous commodity supply.
Consumption	The quantity of product administered to end users over a defined period of time, including reasonable waste that will be experienced during service delivery for vaccines.
Consumption-based forecasting method	A forecasting method that uses past consumption trend to predict future consumption. Forecasting using this method can vary from a simple adjustment of past consumption by an agreed growth factor, to more sophisticated modelling (or trend analysis) techniques.
Data manager/analyst	An individual tasked with the responsibility of reviewing and analysing the data collected during an assessment.
Data triangulation	The process of comparing data points from multiple sources or approaches to improve data analysis results and increase reliability in the targeted output.
Demographic/wastage factor forecasting method	A forecasting method that uses demand (based on demographic information, programme target and immunization schedule) and allowable wastage to estimate future consumption.
Expanded Programme on Immunization (EPI) team	The team responsible for coordination of the national immunization programme to ensure equitable access to life-saving vaccines.
Financial requirements	The cost of the total quantity of each commodity needed to meet the forecasted consumption and ensure that adequate stock levels within the supply chain are maintained to ensure continuous commodity supply. This can include other add-on costs, including product shipping, insurance, customs, handling and distribution costs.
Forecast	The quantity of doses of each vaccine that are estimated to be consumed or utilized for a specific period in the future. This term and projected vaccine demand are used interchangeably throughout the guide.
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. This process can be based on observed trends or patterns from adjusted demographic, health services utilization and/or logistics data. The output of this process is the estimated projected consumption.

Term	Definition
Forecasting and supply planning (FSP) consultation meetings	Meetings that target individuals with some specific skills and expertise that are not available within the FSP team to obtain required inputs for FSP.
FSP review	The process by which programmes review a forecast and supply plan, including previous recommendations, to determine whether corrective actions are required for uninterrupted product availability.
FSP team	The government-led team responsible for coordinating all forecasting and supply planning-related activities.
FSP workshop	The platform for reviewing the historical programme and FSP performance, discussion and ratification of the FSP data and assumptions, and the final forecast and supply plan. The workshop should include a diverse group of stakeholders involved in programme planning and implementation.
Fully immunized person	An individual that has received all the doses of a given vaccine as stipulated in the country's immunization schedule.
Funding advocacy	The process of engaging and soliciting relevant stakeholders' support to ensure adequate funding for commodity procurement.
Key performance indicator (KPI)	An objective measure of performance that indicates current performance and can be used to monitor progress towards the achievement of set targets over time.
Lead time	The time interval between when an order is placed and when the product is delivered by a supplier to the customer (this can be a store or a health facility).
Lead time stock	The stock required between when an order is placed and when the product is delivered by a supplier to the customer (this can be a store or a health facility).
Logistics management information system (LMIS)	An organized system for collecting, processing, reporting, and using logistics data for informed decisions.
Maximum and minimum inventory control level	The stock level that must not be exceeded (maximum) and the lowest quantity of stock (minimum) that should be available under normal conditions per supply chain level, as defined by the country's inventory policy. The maximum and minimum inventory levels are usually expressed in time periods (e.g., months).
Microplanning for immunization services	Microplanning is the process that involves an integrated set of activities used to identify priority communities, identify all beneficiaries, plan for vaccine and logistics requirements, including modes of delivery to address barriers, and ensure robust delivery of immunization services. The output of this exercise is a microplan.
Multidose vial policy	The policy that stipulates the conditions and how long unused doses of opened multidose vials can be reused.
National logistics working group (NLWG) or procurement and supply management technical working group (PSM TWG)	The committee or team responsible for coordinating national logistics and supply chain activities, as well as supply chain investments made by government agencies and development partners. The NLWG or PSM TWG provides guidance, expertise and technical assistance on all matters concerning supply chain operations and improvement initiatives.
Quality data	Data that are accurate, timely, consistent, reliable and complete.
Reporting rate	The proportion of expected reports that were submitted.
Standard operating procedures (SOPs)	A set of step-by-step instructions compiled by an organization to help employees complete tasks in a manner that ensures compliance with the organization's requirements and regulations. SOPs ensure that tasks are consistently performed correctly and include a list of all the essential activities, how to perform these tasks, and who is responsible for the functions listed and required resources.

Term	Definition
Stock allocation	The process of estimating and deciding the quantity of product needed to meet the requirements of specific stores or health facilities for a defined period.
Stock on hand	The quantity of available usable stock at a given point in time.
Stock-out	A situation in which no usable product is available for use.
Stock status	A report of available product quantities in stock, in transit or on order. It can also be expressed in time period for example, how long stock will last in weeks or months.
Stratified forecasting	A vaccine forecasting process that uses disaggregated health and logistics data (for subgroups with common properties) to more accurately predict vaccine demand, in order to improve immunization coverage for traditionally underserved populations such as urban poor, remote rural and conflict-affected populations.
Stratified forecasting and supply planning	A vaccine forecasting and supply planning process that uses disaggregated health and logistics data (for subgroups with common properties) to more accurately predict vaccine demand and supply, in order to improve immunization coverage for traditionally underserved populations such as urban poor, remote rural and conflict-affected populations.
Supply plan	A plan that indicates when, where and how many doses of each vaccine should be delivered to ensure adequate stock levels are maintained throughout the supply chain based on the forecasted consumption, stock status and inventory policies.
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 based on the forecasted consumption, stock status and inventory policies. The supply planning process estimates the total vaccine requirements.
Target coverage	The proportion of eligible individuals desired to be reached for any given vaccine.
Target population	The segment of the population that is desired to receive a given vaccine.
Terms of reference	A document that outlines the purpose, roles and responsibilities, membership, governance structure and operational procedure of a committee or project to facilitate the achievement of defined goal(s).
Total commodity requirements	The quantity of each commodity needed to meet the forecasted consumption and ensure that adequate stock levels within the supply chain are maintained to ensure continuous commodity supply.
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.
Vaccination session forecasting method	A forecasting method that estimates future consumption using estimated demand, vaccination session characteristics, prevailing multidose vial policy, and expected closed and avoidable open vial wastage.
Wastage	The quantity of vaccines lost for various reasons and never administered to the end user. Vaccine wastage is broadly classified into (1) closed vial wastage (vial has not been opened with wastage due to expiry, heat damage, freezing, breakage and/or missing inventory), and (2) opened vial wastage (wastage that occurs when the vial has been opened). Opened vial wastage is categorized as avoidable (due to errors or accidents made during immunization sessions) and unavoidable (due to discarding unused doses of multidose vials at the end of the immunization session).

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Overview of forecasting and supply planning

Chapter

1

Guidance Manual on Forecasting and Supply Planning
for Vaccines and other Immunization Supplies

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Contents

Overview of forecasting and supply planning

This guidance manual provides an overview of forecasting and supply planning (FSP). It covers the definition of FSP, vaccine FSP processes, benefits of FSP and the strategic pillars central to the effective execution of FSP. The chapter is organized into the following sections.

What is forecasting and supply planning?

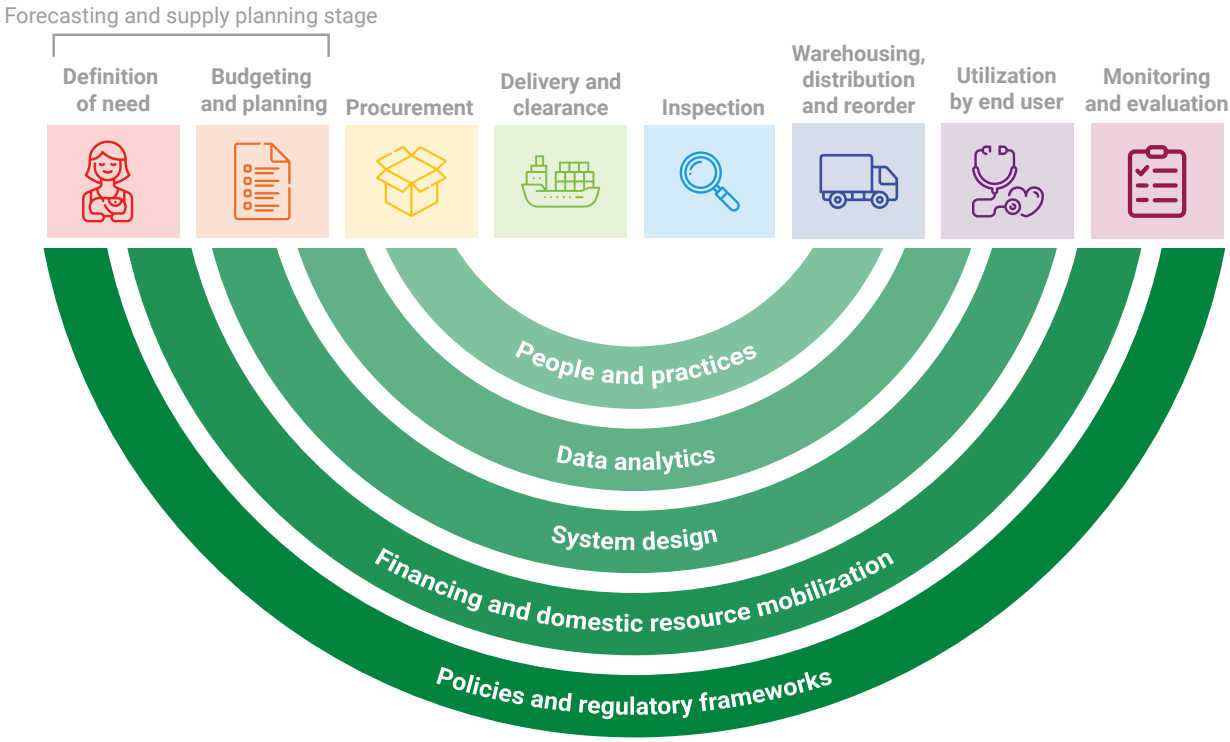
Forecasting and supply planning – also referred to as quantification – are critical supply chain activities necessary for uninterrupted commodity availability and service delivery. These activities are part of the distal supply chain functions (see Figure 1.1) that must be effectively executed if commodities are to be always available and in sufficient quantities at the service delivery point level.

Forecasting is 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.[1] Projected vaccine demand is based on observed trends or patterns from adjusted demographic, health services utilization and logistics data. The output of this process is the estimated projected consumption. As open and closed vial wastage is inevitable for the immunization programme, forecasts for vaccines usually include provisions for reasonable waste that will be experienced during service delivery, taking into consideration actual historical waste among other contextual factors. Depending on the context and the quality of available data, different methods such as demographic data, vaccination sessions, and consumption (or any combination of) can be used for forecasting.

Supply planning, on the other hand, is 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 estimates the total vaccine requirements and costs based on the forecast generated from the demand forecasting stage.[2] The output of the supply planning process is the supply plan.

Following the development of the supply plan, an open and transparent process to procure quantified vaccines and immunization supplies should be initiated.

Figure 1.1: Forecasting and supply planning within the context of supply chain management framework



1 UNICEF Supply Division, 'Strategies to Strengthen Country Vaccine Forecasting Capacity', May 2021.

2 Ibid.

Vaccine forecasting and supply planning processes

The development of annual or multiyear vaccine forecasts requires the completion of several activities. While the categorization, sequencing and timeline of activities vary from country to country, the three phases of FSP should be organized in the same way: preparation, demand forecasting, and supply planning. The key activities and tasks related to these phases include programme description, data collection, estimating future consumption, determining vaccine requirements, costing vaccine requirements, and developing supply plans (Figure 1.2).

Forecasting and supply planning processes should be agile and take into account parameters such as seasonality and risk of outbreaks.

Benefits of forecasting and supply planning

FSP helps programmes, donors and manufacturers to:

- Determine programmatic commodity requirements and associated procurement costs for a defined period
- Develop and advocate for vaccine and programme budgets as well as procurement plans
- Plan for medium- and long-term financial requirements, including when the funding situation changes (e.g., when transitioning out of Gavi support)

Figure 1.2: Generic vaccine forecasting and supply planning processes

Preparation

- Describe programme and define scope
- Collect, clean and adjust health and logistics data
- Aggregate and prepare data for analysis

Demand forecasting

- Review, ratify and collate forecasting data and assumptions
- Analyse data and calculate future vaccine needs

Supply planning

- Determine total vaccine requirements
- Estimate total vaccine costs and coordinate funding commitments and supplies
- Develop country supply plans

- Mobilize resources to meet programmatic needs based on unconstrained forecasts and available funding
- Adjust commodity requirements in line with available funding, and reflect this in the planning and implementation of the national immunization programme
- Prime manufacturers on future demand for better pricing and production planning
- Benefit from economies of scale and support supplier price negotiations
- Ensure vaccine security, including in the context of unpredictable shocks to the system and geographic constraints such as hard-to-reach communities, while ensuring efficient use of scarce resources by mitigating the risk of vaccine stock-outs, overstock and expiries

Strategic pillars of forecasting and supply planning

The five strategic pillars of FSP emerged from an assessment conducted by UNICEF in April 2020 across eight countries that routinely generated accurate forecasts and supply plans (Armenia, Burkina Faso, Georgia, Moldova, Morocco, Senegal, Uzbekistan and Zambia), and a review of best practices recommended by the global health supply chain technical literature. These strategies address the key FSP challenges, including poorly skilled FSP teams, poor data governance and lack of standardized FSP processes, and stress the need to adopt a systems approach.

They include:

1. Ensuring government-led forecasting and supply planning teams are established and institutionalized to coordinate forecasting and supply planning activities and promote the sustainability of forecasting and supply planning performance
2. Establishing quality forecasting and supply planning processes to more effectively harmonize forecasting and supply planning activities and budget development timelines
3. Standardizing forecasting and supply planning methods and ensuring data quality to improve the accuracy of demand forecasts and supply plan
4. Institutionalizing forecasting and supply planning key performance indicators (KPIs) to monitor and manage forecast and supply plan accuracy and performance improvements
5. Investing in staff capacity-building in forecasting and supply planning principles and technical competencies to improve and sustain forecasting and supply planning performance

The strategies are briefly discussed below, while the rest of the guidance manual focuses on operationalizing them.

1. Government-led forecasting and supply planning team

A government-led multidisciplinary FSP team with technical and programmatic experience in FSP and broader supply chain management should coordinate FSP. This team should report directly to the national logistics working group (NLWG) or any other government-led (integrated) procurement and supply management technical working group (PSM TWG) or a designated unit within the Ministry of Health (MOH). By institutionalizing this FSP team, including ensuring they have clearly defined terms of reference, countries will be better positioned to generate accurate forecasts and supply plans (see Chapter 2 for more detail).

2. Quality forecasting and supply planning processes

For effective FSP, timelines and steps involved in FSP must be clearly and properly documented in the form of standard operating procedures (SOPs). This will ensure that all critical activities are completed in a timely manner, and outputs are ready for critical programmatic decisions such as budgeting, resource mobilization, resource allocation and procurement planning. With SOPs in place and routinely updated, new individuals will also have the resources to understand the programme's workflow and their expected roles and responsibilities.

3. Standardized forecasting and supply planning methods and quality data

Programme managers can choose from several FSP methods depending on available human resource capacity and the quality of available data, among other considerations. A detailed review of the various methods considering the country's context is therefore required for arriving at a method or a combination of methods. The chosen method(s) must then be clearly documented by the FSP team, including the data inclusion criteria, tools for data analysis, and the formula used to generate forecasts and supply plans. Doing this will ensure transparency and can be used to track changes in commodity requirements that could be due to a switch of the FSP method. As FSP are highly data-driven, programmes should also put measures in place to assess data quality and implement quality improvement interventions.

4. Institutionalized key performance indicators

To monitor processes and the final FSP outputs, countries are expected to have a system for tracking KPIs (see Chapter 9 on FSP performance monitoring). This will range from monitoring the functionality of FSP teams to evaluating the alignment of the forecast and supply plan with the actual programme performance. In collaboration with relevant stakeholders, the KPI results should also inform the development and implementation of an improvement plan.

5. Investment in capacity-building

Adequate and skilled human resources are essential to effectively executing and monitoring FSP. The skills and competencies required range from hard technical skills needed for activities such as data analysis and generation of forecasts and supply plans, to soft skills necessary for advocacy and managing relationships with diverse stakeholders. A structured system must therefore be in place to continually build the capacity of FSP team members. Ideally, skills gaps should be routinely evaluated, and a structured plan implemented to bridge any identified gaps. Various capacity-building approaches such, as pre-service training, in-person and online training, on-the-job training, and mentorship, can be leveraged for this purpose.

Key takeaways

- **FSP – also referred to as quantification – involve estimating futuristic commodity and financial requirements** over a defined period and determining when products should be delivered to ensure an uninterrupted supply of commodities.
- The **three phases of FSP** include preparation, demand forecasting, and supply planning.
- **FSP help programmes, donors and manufacturers to plan** for commodity and financial requirements, mobilize resources, allocate resources, negotiate prices and plan for production.
- **Effective FSP require an institutionalized FSP team**, quality and well-defined processes, standardized methods and quality data, regular use of KPIs to monitor and improve performance, and an established system for capacity-strengthening.

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Coordinating forecasting and supply planning:

The forecasting and supply planning team

Chapter

2

Guidance Manual on Forecasting and Supply Planning

for Vaccines and other Immunization Supplies

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Contents

Coordinating forecasting and supply planning:

The forecasting and supply planning team

This guidance manual provides an overview of the forecasting and supply planning (FSP) team, including the roles and responsibilities of the team, governance structure, operational procedures, and guidelines for setting up and strengthening an FSP team. The chapter is organized into the following sections.


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Overview of the forecasting and supply planning team

All FSP activities, from compiling data and assumptions to implementing the FSP improvement plan, require strong coordination. The FSP team is the government-led team that should coordinate these activities, and it can have members from relevant national immunization partners. The FSP team will have three to five members with expertise in immunization supply chain management and experience in health programme planning and implementation. Further, the team should be able to collaborate with individuals, organizations and ministries with requisite skills and expertise that are external to the team as needed. Individuals with the following skills and expertise can be part of the FSP team or can be externally consulted: forecasting; supply planning; finance and budgeting; procurement; warehouse, cold chain and stock management; data analysis and management (both supply chain and programme data); and immunization programme management and implementation, including routine and supplementary immunization activities and outbreak response. Given the role of timely fund disbursement in ensuring timely procurement, it is highly recommended that representatives from the Ministry of Finance and Treasury are part of the FSP team or are consulted. Finally, a major requirement for institutionalization is a clearly written, government-endorsed and operationalized terms of reference (see toolbox for sample).

Roles and responsibilities of the forecasting and supply planning team

The FSP team may have responsibilities such as:

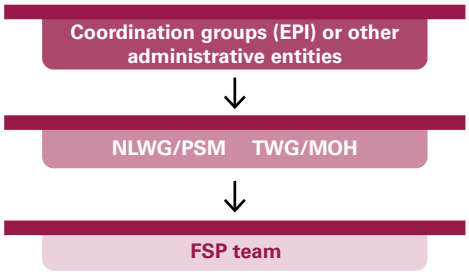
- **Developing a work plan** for FSP activities
- **Organizing and completing preparatory activities** for FSP exercises, including programme description, scope definition, data gathering, obtaining stakeholders' inputs through consultations and finalization of essential data and assumptions
- **Generating forecasts and supply plans**, supporting resource mobilization and eventual operationalization of the forecast and supply plan
- **Reviewing and monitoring FSP performance**, including the development of improvement plans
- **Advocating for the definition and adoption of FSP procedures**, team members' training and adoption of applicable innovations
- Liaising with and **leveraging skills and expertise available in other programme areas** to ensure alignment and integration
- Supporting the programme to **introduce or switch products or programmatic approach**

Governance structure for the forecasting and supply planning team

Ideally, the FSP team should directly report to the NLWG or any other government-led (integrated) procurement and supply management technical working group (PSM TWG) or a designated unit within the Ministry of Health (MOH) (Figure 2.1). The activities and outputs of the FSP team must be communicated to higher-level coordination groups or administrative entities, such as the Expanded Programme on Immunization (EPI) team and/or other specialized responsible entities within the MOH. This will ensure that the responsible authorities are aware of the team's activities and endorse and use the FSP outputs (such as placing orders per plans), and will also enable them to provide the required support to the FSP team, when/if needed. Other teams that use the FSP outputs include the procurement unit, finance unit, central medical stores, etc.

In instances where there is no functional NLWG or PSM TWG, there should be a deliberate effort to set up and/or strengthen the group, given its critical role in coordinating supply chain management activities.

Figure 2.1: FSP team governance structure



The forecasting and supply planning team's operational procedures

Table 2.1 lays out the key operational procedures for the FSP team, including communication and collaboration considerations. FSP team should coordinate all procedures in collaboration with other immunization partners under the leadership of NLWG, PSM TWG and MOH depending on the country context.

Table 2.1: FSP team's operational procedures

Procedure	Activities	Responsible	Stakeholders	Output	Guidance
Planning					
FSP assessment and improvement planning	– Advocate for assessment – Coordinate assessment – Coordinate improvement planning – Disseminate assessment and improvement planning reports – Advocate for implementation of improvement plan, including integration into existing plans/ strategies	FSP team	NLWG, PSM TWG, MOH and other immunization partners	FSP assessment report disseminated FSP improvement plan disseminated	
Work planning	– Develop costed work plan that is informed by FSP improvement plan – Disseminate and advocate for integration of work plan activities into broader EPI plans	FSP team	NLWG, PSM TWG, MOH and other immunization partners	Costed work plan developed, disseminated and integrated	Countries are expected to develop an annual and/or multiyear work plan that is reviewed regularly (quarterly or semi-annually). The timelines for activities should be fixed such that they are completed on time (for example, to meet the country's budgeting, procurement and fund release timelines, etc.). Each activity in the plan should have specific, measurable, achievable, realistic and time-bound (SMART) key performance indicators (KPIs) and realistic targets. The team should assess if they need an evaluation and include it in the work plan.

Procedure	Activities	Responsible	Stakeholders	Output	Guidance
Work plan implementation					
FSP	– Define the scope of FSP – Collect, clean, adjust and aggregate FSP data – Collaborate and collect inputs from relevant stakeholders – Coordinate consultation meetings, including FSP workshop – Facilitate finalization of FSP data and assumptions – Estimate forecast and develop supply plan – Disseminate FSP results	FSP team	NLWG, PSM TWG, MOH and other immunization partners	Forecast and supply plan	The FSP team needs to collect inputs from relevant subject matter experts through individual consultations and/or through stakeholders' consultation workshops, such as an FSP workshop. Ideally, such consultations should involve individuals with experience across all the levels of the immunization supply chain and other functional areas such as procurement, finance and budgeting, data analysis and management (both supply chain and programme data), and immunization programme management and implementation, to ensure all programmatic realities are considered. The consultation with the Ministry of Finance and Budgeting is particularly important, given its role in ensuring that commodity requirements are funded.
FSP monitoring	– Conduct regular FSP reviews – Revise forecast and supply plan where applicable – Disseminate revised forecast and supply plan	FSP team	NLWG, PSM TWG, MOH and other immunization partners	Forecast and supply plan reviewed, revised and disseminated where applicable	While reviewing FSP, the team should identify the underlying causes of observed performance and where applicable put in place measures to improve or maintain performance.
Other activities	– Implement other activities such as capacity-building and support to introduce or switch products or programmatic approach	FSP team	NLWG, PSM TWG, MOH and other immunization partners	Other activities implemented	

Procedure	Activities	Responsible	Stakeholders	Output	Guidance
Monitoring and evaluation					
Monitoring and evaluation (see Chapters 8 and 9 for details on FSP review and performance monitoring)	– Track KPIs – Plan and coordinate evaluation	FSP team	NLWG, PSM TWG, MOH and other immunization partners	KPIs tracked Evaluation report	While tracking the KPIs, the team should identify the underlying causes of observed performance and put in place measures to improve or maintain performance

The operational procedure for the FSP team, including but not limited to work plan development, meetings proceedings, documentation and decision-making processes, should be clearly documented. A generic terms of reference is available in the toolbox for consideration and adaptation.

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Guidelines for setting up and strengthening the forecasting and supply planning team

Setting up the forecasting and supply planning team

A summary of the steps involved in setting up the FSP team is presented in Table 2.2.

Table 2.2: Summary of the steps involved in setting up the FSP team

Steps	Description	Guidance
1	Identify institutionalization of the FSP team as a priority	The FSP team has been proven to play a key role in improving FSP performance. Countries are therefore recommended to set up and institutionalize the FSP team. Once consensus to set up a team is reached by all stakeholders, this activity should be added to the responsible entity's work plan.
2	Draft terms of reference	A generic terms of reference is available in the Immunization FSP toolbox for adaptation.
3	Agree on the primary reporting line	Ideally, the FSP team should directly report to the NLWG or any other government-led (integrated) PSM TWG or a designated unit within the MOH. The activities and outputs of the FSP team must be communicated to higher-level coordination groups or administrative entities such as the EPI team and/or other specialized responsible entities within the MOH.
4	Review and adopt terms of reference	This should be done by the responsible government entity (for example, a specialized entity within the MOH).
5	Nominate and formally appoint FSP team members	The entity responsible for leadership oversight should identify, nominate and appoint team members from the government. They should also collaborate with partners to identify additional team members. Among the FSP team members, the chairperson and the secretary should be identified to coordinate the team's activities. The chairperson should be a government official, while the secretary can come from immunization partners.
6	Implement FSP activities	The FSP team's activities should be guided by a work plan and continuous improvement plan where applicable.
7	Appraise the FSP team's performance periodically	Ideally, the FSP team's performance should be evaluated and a continuous improvement plan implemented to address any observed gaps. The appraisal can be conducted using the questions in Table 2.3 (Rapid FSP team assessment questions).

Strengthening the forecasting and supply planning team

Weaknesses in the operation of the FSP team can be identified through a formal assessment, and an improvement plan should be developed from the gaps identified. UNICEF's FSP assessment tool can be used for this purpose, as it has questions that specifically address the functionality of the FSP team (see Chapter 10).

Countries may find the questions in Table 2.3 useful for a rapid assessment. A "no" to any of these questions indicates a weakness that should be addressed (see Table 2.3 for recommended actions).

Table 2.3: Rapid FSP team assessment questions and recommended actions

S/N	Question	Recommended action (if the answer to the question is no)
1	Does the FSP team have formal terms of reference that include the team's roles and responsibilities, members' competencies, and other essential details?	Develop and adopt a terms of reference
2	Does the FSP team have a resource work plan that is integrated into the broader work plan of the entity responsible for leadership oversight?	Develop a costed work plan and advocate for its integration into broader programme work plans and strategies
3	Does the FSP team have access to resources required for the implementation of FSP activities?	Advocate for provision of resources required for the implementation of FSP activities
4	Are the FSP team's proposed changes to the forecast and supply plan reflected in the country's procurement plans?	Advocate for the consideration and implementation of the FSP team's proposed changes to the forecast and supply plan Institutionalize the use of proposed changes to the forecast and supply plan to inform procurement plans through applicable policy statement and/or development of a standard operating procedure
5	Does the FSP team monitor work plan implementation using agreed indicators?	Review work plan implementation using indicators specified in the work plan
6	Does the FSP team hold regular meetings with evidence of minutes and communication of relevant recommendations to decision makers?	Institutionalize the use of indicators to track the frequency of meetings as defined in the work plan and track the implementation of recommendations
7	Does the FSP team review FSP performance using agreed indicators?	Institutionalize the review of FSP performance using selected FSP KPIs (see Chapter 9 for potential KPIs)

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Key takeaways

- The **FSP team is a government-led team** responsible for coordinating all FSP-related activities.
- The FSP team should (1) develop a **work plan** for FSP activities, (2) organize and complete FSP **preparatory activities**, (3) develop **forecast and supply plan**, (4) ensure **FSP monitoring and implementation** of a continuous improvement plan, (5) **lead standardization of FSP processes** and training of members, (6) liaise with and leverage skills and expertise available in other programme areas to **ensure alignment and integration**, and (7) **support other innovative activities** such as new vaccine introduction.
- **All FSP teams should have a formal terms of reference** that include their functions, operational procedures, and performance-monitoring.
- The **FSP team should develop a costed work plan and advocate for its integration into broader programme** work plans and strategies.
- **UNICEF's FSP assessment tool can be used to assess the functionality of the FSP team** to facilitate the development and implementation of an improvement plan.

August 2023

Preparing for forecasting and supply planning

Chapter

3

Guidance Manual on Forecasting and Supply Planning

for Vaccines and other Immunization Supplies

unicef

for every child

Contents

Preparing for forecasting and supply planning

This guidance manual provides an overview of the forecasting and supply planning (FSP) preparatory phase. It covers the key activities that should be completed, including describing the programme, defining scope, collecting and compiling needed FSP data and assumptions, and obtaining required inputs through targeted consultations and/or an FSP workshop. The chapter is organized into the following sections.

Preparatory phase steps

The output of the preparatory phase will serve as input and influence the quality of the forecast and supply plan. The tasks to be completed during the preparatory phase, including estimated time allocation, are briefly discussed below and in more detail in subsequent sections.

#	Task	Description	Estimated time allocation	Responsible
1	Describe programme and define scope	The FSP team should: – Describe programme background, including historical and current coverage performance, service delivery model, supply chain architecture/design, national immunization partners including donors, financing considerations including past and current funding availability, donor funding requirements and timelines, past programme and supply chain challenges, particular political and service delivery environment, etc. – Describe programme targets, priorities for example, vaccine introduction, forecasting period, products being forecasted, and any foreseen programme and policy changes that can affect the supply and demand for vaccines and other immunization supplies	One day	Chairperson/ secretary of the FSP team
2	Collect, clean, adjust, aggregate and analyse FSP data and assumptions	FSP data and assumptions should cover health and supply chain-related data, as summarized in Table 3.1. All decisions made while completing this step should be documented appropriately, as they will inform discussions during the FSP workshop.	Few days to two weeks	Chairperson/ secretary of the FSP team

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#	Task	Description	Estimated time allocation	Responsible
3	Plan for the FSP consultation meetings and/or workshop	The FSP consultation meetings and/or workshop serves as the platform for the review of historical programme and FSP performance, discussion and ratification of the FSP data and assumptions, and the final forecast and supply. To plan for the consultation meetings the FSP team should: – Articulate the specific objectives of the consultation meetings, including key outputs – Engage the targeted persons and propose a meeting plan – Develop presentations that will inform discussion during the consultation To plan for this workshop, the FSP team should: – Articulate the specific objectives of the workshop, including key outputs – Decide on the type of workshop and participants – Develop the agenda and budget for the workshop – Develop and ensure that invitations are sent to all participants in a timely manner – Confirm the completeness of data, assumptions and analytics, as well as other workshop logistics – Develop presentations and templates that will inform discussion during the workshop	Few days to two weeks	Chairperson/ secretary of the FSP team

The timeline provided is indicative. Countries need to consider their specific context while preparing for FSP.

Table 3.1: FSP data and assumptions

Type of data	#	Data point	Potential source(s)
Programme background data and scope	1.1	**Programme background data**	
	1.1.1	Immunization service delivery model for example description of primary health-care services, community health services, type and distribution of health-care workers and supply chain architecture/ design	Programme strategy documents, key informant interviews
	1.1.2	National immunization partners, including donors	Programme strategy documents, key informant interviews
	1.1.3	Financing considerations, including past and current funding availability, donor funding requirements, and timelines	Budget, donor commitment (decision) letter
	1.1.4	Past programme and supply chain challenges	Supply chain assessment reports, key informant interviews
	1.1.5	Particular political and service delivery environment that can affect immunization service delivery	Programme strategy documents, key informant interviews
	1.1.6	Any foreseen programme and policy changes that can affect the demand and supply for vaccines and other immunization supplies	Programme strategy documents, policy documents, key informant interviews
	1.1.7	Any relevant new products or formulations in the market	Market update reports, key informant interviews
	1.1.8	Seasonality and geographical variation in incidence of specific diseases that may affect demand for vaccine	Programme assessment reports
	1.1.9	Societal and behavioural factors that can affect vaccine uptake, for example HPV vaccine stigma due to misinformation	Epidemiology report, key informant interviews
	1.1.10	Historical coverage	Administrative database, surveys (multiple indicator cluster survey/national immunization coverage survey [MICS/NICS]), standardized monitoring and assessment of relief and transitions (SMART), World Health Organization (WHO) and UNICEF estimates of national infant immunization coverage (WUENIC)
	1.1.11	Historical dropout rate	Administrative database, surveys (MICS/NICS, SMART), WUENIC
	1.2	**Scope**	
	1.2.1	Forecasting period	Programme strategy documents, key informant interviews
	1.2.2	Historical consumption period	Programme strategy documents, key informant interviews
	1.2.3	List of routine immunization antigens	Programme strategy documents
	1.2.4	List of supplementary immunization activities antigen	Programme strategy documents, key informant interviews
	1.2.5	List of antigens for outbreak response	Programme strategy documents, key informant interviews
	1.2.6	List of immunization supplies	Programme strategy documents, key informant interviews
	1.2.7	Vaccine introduction, switch and withdrawal plan	Programme strategy documents, key informant interviews

Type of data	#	Data point	Potential source(s)
Forecasting	2.1	**Demographic**	
	2.1.1	Total population	Population census, United Nations (UN) projection, microplan, geographic information system (GIS) estimate
	2.1.2	Population growth rate	Population census, UN projection, research publications, strategy documents, stakeholders' consensus
	2.1.3	Target population groups	Population census, UN projection, research publications, strategy documents, stakeholders' consensus, campaign plan, zero-dose children report
	2.1.4	Target coverage	Strategy documents, e.g., comprehensive multi-year strategic plan (cMYP), stakeholders' consensus, campaign plan, zero-dose children report
	2.1.5	Target dropout rate	Strategy documents, stakeholders' consensus
	2.1.6	Number of doses per person	Programme/strategy documents, manufacturer
	2.1.7	Wastage rate	Administrative database (LMIS), operational research publication, stakeholders' consensus
	2.2	**Vaccination session:** This forecasting method is to be primarily applied at the health facility or district level. The national level will collate and aggregate lower-level forecasts to obtain the national estimate.	
	2.2.1	Total population	Population census, UN projection, GIS estimate, microplan
	2.2.2	Population growth rate	Population census, UN projection, research publications, strategy documents, stakeholders' consensus
	2.2.3	Target population	Population census, UN projection, GIS estimate, microplan
	2.2.4	Target coverage	Strategy documents, e.g., cMYP, stakeholders' consensus
	2.2.5	Dropout rate	Strategy documents, stakeholders' consensus, reaching every district/reaching every child (RED/REC) books
	2.2.6	Number of doses per person	Programme/strategy documents, manufacturer
	2.2.7	Number of vaccination sessions per period	Programme strategy documents or plans
	2.2.8	Number of weeks per period	Calendar
	2.2.9	Number of weeks an opened multidose vial can be used for subsequent vaccination sessions	Programme policy document, stakeholders' consensus
	2.2.10	Number of doses per vial	Stakeholders' consensus, supplier/manufacturer
	2.2.11	Unopened (closed) vial wastage	Strategy documents, stakeholders' consensus, administrative sources, operational research publication
	2.2.12	Avoidable opened vial wastage	Operational research publication, stakeholders' consensus

Type of data	#	Data point	Potential source(s)
Forecasting	2.3	**Consumption**	
	2.3.1	Historical consumption for the defined review period	Administrative database (LMIS)
	2.3.2	Historical reporting rate for the defined review period	Administrative database (LMIS)
	2.3.3	Historical stock-out days for the defined review period	Administrative database (LMIS)
	2.3.4	Population data	Population census, UN projection, GIS estimate, microplan
	2.3.5	Projected growth rate	Strategy documents, stakeholders' consensus
Supply Planning	3.1	Projected consumption for the remainder of the implementation year	Administrative database (LMIS), FSP report
	3.2	Stock on hand (quantities including expiry dates) as available from the most recent logistics reports	Administrative database (LMIS)
	3.3	Months of stock on hand (expressed as stock on hand divided by average monthly consumption)	Administrative database (LMIS)
	3.4	Shipments in the pipeline (confirmed and unconfirmed orders)	Supply plan, procurement plan
	3.5	Maximum and minimum inventory control level or buffer rates as defined or applied in the national management policy or practice	Programme policy document, supply chain strategy document, supply chain standard operating procedures, stakeholders' consensus
	3.6	Established shipment intervals	Programme strategy document, key informant interviews
	3.7	**Product information**	
	3.7.1	Registration status	National regulatory agency's website or registration status document
	3.7.2	Status on national essential medicines list	National essential medicines list
	3.7.3	Prices	Procurement agent, finance department
	3.7.4	Vial size	Procurement agent/manufacturer
	3.7.5	Number of units per pack size	Procurement agent/manufacturer
	3.8	**Procurement information**	
	3.8.1	Procurement mechanism	Programme strategy document, key informant interviews
	3.8.2	Procurement lead time for each procurement mechanism	Procurement agent
	3.9	**Supplier information**	
	3.9.1	Prices	Supplier
	3.9.2	Packaging information	Supplier
	3.9.3	Lead time	Supplier
	3.9.4	Shipping and handling cost (freight etc.)	Supplier

Type of data	#	Data point	Potential source(s)
Supply Planning	3.10	**Funding information**	
	3.10.1	Funders/sources	Programme strategy document, key informant interviews, donors
	3.10.2	Funding commitment	Budget, donor commitment (decision) letter
	3.10.3	Fund disbursement schedule	Donor commitment (decision) letter
	3.11	**Distribution information**	
	3.11.1	Customs clearance fees including taxes	Programme budget and invoices
	3.11.2	In-country distribution costs	Programme budget and invoices
	3.12	**Storage and other in-country information**	
	3.12.1	In-country storage costs	Programme budget and invoices
	3.12.2	In-country sampling and quality assurance costs	Programme budget and invoices
	3.12.3	Insurance cost	Programme budget and invoices

Collect, clean, adjust, aggregate and analyse forecasting and supply planning data and assumptions

The key considerations for each subactivity are explained in detail below.

1) Collect FSP data and assumptions

#	Consideration	Description	Guidance
1.1	Collect data and assumptions for all forecasting methods	The team should collect data and assumptions for all forecasting methods	These data and assumptions must be collected from established sources, as defined by the programme. Where the data and assumptions for any forecasting method are unavailable, the programme should put necessary measures in place to ensure they are available for subsequent forecasting period.
1.2	Collect data and assumptions for all administrative and/or supply chain levels	The FSP team should collect data and assumptions up to the lowest administrative and/or supply chain level possible, as this is foundational to equity and accurate estimation of commodity requirements.	
1.3	Consider multiple sources for each data point	The FSP team should consider multiple sources for any given data, as this creates an opportunity for triangulation. For example, historical coverage data may be sourced from administrative reports, WUENIC, and coverage survey reports.	The final decision on which data source to use will depend on the quality and reliability of the data from these different sources, among other considerations.
1.4	Collect historical data and futuristic projections	Where applicable, historical performance and futuristic projections are required. The historical performance could help (1) determine how well the programme has performed in the past (see Chapter 9 for details on FSP performance monitoring) and (2) assess how realistic futuristic projections are, and can even inform revisions when considered in combination with other factors that may impact future demand. For example, a review of historical performance can reveal that the best coverage performance over the past five years has been 50%, resulting in the decision that a coverage target of 90% for the forecast year is unrealistic given the planned investments.	When the historical performance is unavailable, the programme should put necessary measures in place to ensure they are available for subsequent FSP period.
1.5	Collect preliminary assumptions when data is unavailable	The FSP team can also work with stakeholders to generate preliminary informed assumptions when the needed data are unavailable.	The preliminary informed assumptions should be discussed and ratified during the FSP consultation meetings and/or workshop.

2) Clean data

As collected data, especially those from administrative sources, may not be error-free, all data should be reviewed for possible errors and cleaned in line with the existing country protocols.

The quality review should establish availability, after which available data should be reviewed for accuracy, completeness, and recency. All observed errors and actions taken, including unresolved issues, should be documented during the quality review process.

Table 3.2 summarizes common quality issues and recommended actions. The list is, however, not exhaustive, and countries may encounter other issues outside the list. It is the responsibility of the FSP team to work with other stakeholders to decide on a course of action in such situations.

Table 3.2: Common quality issues and recommended actions

Type of data	Data	Quality issue	Recommended action
Programme performance, targets, and policy	Historical coverage, dropout rate	Administrative coverage may be inaccurate, e.g., ≥100% coverage due to overreporting of numerator or wrong denominator, negative dropout rate	Consider using alternative sources, e.g., WUENIC estimates and survey results. In doing so, the cohort birth year, rather than the year the survey results were released, should be matched with the appropriate administrative year
			Adjust coverage and/ or dropout rate based on verification factor from data quality assessment (DQA)
	Target coverage and dropout rate	May be unrealistic	Revise based on historical trends and interventions that may impact future demand
	Maximum and minimum inventory control level	No formal policy is in place	Work with stakeholders to come up with an informed assumption
Demographic/morbidity	Total population	Population data from some sources, e.g., population census, may be outdated and not available for all administrative levels	Explore triangulation of projected population census data with data from more recent alternative sources, e.g., aggregated microplan
	Population growth rate	Information may not be available for the lower administrative levels	Use the growth rate for the closest upper administrative level, e.g., the state average can be used for all districts
	Target population	Information on the proportion of the population that falls within a certain age group may be unavailable	Use guesstimate

Type of data	Data	Quality issue	Recommended action
Logistics	Consumption	Data may be unavailable or inaccurate	Consider using issues data from the lowest distribution point
			Consider estimating consumption using opening stock, receipts, and stock balance
	Wastage rate (historical)	Data may be unavailable or inaccurate, e.g., 0% or negative wastage rate for multidose vial	Use data from the most recent wastage study
	Wastage rate (future projection)	May not reflect programme implementation reality	Revise based on WHO wastage calculator projection, wastage rate study findings, or most recent administrative data if of good quality
	LMIS reporting rate	Data may be unavailable	Work with stakeholders to produce a guesstimate
	Stock-out days	Data may be unavailable	Work with stakeholders to produce a guesstimate
	Stock on hand	Data may be unavailable or inaccurate	Conduct physical stock count just before the FSP exercise
			Exclude poor-quality data if quality issues are localized to a level of the supply chain that does not hold a significant volume of stock
Services	Number of children immunized	Administrative data may be inaccurate due to overreporting or underreporting	Use the results of DQA to adjust estimates
			Consider other sources for assumptions that require the use of children immunized, e.g., use the WHO wastage calculator for wastage rate
	Number of active immunization sites	Data may be inaccurate	Work with stakeholders to produce a guesstimate
	Vaccination session frequency	Data may be inaccurate	Work with stakeholders to produce a guesstimate

3) Adjust data

Due to service interruption or stock-out, incompleteness, product switch and programmatic changes, the cleaned data may require adjustment before they are used to inform discussions during the FSP consultation meetings/ workshop and/or generate the final forecast. Table 3.3 shows the possible reasons and formula for adjusting consumption data.

Table 3.3: Possible reasons and formula for adjusting consumption data

#	Possible reason for adjustment	Formula	Comments
1	Stock-out	$\text{Unadjusted consumption} \times \frac{\text{Review period months (or days)}}{\text{Review period months (or days)} - \text{months (or days) of stock-out}}$	Where feasible, the adjustment should be made at the health facility level.
2	Reporting rate	$\text{Unadjusted consumption} \times \frac{100\%}{\text{Reporting rate}}$ Stratified adjustment based on jurisdiction population can be conducted following the steps listed below (see illustrative example): I. Group health facilities by population served II. Estimate reporting rate for each stratum III. Adjust consumption for each stratum (using the formula above) IV. Pool together estimates across all strata	Where feasible, the adjustment should be calculated by stratification, i.e., based on "high", "medium" and "low" consumption facilities, or by jurisdiction populations, and should be adjusted separately, following which the resulting estimates should be pooled together.
3	Potential decrease in wastage	$\text{Unadjusted consumption} \times (100\% - \%\text{ decrease in consumption})$	This could be due to anticipated improvements in product handling practices, such as improved adherence to multidose vial policy by health-care workers, or product changes, such as a switch to a smaller vial size (number of doses/ vial).
4	Potential increase wastage	$\text{Unadjusted consumption} \times (100\% + \%\text{ increase in consumption})$	This could be due to a switch to a bigger vial size (number of doses/vial).

Notes:

- Multiple adjustments may be required, i.e., the FSP may need to be adjusted based on all four reasons provided in Table 3.3.
- The third and fourth adjustments described in Table 3.3. (potential decrease or increase in wastage) are only required for consumption-based forecasting, to ensure that historical trends not expected to extend into the future are duly accounted for.

Illustrative example: Reporting rate adjustment

Consider a hypothetical country with 30 health facilities, 24 of which reported BCG consumption for the month as indicated below (Table 3.4).

Table 3.4: Data for hypothetical country

#	Health facility name	Catchment population	Reported (yes/no)	BCG consumption (doses)
1	A	1,000	Yes	1,800
2	C	800	Yes	1,440
3	N	1,650	Yes	2,970
4	O	1,920	Yes	3,460
5	P	1,800	Yes	3,240
6	Q	1,320	Yes	2,380
7	D	850	No	-
8	Z	2,020	Yes	3,640
9	A1	2,023	Yes	3,650
10	F	980	Yes	1,770
11	G	840	No	-
12	H	650	Yes	1,170
13	I	999	Yes	1,800
14	J	899	No	-
15	K	1,999	Yes	3,600
16	M	1,500	No	-
17	R	1,400	Yes	2,520
18	S	1,450	Yes	2,610
19	T	1,620	Yes	2,920
20	U	2,001	Yes	3,610
21	V	2,500	Yes	4,500
22	E	920	Yes	1,660
23	W	3,000	Yes	5,400
24	X	2,120	No	-
25	Y	2,300	Yes	4,140
26	B	900	Yes	1,620
27	B2	2,400	No	-
28	L	1,200	Yes	2,160
29	C3	2,700	Yes	4,860
30	D4	2,800	Yes	5,040

Calculate adjusted consumption:

1: without stratification
2: with stratification based on the catchment population categorization indicated below

Category	Catchment population
Low	≤1,000
Medium	>1,000, ≤2,000
High	>2,000

Solution 1: Adjusted consumption without stratification

Formula

$$\text{Unadjusted consumption} \times \frac{100\%}{\text{reporting rate}}$$

Unadjusted consumption = sum of all reported consumption = 71, 960 doses

$$\text{Reporting rate} = \frac{\text{Total number of reports received}}{\text{Total number of reports expected}} \times 100\% =$$

$$\frac{24}{30} \times 100\% = 80\%$$

Adjusted consumption =

$$71{,}960 \times \frac{100\%}{80\%} = 89{,}950 \text{ doses}$$

Solution 2: Adjusted consumption with stratification

I. Group health facilities by population served (see the category column in Table 3.5)
Based on the agreed categorization, there are 10 health facilities each in low, medium and high categories.

II. Estimate reporting rate for each stratum

Formula

$$\text{Reporting rate} = \frac{\text{Total number of reports received}}{\text{Total number of reports expected}} \times 100\%$$

As shown in the table below, the reporting rates for low, medium and high categories are 70 per cent, 90 per cent and 80 per cent respectively.

III. Adjust consumption for each stratum

Formula

$$\text{Unadjusted consumption} \times \frac{100\%}{\text{Reporting rate}}$$

Where unadjusted consumption = sum of all reported consumption for each stratum

Adjusted consumption is 16,086, 28,733 and 43,550 for low, medium and high categories respectively.

IV. Pool together estimates across all strata i.e., sum of all adjusted consumption for each stratum

Adjusted consumption for the country =
16,086 + 28,733 + 43,550 = 88,369 doses

Table 3.5: Solution: Adjusted consumption with stratification

#	Health facility name	Catchment population	Category	Reported (yes/no)	BCG consumption (doses)	Reporting rate by stratum	Unadjusted consumption by stratum	Adjusted consumption by stratum	Adjusted consumption for the country
1	H	650	Low	Yes	1,170	70%	11,260	16,086	(16,086 + 28,733 + 43,550) = 88,369
2	C	800	Low	Yes	1,440				
3	G	840	Low	No	-				
4	D	850	Low	No	-				
5	J	899	Low	No	-				
6	B	900	Low	Yes	1,620				
7	E	920	Low	Yes	1,660				
8	F	980	Low	Yes	1,770				
9	I	999	Low	Yes	1,800				
10	A	1,000	Low	Yes	1,800				
11	L	1,200	Medium	Yes	2,160	90%	25,860	28,733	
12	Q	1,320	Medium	Yes	2,380				
13	R	1,400	Medium	Yes	2,520				
14	S	1,450	Medium	Yes	2,610				
15	M	1,500	Medium	No	-				
16	T	1,620	Medium	Yes	2,920				
17	N	1,650	Medium	Yes	2,970				
18	P	1,800	Medium	Yes	3,240				
19	O	1,920	Medium	Yes	3,460				
20	K	1,999	Medium	Yes	3,600				
21	U	2,001	High	Yes	3,610	80%	34,840	43,550	
22	Z	2,020	High	Yes	3,640				
23	A1	2,023	High	Yes	3,650				
24	X	2,120	High	No	-				
25	Y	2,300	High	Yes	4,140				
26	B2	2,400	High	No	-				
27	V	2,500	High	Yes	4,500				
28	C3	2,700	High	Yes	4,860				
29	D4	2,800	High	Yes	5,040				
30	W	3,000	High	Yes	5,400				

Note: There is a difference between the unstratified and stratified adjusted consumption (89,950 doses versus 88,369 doses). Where possible, stratified adjustment should be conducted, as it will be more accurate, given that it considers the variation in the population served by health facilities.

4) Aggregate data

Following data collection, cleaning, quality review and adjustment, the data can then be aggregated in preparation for analysis. The aggregation level will depend on the forecasting approach, i.e., single national forecast versus stratified/disaggregated forecast by region (see the subsections on equity and zero-dose considerations and disaggregated forecasting).

5) Prepare FSP data and assumptions and conduct a preliminary analysis

At this stage, the aggregated data and assumptions are presented in a format that can facilitate discussions at the FSP workshop. This will include conducting a preliminary analysis to show historical programme performance as a means of establishing how realistic programme targets are. The type of analytics can include:

- Coverage and dropout rate trend
- Consumption trend
- Historical forecast and supply plan accuracy

For equity reasons, the analysis should include subnational performance to detect any significant variations.

Considerations for ensuring equity, reaching zero-dose children, and stratified forecasting and supply planning

Equity and zero-dose considerations

The FSP team should consider equity and strategies for reaching zero-dose children, which should be informed by the existing country strategy and/or discussions during the FSP consultations/workshop. The factors discussed below can guide the team's discussion.

- **Variation in subnational coverage and dropout rate:** This is important in establishing the magnitude of inequity and which regions are most affected. The country can set separate targets for different areas based on historical performance and planned interventions with this information. For example, following the review of subnational coverage and discussions on the potential impact of planned interventions, a country may decide on four categories, as shown below, to facilitate stratified forecasting.

Category	Historical coverage	Target coverage
1	≤30%	50%
2	>30 – ≤50%	80%
3	>50 – ≤80%	90%
4	>80%	99%

- Subnational geographical characteristics, including distances to the last distribution point and climate considerations, are equally important.
- **Representativeness of population figures:** One reason for the inability to reach zero-dose children is the lack of their inclusion in the population estimate used for FSP. The FSP team should therefore attempt to establish whether the population estimate considers these children. This could mean triangulating data from the population census with an aggregated microplan or other sources, and making necessary adjustments. Alternatively, the team may want to ascertain whether the buffer stock will be sufficient to accommodate the vaccine requirement of this population. If the buffer stock is considered insufficient, the team may, at this point, decide to increase it for the affected regions, while considering available storage capacity.
- **Seasonal variability in demand:** In some countries' contexts, one reason for poor forecast accuracy is the lack of consideration of possible seasonal variation in demand. Countries should therefore take into account this variation when setting forecasting parameters (e.g., target population, dropout rate) or choosing forecasting approach. For example, this can be important for countries with seasonal cross-border migration (e.g., nomadic pastoralists) or seasonal conditions (e.g., rainy season) that can impact the likelihood of caregivers accessing immunization services at certain periods of the year.

— **Planned interventions**
Planned interventions for addressing the underlying causes of inequitable coverage should also be considered while compiling FSP inputs. For example, the country may decide that a switch to a smaller dose vial or an increase in allowable wastage rate will be the supply-side intervention to address missed opportunities for vaccination due to health workers' reluctance to open a multidose vial in certain regions. In other instances, it could be a change in vaccination session frequency. These interventions have implications for FSP and must be considered while collating data and assumptions.

Stratified forecasting and supply planning

Stratified FSP helps countries develop more accurate forecast and supply plans, and should be considered when there is significant subnational variation in coverage performance. This will involve setting different targets for different regions and deploying targeted interventions that can affect commodity needs. The FSP inputs should be compiled in a format that aligns with the agreed-upon categorization and planned interventions. For example, a country that chooses four categorizations for demographic/wastage factor-based forecasting should have assumptions stratified by categories, as shown below.

	Region One	Region Two	Region Three	Region Four
Target population (TP)	TP_1	TP_2	TP_3	TP_4
Target coverage (TCov)	$TCov_1$	$TCov_2$	$TCov_3$	$TCov_4$
Target dropout rate (TDpr)	$TDpr_1$	$TDpr_2$	$TDpr_3$	$TDpr_4$
Wastage rate (WR)	WR_1	WR_2	WR_3	WR_4
Buffer rate (BR)	BR_1	BR_2	BR_3	BR_4

Plan for the forecasting and supply planning consultation meetings and/or workshop

The last FSP preparatory activity is planning for FSP consultation meetings and/or workshop. The FSP consultation meetings and/or workshop can serve as the platform for (1) reviewing the historical programme and FSP performance, (2) discussion and ratification of data and assumptions, including adjustments where applicable, (3) development of a forecast and supply plan, and (4) development of recommendations to facilitate operationalization and improvement of FSP performance.

Forecasting and supply planning consultation meetings

The FSP consultation meetings target individuals with some specific skills and expertise that are not available within the FSP team. To prepare for the FSP consultation meetings, the FSP team should accomplish the following tasks.

#	Task	Description
1	Articulate the specific objectives of the consultation meetings, including key outputs	The specific objectives should be clearly articulated before the consultation meeting. Also, the team should be clear on the key outputs from the consultation.
2	Engage the targeted persons and propose a meeting plan	Efforts should also be made to ensure that the targeted persons are engaged well ahead of time, including proposing possible meeting dates and key discussion points.
3	Develop presentations that will inform discussion during the consultation	Presentations that will inform discussions during the consultation meeting should be developed by the FSP team.

Forecasting and supply planning workshop

In addition, or as an alternative to the consultation meetings, the FSP team can organize an FSP workshop. Participants at this workshop should include a diverse group of stakeholders involved in programme planning and implementation. To prepare for the FSP workshop, the FSP team should accomplish the following tasks.

#	Task	Description
1	Articulate the specific objectives of the workshop, including key outputs	The specific objectives of the FSP workshop should be clearly articulated during the preparatory phase. Also, the team should be clear on the key outputs from the workshop.
2	Decide on the type of workshop and participants	Based on the prevailing situation and available funding, the team should decide whether the FSP workshop will be in-person, virtual or hybrid. Also, the team should develop and finalize a participants list.
3	Develop agenda and budget for the workshop	This should detail the various sessions that will be held, time allotment, facilitator, and key output from each session. The unit responsible for overseeing the activity of the FSP team is expected to review and approve the final copy of the agenda. Where applicable, the team should also develop and obtain approval for the workshop budget.
4	Develop and ensure that invitations are sent to all participants in a timely manner	Invitations for this workshop should be sent out on time, considering the time needed for administrative approval. Efforts should also be made to ensure that the invitations are shared with the appropriate contact point responsible for approving participation. Also, the team should follow up to confirm receipt of the invitation and, more importantly, confirm attendance ahead of the workshop. Apart from clearly stating the date(s) and venue of the workshop, the invitation should also be clear on the roles of invitees during the workshop. An example will be a specific presentation or facilitation role.
5	Confirm completeness of data, assumptions and analytics, as well as other workshop logistics	The FSP team must ensure that the key data, assumptions, and analytics needed for informed discussions are ready ahead of the workshop (see Annex 1). Also, the FSP team should ensure that tools for FSP are in place. All necessary logistics for the workshop, such as venue, presentation aid and refreshment arrangements, should also be confirmed.
6	Develop presentations that will inform discussion during the workshop	Presentations that will inform discussions in the FSP workshop should be developed by the FSP team. Also, templates for reporting and documenting resolutions from the workshop should be created.

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Key takeaways

- **Planning for FSP should be led by the FSP team**, while reporting to the government entity responsible for leadership oversight.
- During the preparatory phase, **the FSP team should prepare data, assumptions and analytics for the FSP workshop/ consultation meetings**.
- **Countries can organize an FSP workshop in addition** to, or as an alternative to, the consultation meetings.
- In collating data and assumptions, the **FSP team should ensure that equity and strategies for reaching zero-dose children are considered**.
- By the time planning for the FSP workshop is completed, **all the inputs needed to make informed decisions during the FSP workshop/consultation meetings should be ready**.

August 2023

Estimating forecast for vaccines and immunization supplies

Chapter

4

Guidance Manual on Forecasting and Supply Planning

for Vaccines and other Immunization Supplies

unicef

for every child

Contents

Estimating forecast for vaccines and immunization supplies

This guidance manual provides an overview of the various forecasting methods, including the steps involved in implementing each method. Examples illustrating how each method can be applied are also provided. The chapter is organized into the following sections.

Overview of forecasting

Forecasting is 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 adjusted demographic, health services utilization and logistics data. The output of this process is the estimated projected consumption. This output is used as an input into supply plans. One key activity during the forecasting phase is for relevant stakeholders to discuss and ratify forecasting data and assumptions. Depending on the type and quality of available data, three major methods can be used as explained briefly below.

Method	Description	Guidance
Demographic/ wastage factor	This method uses demand (based on demographic information, programme target and immunization schedule) and allowable wastage to estimate future consumption.	Depending on the age or recency of the data, programmes should explore triangulation of projected population census data with data from more recent alternative sources, e.g., aggregated microplan.
Vaccination session	Future consumption is estimated using estimated demand and vaccination session characteristics, including planned sessions, prevailing multidose vial policy, and expected closed and avoidable open vial wastage.	This method is only recommended at the health facility level, and the FSP team is expected to collate all estimates at the national level.
Consumption	The past consumption trend is used to predict future consumption. Forecasting using this method can vary from a simple adjustment of past consumption by an agreed growth factor to more sophisticated modelling techniques. Ideally, wastages are included in the consumption data.	This method is only suitable for programmes with reliable consumption data; adjustments can be made for stock-outs and reporting rates.

Depending on the capacity of country personnel, programme managers can use various tools that range from simple Microsoft Excel, to more sophisticated software using the three methods described above.

Additional trend analysis approaches or models

With consumption data, various trend analysis models can be used to determine forecasts. Below is a list of methods:

- **Linear regression** assumes a linear relationship and estimates future consumption based on a linear trend. This approach is not suitable for non-linear or seasonal data.
- **Moving average** relies on the use of averages of past consumption to estimate future consumption.
- **Weighted average** is an extension of moving average that ascribes more weight to recent historical data than to less recent data.
- **Exponential smoothing** uses a weighted average of past observations with the weights decreasing exponentially as the observations become older. This helps to capture the trend and seasonality patterns in the data and produce a forecast that is updated as new observations become available.
- **Autoregressive integrated moving average (ARIMA)** uses a combination of autoregressive (current values depend on or are correlated to values in the past) and moving average models to estimate future consumption.

Forecasting using these modelling approaches is better done using forecasting software, but can be done in Microsoft Excel, although this can be time-consuming. Some of the available software allows programmes to forecast using multiple methods, following which the "most representative forecast" can be chosen by reviewing forecast errors.

Stratified forecasting

Stratified forecasting helps countries to develop more accurate forecasts, and should be considered when there is significant subnational variation in coverage performance, geographic and population characteristics, and planned interventions. This forecasting approach involves generating forecast estimates for the different strata (based on predetermined parameters), which are later combined to give the national estimate.

Forecasting for epidemics, pandemics and new programmes

Forecasting for epidemics, pandemics and new programmes present unique challenges as there are usually no historical programme, service and consumption data. The forecasting process is therefore heavily reliant on demographic and epidemiological data. As epidemics and pandemics usually evolve rapidly, assumptions can easily become obsolete. Similarly, uptake of new programmes may not align with earlier projections. More frequent monitoring and review of assumptions where indicated is therefore critical to ensure that projections align with evolving needs.

Forecasting steps

#	Task	Description	Guidance	Responsible
1	Review, ratify and collate forecasting data and assumptions	During the forecasting and supply planning (FSP) consultations and/or workshop: – The FSP team should present the forecasting data and assumptions, as well as associated analyses. – Stakeholders should review and ratify all forecasting data and assumptions, as well as associated analyses. – The FSP team should implement the ratified changes to the data and assumptions. – The FSP team should then collate ratified forecasting data assumptions. This should cover the entire forecasting period and minimum data requirements for each forecasting method (Table 4.1) and should be stratified when stratified forecasting approach is being used.	The presentation by the FSP team should cover the type of data, source of data, quality considerations (availability, recency) and related analyses. When reviewing, the FSP team should suggest solution(s) to any issue related to the data and associated analyses. For example, when essential data is missing or of questionable quality, the team should formulate and agree on assumptions on future programme performance.	FSP team
2	Decide on forecasting method	Based on the available data and assumptions, a decision on which forecasting method(s) and tool(s) to apply should be made.	It is recommended to use multiple forecasting methods.	FSP team
3	Estimate forecast	To estimate a forecast, the forecasting data and assumptions are entered into relevant tools to determine the product quantities based on agreed method(s).	Depending on the capacity of forecasting stakeholders, the FSP team can use various tools that range from simple Microsoft Excel, to more sophisticated software.	FSP team
4	Select or combine forecasts	When multiple methods are used, forecasting stakeholders should decide on the 'final' estimate, considering the quality of the data that have informed each forecasting method, current and future programme performance, the country's political economic outlook, and other events that can have an impact future consumption or service utilization. The final decision could be any of the following: – Select a forecast that is based on a single (one) method – Combine forecasts from multiple (two or more) methods using equal weighting – Combine forecasts from multiple (two or more) methods using different weighting	This step does not apply when only one forecasting method is used (though this is not recommended), as there is only one estimate.	FSP team

Table 4.1: Minimum data requirements

Forecasting

Demographic	Vaccination session	Consumption
Target population+	Target population	Historical consumption
Target coverage	Target coverage	Historical reporting rate per stratification*
Dropout rate	Dropout rate	Historical stock-out days per stratification*
Number of doses per person	Number of doses per person	Population data*
Wastage rate	Number of vaccination sessions per period	Projected growth rate
	Number of weeks per period	
	Number of doses per vial	
	Number of weeks of reuse for opened multidose vial	
	Number of supply chain levels	
	Closed vial wastage	
	Avoidable opened vial wastage	

Some of the data are required for individual product.

+ Usually estimated as a percentage of the total population, i.e., the total population multiplied by A%, where A% represents the proportion of the total population that is eligible for the vaccine.

* Required for adjustment of historical consumption where indicated.

Forecasting formula and illustrative examples

I. Demographic/wastage factor method

Formula

The general formula for forecasting using the demographic method is:

Target population × coverage × number of doses per fully immunized person (FIP) × wastage factor

Where wastage factor = $\frac{100\%}{100\% - \text{wastage rate}}$

Target population is usually estimated as a percentage of the total population.

The formula above assumes there is no dropout for vaccines requiring multiple dosing. When dropout is being considered, an alternative formula can be used:

Target population × sum of coverage for all doses in the schedule × wastage factor

The first three parameters of the formula (target population × coverage × number of doses per FIP) estimate demand, i.e., the number of doses to be administered, while forecasted consumption is calculated by adjusting this demand by wastage factor, since some level of wastage is expected partly because most of the vaccines used in the immunization programme are multidose, and some may have to be discarded at the end of the immunization session or within six hours, whichever comes first.

Illustrative example 1

The following example covers demography/wastage factor-based forecasting when there is no significant subnational variation in coverage (single national forecast). Two scenarios, with and without dropout, are considered.

Case description

Country A, with a projected total population of 212.5 million, plans to forecast for pentavalent vaccine for the upcoming year. Only children under 1 year of age are eligible for this vaccine, representing 4 per cent of the total population. Three doses of pentavalent vaccine are required to immunize each child fully, and the country expects a wastage rate of 25 per cent for the preferred 10-dose vial.

For **scenario 1**, the country assumed that 90 per cent of eligible children would receive all three doses, i.e., no dropout. However, for **scenario 2**, the country assumed that 5 per cent of children that receive the first dose would not get the second dose, while 9 per cent of those that receive the first dose would not get the third dose.

Assumptions

The assumptions for these two scenarios are summarized in Table 4.2.

Table 4.2: Summary of assumptions

Forecasting assumptions	Scenario 1	Scenario 2
Total population	212,500,000	212,500,000
Proportion of total population eligible	4%	4%
Target coverage – first dose	90%	90%
Target dropout rate – first to second	0%	5%
Target dropout rate – first to third	0%	9%
Number of doses per fully immunized child	3	3
Wastage rate	25%	25%

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Solution: Unstratified forecasting

Steps	Description	Formula		Scenario 1 – no dropout	Scenario 2 – dropout considered
1	Estimate target population	**Total population × proportion of total population eligible**		212,500,000 × 4% = 8,500,000	212,500,000 × 4% = 8,500,000
2	Determine target coverage for each dose	**Target coverage (2nd and 3rd doses) = first dose coverage × (100% – dropout rate)**	1st dose	90%	90%
			2nd dose	90%	90% × 95% = 85.5%
			3rd dose	90%	90% × 91% = 81.9%
3	Estimate demand	**Target population × target coverage**	1st dose	8,500,000 × 90% = 7,650,000	8,500,000 × 90% = 7,650,000
			2nd dose	8,500,000 × 90% = 7,650,000	8,500,000 × 85.5% = 7,267,500
			3rd dose	8,500,000 × 90% = 7,650,000	8,500,000 × 81.9% = 6,961,500
			Total	22,950,000	21,879,000
4	Estimate wastage factor	$\frac{100\%}{100\% - \text{wastage rate}}$		$\frac{100\%}{100\% - 25\%} = 1.33$	$\frac{100\%}{100\% - 25\%} = 1.33$
5	Estimate forecast	**Demand × wastage factor**		22,950,000 × 1.33 = 30,523,500	21,879,000 × 1.33 = 29,099,070

Illustrative example 2

The example below illustrates demography/wastage factor-based forecasting when there is significant subnational variation in coverage (stratified forecasting). Two scenarios, with and without dropout, are considered.

Case description

Country Y, with a projected total population of 212.5 million, plans to forecast for pentavalent vaccine for the upcoming year. However, due to significant subnational variation in coverage, the country has different coverage targets for different regions. Similarly, the expected wastage rate varies across regions for their preferred 10-dose vial. Only children under 1 year of age are eligible for this vaccine, representing 4 per cent of the total population across regions. Three doses of pentavalent vaccine are required to immunize each child fully.

For scenario 1, the country assumed that there would be no dropout (Table 4.3). However, for scenario 2, the country assumed that some children who received the first dose would miss their second and third doses (Table 4.4).

Table 4.3: Data/assumptions, no dropout

Forecasting assumptions	Region 1	Region 2	Region 3	Region 4
Total population	63,750,000	74,375,000	42,500,000	31,875,000
Proportion of total population eligible	4%	4%	4%	4%
Target coverage – first dose	95%	80%	70%	50%
Target dropout rate – first to second	0%	0%	0%	0%
Target dropout rate – first to third	0%	0%	0%	0%
Number of doses per fully immunized child	3	3	3	3
Wastage rate	15%	20%	25%	30%

Table 4.4: Data/assumptions, dropout considered

Forecasting assumptions	Region 1	Region 2	Region 3	Region 4
Total population	63,750,000	74,375,000	42,500,000	31,875,000
Proportion of total population eligible	4%	4%	4%	4%
Target coverage – first dose	95%	80%	70%	50%
Target dropout rate – first to second	4%	5%	6%	7%
Target dropout rate – first to third	6%	7%	8%	9%
Number of doses per fully immunized child	3	3	3	3
Wastage rate	15%	20%	25%	30%

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Solution: Stratified forecasting, no dropout

Steps	Description	Formula		Region 1	Region 2	Region 3	Region 4
1	Estimate target population	**Total population × proportion of total population eligible**		63,750,000 × 4% = 2,550,000	74,375,000 × 4% = 2,975,000	42,500,000 × 4% = 1,700,000	31,875,000 × 4% = 1,275,000
2	Determine target coverage for each dose	**Target coverage (2nd and 3rd doses) = first dose coverage × (100% — dropout rate)**	1st dose	95%	80%	70%	50%
			2nd dose	95%	80%	70%	50%
			3rd dose	95%	80%	70%	50%
3	Estimate demand	**Target population × target coverage**	1st dose	2,550,000 × 95% = 2,422,500	2,975,000 × 80% = 2,380,000	1,700,000 × 70% = 1,190,000	1,275,000 × 50% = 637,500
			2nd dose	2,550,000 × 95% = 2,422,500	2,975,000 × 80% = 2,380,000	1,700,000 × 70% = 1,190,000	1,275,000 × 50% = 637,500
			3rd dose	2,550,000 × 95% = 2,422,500	2,975,000 × 80% = 2,380,000	1,700,000 × 70% = 1,190,000	1,275,000 × 50% = 637,500
			Total	7,267,500[a]	7,140,000[a]	3,570,000	1,912,500
4	Estimate wastage factor	$\frac{100\%}{100\% - \text{wastage rate}}$		$\frac{100\%}{100\% - 15\%} = 1.18$	$\frac{100\%}{100\% - 20\%} = 1.25$	$\frac{100\%}{100\% - 25\%} = 1.33$	$\frac{100\%}{100\% - 30\%} = 1.43$
5	Estimate forecast	**Demand × wastage factor**		7,267,500 × 1.18 = 8,575,650[a]	7,140,000 × 1.25 = 8,925,000[a]	3,570,000 × 1.33 = 4,748,100[a]	1,912,500 × 1.43 = 2,734,875[a]
6	Combine forecast	**Region 1 + region 2 + region 3 + region 4**		~24,983,630			

[a] Rounded up to the nearest vial size

Solution: Stratified forecasting, dropout considered

Steps	Description	Formula		Region 1	Region 2	Region 3	Region 4
1	Estimate target population	Total population × proportion of total population eligible		63,750,000 × 4% = 2,550,000	74,375,000 × 4% = 2,975,000	42,500,000 × 4% = 1,700,000	31,875,000 × 4% = 1,275,000
2	Determine target coverage for each dose	Target coverage (2nd and 3rd doses) = first dose coverage × (100% – dropout rate)	1st dose	95%	80%	70%	50%
			2nd dose	96% × 95% = 91.2%	95% × 80% = 76.0%	94% × 70% = 65.8%	93% × 50% = 46.5%
			3rd dose	94% × 95% = 89.3%	93% × 80% = 74.4%	92% × 70% = 64.4%	91% × 50% = 45.5%
3	Estimate demand	Target population × target coverage	1st dose	2,550,000 × 95% = 2,422,500	2,975,000 × 80% = 2,380,000	1,700,000 × 70% = 1,190,000	1,275,000 × 50% = 637,500
			2nd dose	2,550,000 × 91.2% = 2,325,600	2,975,000 × 76% = 2,261,000	1,700,000 × 65.8% = 1,118,600	1,275,000 × 46.5% = 592,875
			3rd dose	2,550,000 × 89.3% = 2,277,150	2,975,000 × 74.4% = 2,213,400	1,700,000 × 64.4% = 1,094,800	1,275,000 × 45.5% = 580,125
			Total	7,025,250	6,854,400	3,403,400	1,810,500
4	Estimate wastage factor	$\frac{100\%}{100\% - \text{wastage rate}}$		$\frac{100\%}{100\% - 15\%} = 1.18$	$\frac{100\%}{100\% - 20\%} = 1.25$	$\frac{100\%}{100\% - 25\%} = 1.33$	$\frac{100\%}{100\% - 30\%} = 1.43$
5	Estimate forecast	Demand × wastage factor		7,025,250 × 1.18 = 8,289,795	6,854,400 × 1.25 = 8,568,000	3,403,400 × 1.33 = 4,526,522	1,810,500 × 1.43 = 2,589,015
6	Combine forecast	Region 1 + region 2 + region 3 + region 4		~23,973,340			

~ Rounded up to the nearest vial size

II. Vaccination session-based method

For this method, the FSP team only needs to collate and sum up all vaccination session-based forecasts across all health facilities/districts in the country. The World Health Organization (WHO) provides detailed guidance on how to estimate forecast using this approach.

III. Consumption

The calculation steps involved in estimating forecast using this consumption-based approach are summarized as follows.

Step	Action		Formula	Comments
1	Collate (monthly) consumption		Not applicable	
2	Adjust (monthly) consumption if required		Chapter 3 (Table 3.3) provides the formula for these adjustments.	Since the consumption-based method uses historical performance to predict the future, it is important to adjust consumption for stock-out, incomplete logistics management information system (LMIS) reporting, avoidable losses, and other anticipated programmatic changes, for example change in vial size or improvement in health-care workers' practices, such as improved adherence to multidose vial policy. Doing this will help prevent underestimation of forecast and, in some cases, reinforcement of health-care workers' poor practices.
3	Calculate (adjusted) average monthly consumption		$\frac{\text{Total (adjusted) consumption for the review period}}{\textit{Number of months in review period}}$	
4	Project future consumption by applying growth rate(s)	Monthly	Fully adjusted AMC × (100% + projected growth rate)	This step involves projecting futuristic consumption by considering the expected increase in programme performance. Population growth and anticipated improvement in programme performance should be considered.
		Annual	Monthly forecast × 12	

Notes:

- For multiyear forecasting, apply the expected year-on-year growth rate.
- More sophisticated modelling techniques are available for consumption-based forecasting. The adjustments described may still be required when using these modelling techniques.

Illustrative example 3 – forecasting using the consumption method

Country F plans to forecast the pentavalent vaccine requirement for the upcoming year using historical consumption. From the available LMIS data, 30 million vaccine doses were consumed in the last 12 months. On average, the programme has access to LMIS reports from 80 per cent of the health facilities in the country, while there was stock-out for an average of 20 days in the year. Stakeholders projected that 5 per cent of the pentavalent vaccine consumption in the prior year was due to poor adherence to multidose vial policy and heat damage due to the untimely activation of the contingency plan at the central warehouse. The country expects an improvement in compliance with the policy in the coming year, as health-care workers were recently trained. At the same time, on-site mentoring and adherence monitoring are now prioritized during routine supportive supervision. Measures have also been put in place to ensure prompt activation of the contingency plan at the central store. The programme anticipates a 5 per cent growth in programme performance in the upcoming year.

Step	Action		Formula	Result	Comments
1	Collate historical consumption data		N/A	30,000,000	
2	Adjust consumption for*	Stock-out	$\textit{Unadjusted consp.} \times \frac{\text{Review period months}}{\textit{Review period months – months of stock-out}}$	$30{,}000{,}000 \times \frac{12}{12 - 0.66}$ = 31,746,031.75 *Assumes an average of 30.5 days per month	Assumes the consumption during the stock-out period is the same as the period when the stock was available
		Reporting rate	$\textit{Partially adjusted consp.} \times \frac{100\%}{\textit{Reporting rate}}$	$31{,}746{,}031.75 \times \frac{100\%}{80\%}$ = 39,682,539.68	Assumes consumption in reporting and non-reporting health facilities are the same
		Potential decrease in avoidable wastage	$\textit{Partially adjusted consp.} \times \textit{(100\% – \% decrease in consp.)}$	39,682,539.68 × (100% – 5%) = 37,698,412.70	
3	Calculate adjusted average monthly consumption (AMC)		$\frac{\text{Total (adjusted) consumption for the review period}}{\textit{Number of months in review period}}$	$\frac{37{,}698{,}412.70}{12}$ = 3,141,534.39	
4	Project future consumption by applying growth rate(s)	Monthly	Fully adjusted AMC × (100% + projected growth rate)	3,141,534.39 × (100% + 5%) = 3,298,611.11	Consider population growth and anticipated improvement in programme performance
		Annual	Monthly forecast × 12	3,298,611.11 × 12 = ~39,583,340	

Notes: consp. = consumption

* Adjustment in this example was done for a year at once. Adjustment can be conducted for individual months and, where feasible, could also be stratified (see Chapter 3, for example).

IV. Select or combine forecasts

When multiple methods are used, programmes will need to decide on the 'final' estimate considering the quality of the data that informed each forecasting method, stakeholders' confidence in the various approaches, and how well forecast estimates align with historical consumption patterns (where available) and anticipated programme growth, including historical consumption and expected programme performance. The possible considerations and final decisions are reflected in illustrative example 4.

Illustrative example 4 – select or combine forecasts

The annual pentavalent vaccine forecast for countries A, B and C using three different methods is shown below. Assume the three countries have the same forecast for each method.

Forecasting method	Forecast in doses
Demography/wastage factor	35,000,000
Vaccination session	40,000,000
Consumption	45,000,000

If the following details reflect country stakeholders' appraisal of each method, determine the possible decision(s) of stakeholders and the final forecast for each country.

Method	Methods appraisal
Country A	– The data used for demography/wastage factor-based forecasting is reliable. – Vaccination session and consumption data are of poor quality.
Country B	There is reasonable confidence in the data that informed the three methods.
Country C	– The data that informed the demographic and vaccination session-based forecasting are of reasonably good quality. However, the team has more confidence in the demographic/wastage factor method. – The quality of consumption data is poor.

Possible decisions

Country	Decision			Comment
	Decision type	Method(s) chosen	Final forecast	
Country A	Choose one forecast	Demography/wastage factor	35 million	
Country B	Combine forecasts from different methods (equal weighting)	– Demography/ wastage factor – Vaccination session – Consumption	(35 million + 40 million + 45 million) / 3 = 40 million	Choosing any of the three forecasts will also be appropriate
Country C	Combine forecasts from different methods (different weighting)	– Demography/ wastage factor – Vaccination session	If the team assigns a weight of 0.6 to the demography/wastage factor forecast and 0.4 to the vaccination session forecast, the final forecast will be (35 million × 0.6) + (40 million × 0.4) = 37 million	The weight assigned in this example is for illustration. Stakeholders' informed opinions should inform the final weight.

V. Forecasting for auto-disable syringes, reconstitution syringes and safety boxes

a. Auto-disable syringes

This only applies to vaccines that require auto-disable syringes for administration. The forecast discounts open vial wastage, as an auto-disable syringe is not required for vaccines that are not administered, i.e., discarded.

General formula

Number of auto-disable syringes per vaccine =

Demand × anticipated wastage factor (for auto-disable syringes)

When determining the requirements for multiple vaccines requiring auto-disable syringes of the same size, the calculation steps are:

1. Estimate the number of auto-disable syringes per vaccine
2. Add up the estimated same-size auto-disable syringes for all vaccines in the immunization schedule

Note: Different vaccines may require different sizes of auto-disable syringes.

b. Reconstitution syringes

Reconstitution syringes are only required for vaccines that require reconstitution.

General formula

$$\text{Number of reconstitution syringes} = \frac{\text{Forecast}}{\text{Number of doses per vial}} \times \text{wastage factor}^*$$

*wastage factor for reconstitution syringes

When determining the requirements for multiple vaccines requiring reconstitution syringes of the same, the calculation steps are:

1. Estimate the number of reconstitution syringes per vaccine
2. Add up the estimated same-size reconstitution syringes for all vaccines in the immunization schedule

Note: Different vaccines may require different sizes of reconstitution syringes.

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c. Safety boxes
Safety boxes are required for the safe disposal of auto-disable syringes and reconstitution syringes.

Formula

$$\frac{\text{Total autodisable syringe units} + \text{total reconstitution syringe units}}{\text{Maximum units allowed per box}} \times \text{wastage factor*}$$

*wastage factor for safety boxes

Notes:

- Countries may choose not to fill safety boxes to maximum capacity.
- A 10 per cent wastage rate assumption is considered sufficient if there is no country data to inform the wastage rate for auto-disable syringes, reconstitution syringes and safety boxes.
- When a consumption-based method is used, the historical trend can be applied to predict future immunization supply consumption. However, adjustments for stock-out and reporting rate may still be required.

Illustrative example 5 – forecasting for auto-disable syringes, reconstitution syringes and safety boxes

Using the assumptions provided in Table 4.5, estimate the total number of auto-disable syringes, reconstitution syringes and safety boxes required by country Y. Assume the two vaccines require the same size of auto-disable syringe and only vaccine A requires reconstitution.

Table 4.5: Assumptions for auto-disable syringes, reconstitution syringes and safety boxes

Assumptions	Vaccine A	Vaccine B
Total population	212,500,000	212,500,000
Proportion of total population eligible	4%	4%
Target coverage (doses 1, 2 and 3)	90%	90%
Number of doses per FIP	1	3
Vaccine wastage rate	40%	40%
Vial size (number of doses per vial)	10	10
Anticipated wastage rate for auto-disable syringes, reconstitution syringes and safety boxes	10%	10%
Maximum number of syringes allowed per safety box	100	

Solution: Auto-disable syringes

Steps	Description	Formula	Vaccine A	Vaccine B
1	Estimate vaccine demand	**Total population × proportion of total population eligible × coverage × number of doses per FIP**	212,500,000 × 4% × 90% × 1 = 7,650,000	212,500,000 × 4% × 90% × 3 = 22,950,000
2	Estimate anticipated wastage factor	**100% + expected wastage rate**	100% + 10% = 1.1	100% + 10%=1.1
3	Estimate auto-disable syringe forecast	**Demand × anticipated wastage factor**	7,650,000 × 1.1 = 8,415,000	22,950,000 × 1.1 = 25,245,000
4	Add up the estimated auto-disable syringes	**Vaccine A forecast + Vaccine B forecast**	8,415,000 + 25,245,000 = 33,660,000	

Solution: Reconstitution syringes

Steps	Action	Formula	Vaccine A
1	Estimate vaccine forecast	**Total population × proportion of total population eligible × coverage × number of doses per FIP**	212,500,000 × 4% × 90% × 1 × 1.67 = 12,775,500
2	Estimate unadjusted reconstitution syringe forecast	$\frac{\text{Forecast}}{\text{No. of doses per vial}}$	$\frac{12,775,500}{10}$ = 1,277,550
3	Estimate anticipated wastage factor	**100% + expected wastage rate**	100% + 10% = 1.1
4	Estimate forecast	**Forecast (in vials) × anticipated wastage factor**	1,277,550 × 1.1 = 1,405,305

Solution: Safety boxes

Steps	Action	Formula	Vaccine A
1	Estimate unadjusted forecast	$\frac{\text{Total autodisable and reconstitution syringes}}{\text{Maximum units allowed per box}}$	$\frac{33{,}660{,}000 + 1{,}405{,}305}{100} = 350{,}653.05$
2	Estimate anticipated wastage factor	100% + expected wastage rate	100% + 10% = 1.1
3	Estimate forecast	Unadjusted units of safety boxes × Anticipated wastage factor	350,653.05 × 1.1 = ~385,719

Key takeaways

- **Forecasting involves the estimation of future consumption** using agreed data and assumptions.
- **One key activity during the forecasting phase is for relevant stakeholders to discuss and ratify forecasting data and assumptions.**
- **Forecasting methods for vaccines and immunization supplies** can include (1) demographic/wastage factor, (2) vaccination session and (3) consumption-based forecasting.
- It is **highly recommended to forecast using multiple methods**, following which a final decision as to whether and how forecasts will be combined should be made.

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Supply planning

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Supply planning

This guidance manual provides an overview of the supply planning concept, including the steps involved in estimating and costing commodity requirements. An example illustrating how commodity requirements can be estimated and costs determined is also provided. The chapter is organized into the following sections.

Overview of supply planning

Supply planning is how programmes estimate the total commodity requirements based on the forecast generated from the forecasting phase. Estimates generated during supply planning cover the quantity of product required to meet the forecasted consumption, the stock needed when deliveries are being awaited, and other fluctuations in demand. For products already in use, programmes must consider the stock that would be available at the beginning of a new implementation cycle to prevent the over- or underestimation of requirements. Overall, supply planning facilitates scheduling of shipments, budgeting, coordination of commodity funding, resource mobilization and ultimately the maintenance of optimal stock level in line with the country's inventory control policy. Countries without an inventory control policy are encouraged to have this in place.

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Supply planning steps

#	Task	Description	Guidance	Responsible
1	Review, ratify and collate supply planning data and assumptions	During the forecasting and supply planning (FSP) consultations and/or workshop: – The FSP team should present the supply planning data (Table 5.1) and assumptions, as well as associated analyses. – Stakeholders should review and ratify all supply planning data and assumptions, as well as associated analyses. – The FSP team should implement the ratified changes to the data and assumptions. – The FSP team should then collate ratified supply planning data and assumptions. This should cover the: – Entire supply planning period – Minimum data requirements for supply planning (Table 5.1)	The presentation by the FSP team should cover the type of data, source of data, quality considerations (availability, recency) and related analyses. When reviewing, the FSP team should discuss and proffer solution(s) to any issue related to the data and associated analyses. For example, when essential data is missing or of questionable quality, the team should formulate and agree on assumptions.	FSP team
2	Estimate commodity requirements	At this stage, the forecasting and supply planning stakeholders will determine the quantity of each product required to cover the forecasted consumption and to maintain the optimal stock levels throughout the supply chain.	The total commodity requirements will be determined by estimating the absolute commodity requirement based on the forecast and the programme's maximum and minimum inventory control policy or buffer rate from which the carryover stock[a] is deducted. In addition to the forecasted consumption, the maximum and minimum inventory control policy or buffer rate allows the programme to accommodate: – Lead time stock – Quantity required to cover fluctuations in demand – Quantity required to cover potential losses and expiries	FSP team

#	Task	Description	Guidance	Responsible
3	Determine when shipments should be delivered	This involves scheduling shipments to ensure that an optimal stock level is maintained.	When supply planning software is used, steps 2 and 3 can take place simultaneously. Shipments should be planned so that the programme does not fall below the minimum stock level (i.e., optimal stock level should be maintained) at any point within the FSP period. The available storage space and distribution capacity should also be considered when planning shipments.	FSP team
4	Cost commodity requirements	This involves estimating the cost of procuring the estimated product requirements.	It is highly recommended that the costing takes into consideration: – Shipping and handling cost (freight etc.) – Customs clearance fees, including taxes – In-country distribution costs – In-country storage costs – In-country sampling and quality assurance (QA) costs – Insurance costs Various tools and software can be used by countries for costing.	FSP team
5	Decide final quantity to procure	During this step, programmes should compare the total commodity funding requirements, with anticipated funding from both government and different donors/ funding institutions, to determine the final quantity to procure.	If the funding is anticipated to be available or can be mobilized, the team should decide to procure the total commodity requirements. If adequate funding is not available and cannot be mobilized through relevant advocacy initiatives, the team should revise the forecasting and/or supply planning assumptions and re-estimate total commodity requirements.	FSP team, Expanded Programme on Immunization (EPI)

[a] Estimated as the sum of the current stock on hand and stock on order, minus projected consumption and projected expiries for the remaining time in the current planning period.

Table 5.1: Minimum data requirements for supply planning

Supply planning data
Stock on hand – quantities, including expiry dates – as available from the most recent logistics reports.
Months of stock on hand (expressed as stock on hand divided by average monthly consumption)
Expected product shipments (stock on order)
Projected consumption for the remainder of the implementation year
Maximum and minimum inventory control level
Buffer rate
Established shipment intervals
Product information: – Registration status – Status on national essential medicines list – Prices – Vial size – Number of units per pack size
Supplier information and cost: – Product prices – Pack size – Lead time – Shipping and handling cost (freight etc.)
Funding information: – Funders/sources – Funding commitment – Fund disbursement schedule
Procurement mechanism and lead time
Distribution cost: – Customs clearance fees, including taxes – In-country distribution costs
Storage and other in-country costs: – In-country storage costs – In-country sampling and QA costs – Insurance costs

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Estimating and costing of commodity requirements

Steps	Description	Formula	Comments
1	Determine absolute commodity requirement	**Forecast × (100% + buffer rate)**	
2	Estimate carryover stock	**(Stock on hand + stock on order) — (projected consumption + projected expiries)**	This only applies to products that are already in use. It will be nil for new products.
3	Determine adjusted commodity requirements (procurement quantities)	**Absolute commodity requirement — carryover stock**	
4	Determine product cost	**Adjusted commodity requirement × product price**	
5	Add other add-on costs	**Product cost + product add-on costs**	Add-on costs can include the following: – Shipping and handling cost (freight etc.) – Customs clearance fees, including taxes – In-country distribution costs – In-country storage costs – In-country sampling and QA costs – Insurance cost

Illustrative example

Case description

Country Y plans to determine the quantity of pentavalent vaccine to procure after forecasting 30 million doses for the upcoming year. The available inventory report indicates that the current in-country stock is 10 million doses, with an additional 5 million doses on order. Of the available stock, 500,000 doses may not be consumed before expiration, while the consumption for the remaining months in the current implementation year is estimated at 7 million doses. The average price of their preferred product is $0.9 per dose, and the country expects to spend approximately 10 per cent of the product cost on other add-on expenses, including product shipping, handling and distribution. The country's official buffer rate is 25 per cent.

Case summary

Supply planning assumptions	
Forecast	30 million doses for 12 months
Buffer rate	25%
Stock on hand	10 million doses
Stock on order	5 million doses to arrive by the end of the current implementing year
Projected consumption	7 million doses
Projected expiries	500,000 doses
Product cost	$0.9 per dose
Add-on cost	10% of the product cost

Solution

Steps	Description	Formula	Comments
1	Determine absolute commodity requirement	Forecast × (100% + buffer rate)	30,000,000 × (100% + 25%) = 37,500,000
2	Estimate carryover stock	(Stock on hand + stock on order) – (projected consumption + projected expiries)	(10,000,000 + 5,000,000) – (7,000,000 + 500,000) = 7,500,000
3	Determine adjusted commodity requirements (procurement quantities)	Absolute commodity requirement – carryover stock	37,500,000 – 7,500,000 = 30,000,000
4	Determine product cost	Adjusted commodity requirement × product price	30,000,000 × 0.9 = $27,000,000
5	Add other add-on costs	Product cost + product add-on costs	27,000,000 × 1.1 = $29,700,000

Budgeting and funding advocacy

The costed commodity requirements from the supply planning phase inform programme budgeting and funding advocacy.

The following are the key budgeting and funding advocacy considerations:

- When there is a funding gap or uncertainties about the availability and timely release of funds, the FSP team should work with the entity responsible for leadership oversight to initiate the process for funding advocacy.
- To build trust in the final FSP results, which is an important factor for funding advocacy, programmes should:
  - Have a standardized process and use quality data from established sources
  - Involve and/or consult the finance team during FSP processes
  - Ensure that all FSP data and assumptions are transparently documented and can be made available to relevant stakeholders for verification
  - Ensure that presentations and reports provide adequate visibility into the processes that generated the final forecast and supply plan
  - Ensure that presentations during funding advocacy, especially to higher-level government stakeholders, are led by an individual that understands the processes as well the data and assumptions that inform the final forecast and supply plan
- Where possible, programme should ensure that critical pieces of evidence such as assessment reports, (operational) research studies, etc., are made available to support higher-level funding allocation decisions.
- Longer term forecasts (e.g., five years) are useful for funding advocacy and strategic planning.

UNICEF Supply Division has developed a budgeting tool that can support budgeting and subsequent funding advocacy (see toolbox).

Key takeaways

- **Supply planning is the process by which programmes estimate the total commodity requirements**, and also determine when products should be delivered to ensure uninterrupted commodity availability.
- **Commodity requirements are estimated based on the forecast, the country's inventory management policy and projected carryover stock.**
- **Supply planning should inform commodity procurement, budgeting, resource mobilization and timing of fund release** to ensure optimal stock availability.

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Presenting forecasting and supply planning results

Chapter

6

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Presenting forecasting and supply planning results

Following the development of the forecast and supply plan using the ratified data and assumptions, the next activity is presenting results to key stakeholders. This section discusses why the presentation is important, the audience for the presentation, and the key elements of the presentation and the final report. This presentation to the stakeholders should be led by the chairperson of the forecasting and supply planning (FSP) team or an assigned designate. The chapter is organized into the following sections.

Importance of presenting forecasting and supply planning results

The purpose of this activity is for the FSP team to collect feedback, secure approval, and advocate for action from targeted decision makers and/or the audience, with the following significance:

- Provides an avenue for securing stakeholders' buy-in and endorsement of the FSP data, assumptions, forecast and supply plan
- Validates funding from multiple funders
- Facilitates advocacy, mobilization and allocation of resources
- Serves as an opportunity for clarifying the roles and responsibilities of all stakeholders
- Share plan for use

Audience for forecasting and supply planning presentation

Depending on the country's context, the following can be the targeted audience for the FSP presentation:

- The national logistics working group (NLWG) or any other government-led (integrated) procurement and supply management technical working group (PSM TWG) or a designated unit within the Ministry of Health (MOH).
- Any relevant working group at the Expanded Programme on Immunization (EPI) level
- Any other stakeholder, organization or coordination platform as determined by the entity responsible for leadership oversight and/or EPI, including programme managers, policy makers, funders, procurers, etc.

Key elements of the forecasting and supply planning presentation

The presentation should summarize:

- Programme background data
- Forecasting and supplying scope, purpose and time frame
- Forecasting data and assumptions, including data sources, their limitations, and adjustments made
- Supply planning data and assumptions, including data sources and their limitations
- Method(s) and tool(s) used
- Commodity forecasts (annual and multiyear)
- Commodity and financial requirements
- Confirmed funding and financial gaps
- Shipment plan by supplier
- Critical recommendations that will ensure the effective implementation, including responsible stakeholders and timeline where applicable

The presentation can be in one session or multiple targeted sessions. Stakeholders may suggest minor or major changes to the initial assumptions that inform the presented results. All the suggested changes should be reflected in the final FSP report.

The entity responsible for FSP team leadership oversight should oversee the activities for the presentation of results.

The final forecasting and supply planning report

Once the forecast and supply plan are approved, the FSP team should develop a formal FSP report. This report should be more detailed than the FSP presentation, and serves as the official reference for short-, medium- and long-term reviews. The report should be structured as follows.

— **Background**

- Country context
- Programme background data
- Forecasting and supplying scope, purpose and time frame

— **Methods**

- Forecasting data and assumptions, including data sources, their limitations, and adjustments made
- Supply planning data and assumptions, including data sources and their limitations
- Method(s) and tool(s) used

— **Results**

- The information presented here should be disaggregated by product.
    - Commodity forecasts (annual and multiyear)
    - Commodity and financial requirements
    - Confirmed funding and financial gaps
    - Shipment plan by supplier

— **Key recommendations**

- Critical recommendations that will ensure the effective implementation, including responsible stakeholders and timeline where applicable


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Key takeaways

- Presenting FSP results (1) **provides an avenue for securing stakeholders' buy-in** and endorsement of the FSP data, assumptions, forecast and supply plan, (2) **ensures validation of funding** from multiple funders, (3) **facilitates advocacy, mobilization and allocation of resources**, (4) **serves as an opportunity for clarifying the roles and responsibilities of all stakeholders**, and (5) **enables sharing of plan for use**.
- **The entity responsible for FSP team leadership oversight should oversee the activities on the presentation of results.**
- Depending on the country's context, **the targeted audience for the FSP presentation can include relevant supply chain and programme working groups and any other stakeholder, organization or coordination platform as determined by the entity** responsible for leadership oversight and/or EPI.
- **The presentation should summarize the programme and forecasting background, as well as the output(s) from each phase** of FSP. It should also discuss the key recommendations that will ensure effective implementation.
- **Once the forecast and supply plan are adopted, the FSP team should develop a detailed FSP report** that will serve as the official reference for short-, medium- and long-term reviews.

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Operationalizing the forecast and supply plan

Chapter

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Operationalizing the forecast and supply plan

This guidance manual explains why it is important to consider the key activities required to initiate the operationalization of the forecast and supply plan and briefly discusses them. The chapter is organized into the following sections.

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Overview of operationalization of the forecast and supply plan

The finalization of the forecast and supply plan marks only the beginning of the implementation cycle. Some immediate actions are required to initiate its implementation. These activities **enable the programme to mobilize adequate funding, initiate timely procurement, ensure alignment of FSP assumptions with stock allocation assumptions and ensure implementation of recommended actions** to improve forecasting and supply planning (FSP) performance.

Key activities involved in operationalizing the forecast and supply plan

See table below.

#	Task	Description	Guidance	Responsible
1	Support mobilization of financial resources and initiate procurement	The FSP team should work with responsible stakeholders to ensure funds are released on time and to kick-start the procurement process.		FSP team and the entity responsible for leadership oversight
2	Support programme efforts to align FSP assumptions with stock allocation assumptions	The FSP team should verify that final FSP assumptions are used to inform the actual commodity allocation. Where these do not align, advocacy should follow.	Implementation of this task typically involves revising the assumptions and data in the applicable stock allocation tools. This may also entail revision or adaptation of stock management and distribution policies. This must be done early enough to ensure that the FSP assumptions inform the first allocation for the forecast implementation cycle. The assumptions may be revised during programme implementation, especially in instances where actual utilization does not align with the forecast, thus highlighting the need for constant review, as discussed in more detail in Chapter 8.	FSP team and the entity responsible for leadership oversight
3	Support programme efforts to implement recommendations from the FSP exercise	The team should advocate for activities related to the recommendations from the FSP exercise to be integrated into the work plan of the programme/unit responsible for leadership oversight. The team should also track the implementation status of these activities.	The implementation status of the recommended activities should be discussed during review meetings.	FSP team and the entity responsible for leadership oversight

Key takeaways

- **The adoption and finalization of the forecast and supply plan mark only the beginning of the implementation cycle.**
- **The FSP team should advocate for activities related to the recommendations from the FSP exercise to be integrated into the work plan** of the programme/unit responsible for leadership oversight.
- Key activities required to initiate forecast and supply implementation include: (1) supporting **mobilization of financial resources and initiation of procurement**; (2) supporting programme **efforts to align FSP assumptions with stock allocation assumptions**; and (3) supporting programme **efforts to implement recommendations** from the FSP exercise.

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Forecasting and supply planning review

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Forecasting and supply planning review

This guidance manual provides an overview of the steps involved in conducting a forecasting and supply planning (FSP) review. The chapter is organized into the following sections.

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Overview of forecasting and supply planning review

FSP review is the process by which programmes review the forecast and supply plan, including previous recommendations, to determine whether corrective actions are required for uninterrupted product availability. The review should take place at least every three months (quarterly). The frequency can increase for rapidly changing programmes, such as when a new programme or policy is introduced during an implementation cycle. This activity is critical as assumptions that inform FSP may not mirror actual programme performance, and orders need to be adjusted due to this discrepancy.

The review may result in the revision of the forecast, the timing and quantity of orders planned, and recalculation of the total commodity requirements and costs. Through the review, programmes can determine the underlying causes of poor performance and identify corrective actions such as procurement of additional stock, fast-tracking, and delay or cancellation of existing shipments. Thus, programme managers must build flexibility into budgeting/resource mobilization and suppliers' contract terms.

Forecasting and supply planning review types

The various types of FSP review are discussed in the following table.

Type	Description	Guidance
Systematic	A detailed review of FSP data, assumptions and recommendations, including comparison with the current context and programme performance	Programmes need to default to this type of review.
Rapid/high level	A non-detailed high-level review of FSP data, assumptions and recommendations, including comparison with the current context and programme performance	Applies when there is a time constraint
Targeted	A detailed review of certain aspect(s) of the FSP process targeting, for example, specific product(s), forecasting phase(s) and assumption(s) that have been pre-identified	Applies to programmes with pre-identified FSP issues

Forecasting and supply planning review steps

The FSP team should conduct the review and develop the review report, including recommendations in coordination with the unit responsible for leadership oversight. Relevant stakeholders should be consulted for inputs throughout the review process when needed.

#	Task	Description	Guidance	Responsible
1	Gather FSP data and assumptions, including recommendations from a precedent exercise.	This first step is aimed at establishing the baseline against which current performance will be compared.		FSP team and the entity responsible for leadership oversight
2	Gather data on the current context and actual programme performance, including consumption and shipments delivered, for the period under review.	This step provides an indication of current performance and informs the calculation of relevant KPIs following requisite adjustment.		FSP team and the entity responsible for leadership oversight
3	Adjust data (e.g., consumption) where required.	This step is only applicable when there is a need to adjust for non-reporting and/or stock-out.		FSP team and the entity responsible for leadership oversight
4	Calculate relevant KPIs, including forecast and supply plan accuracy.	At this stage, relevant KPIs such as forecast accuracy are calculated.	For calculation details, refer to Chapter 9.	FSP team and the entity responsible for leadership oversight
5	Determine whether the FSP data and assumptions align with the current context and actual programme performance.	This involves deciding whether observed performance aligns with expected performance/set targets.		FSP team and the entity responsible for leadership oversight

#	Task	Description	Guidance	Responsible
6	Determine the underlying causes of poor performance and develop recommendations.	This step is only applicable if the performance benchmark has not been met. The causes of poor performance should be established in order to help the programme develop and implement corrective actions.	This process should take into account any legitimate reason (such as introduction of a new policy during implementation) that may account for 'suboptimal' performance.	FSP team and the entity responsible for leadership oversight
7	Develop an FSP review report.	The FSP team should ensure that the entire FSP review process is clearly documented in the form of a report (see guidance for the key details that should be included).	– Background > Scope and purpose of FSP review – Methods > Type of FSP review > Data sources, tools, KPIs and their limitations > Calculation methods and their limitations – Results > Evaluation of the current situation > Revised forecast and recalculated total commodity requirements and costs where applicable > Revised shipment plan where applicable – Key recommendations > Critical recommendations that will help ensure commodity security, including responsible stakeholders and timeline where applicable. > Any proposed changes to the initial action plan	FSP team and the entity responsible for leadership oversight
8	Share FSP review results with relevant stakeholders.	The FSP team should identify key information from the FSP review process for dissemination to relevant stakeholders.	The report can be shared and discussed with relevant stakeholders individually and through established coordination platforms.	FSP team and the entity responsible for leadership oversight


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Conducting a forecasting and supply planning review: Illustrative example

Country T is conducting the year's first FSP review. The FSP team has collated the required data for pentavalent, pneumococcal and measles vaccines, as shown in Table 8.1. Estimate forecast accuracy (see Table 8.2 for formula and analysis steps) and determine whether the country needs to take corrective action to ensure uninterrupted vaccine availability.

Note: The country recently introduced the pneumococcal conjugate vaccine.

Table 8.1: Collated data for the review period

	Jan	Feb	Mar
Pentavalent vaccine			
Forecast	30,000,000	30,000,000	30,000,000
Consumption	20,000,000	20,100,000	20,400,000
Reporting rate	80%	80%	80%
Days of stock-out	0	0	0
Pneumococcal conjugate vaccine			
Forecast	27,000,000	27,000,000	27,000,000
Consumption	17,000,000	17,450,000	17,900,000
Reporting rate	80%	80%	80%
Days of stock-out	0	0	0
Measles vaccine			
Forecast	9,000,000	9,000,000	9,000,000
Consumption	3,150,000	2,700,000	3,240,000
Reporting rate	80%	80%	80%
Days of stock-out	0	5	0

Table 8.2: Formula and analysis steps for forecast accuracy

Formula for forecast accuracy*	$1 - \frac{\lvert\text{Forecast} - \text{actual consumption}\rvert}{\text{Actual consumption}} \times 100$
Analysis steps	I. Collate forecast and consumption data. II. Adjust consumption data for poor reporting and/or stock-out III. Calculate forecast error: **(Forecast – actual consumption)** IV. Determine absolute forecast error: **|Forecast – actual consumption|** V. Determine percentage absolute forecast error: $\frac{\lvert\text{Forecast} - \text{actual consumption}\rvert}{\text{Actual consumption}} \times 100$ **Forecast accuracy is 0% if % absolute forecast error is >100%* VI. Determine forecast accuracy: **100% – percentage absolute forecast error** *When there is need for adjustment, adjusted consumption is the same as actual consumption.*
Interpretation	The closer the forecast accuracy is to 100%, the more accurate the forecast is.
Performance target	≥80%**

* The forecast accuracy method described is only one out of the several methods that can be used to measure forecast error. Each method has its pros and cons, as discussed in Chapter 17 of 'Demand Forecasting for Executives and Professionals'.

** The performance target is context-dependent, and countries should aim to produce more accurate forecasts over time.

#	Task/formula		Pentavalent vaccine Jan	Feb	Mar
1	Collate monthly forecast and consumption data	Forecast	30,000,000	30,000,000	30,000,000
		Consumption	20,000,000	20,100,000	20,400,000
2	Adjust consumption data for poor reporting and/or stock-out	Reporting rate $MC \times \frac{100\%}{100\% - RR}$	25,000,000	25,125,000	25,500,000
		Stock-out $UnadjMC \times \frac{MD}{MD - Dstockout}$	25,000,000	25,125,000	25,500,000
3	Estimate forecast accuracy $1 - \frac{\lvert MF - MC \rvert}{MC} \times 100$	Forecast error $(MF - MC)$	5,000,000	4,875,000	4,500,000
		Absolute forecast error $\lvert MF - MC \rvert$	5,000,000	4,875,000	4,500,000
		*% Absolute forecast error $\frac{\lvert MF - MC \rvert}{MC} \times 100$	20%	19%	18%
		Forecast accuracy $1 - \frac{\lvert MF - MC \rvert}{MC} \times 100$	80%	81%	82%
4	Determine whether the forecast and actual consumption are well aligned		Yes	Yes	Yes
5	Determine possible underlying causes of poor forecast accuracy		N/A	N/A	N/A
6	Develop corrective actions		N/A		

MC: monthly consumption; RR: reporting rate; UadjMC: unadjusted monthly consumption; MD: total number of days in the month; Dstock-out: total number of days of stock-out in the month; MF: monthly forecast
* Forecast accuracy is 0% for instances where % absolute forecast error is >100%.

#	Task/formula		Pneumococcal conjugate vaccine Jan	Feb	Mar
1	Collate monthly forecast and consumption data	Forecast	27,000,000	27,000,000	27,000,000
		Consumption	17,000,000	17,450,000	17,900,000
2	Adjust consumption data for poor reporting and/or stock-out	Reporting rate $MC \times \frac{100\%}{100\% - RR}$	21,250,000	21,812,500	22,375,000
		Stock-out $UnadjMC \times \frac{MD}{MD - Dstockout}$	21,250,000	21,812,500	22,375,000
3	Estimate forecast accuracy $1 - \frac{\lvert MF - MC \rvert}{MC} \times 100$	Forecast error $(MF - MC)$	5,750,000	5,187,500	4,625,000
		Absolute forecast error $\lvert MF - MC \rvert$	5,750,000	5,187,500	4,625,000
		*% Absolute forecast error $\frac{\lvert MF - MC \rvert}{MC} \times 100$	27%	24%	21%
		Forecast accuracy $1 - \frac{\lvert MF - MC \rvert}{MC} \times 100$	73%	76%	79%
4	Determine whether the forecast and actual consumption are well aligned		No	No	No
5	Determine possible underlying causes of poor forecast accuracy		The vaccine is newly introduced and uptake is not yet optimal. Consumption and forecast accuracy trends indicate that demand is peaking.		
6	Develop corrective actions		No forecast and supply plan revision is required in the immediate term. Continue to monitor the pipeline closely.		

MC: monthly consumption; RR: reporting rate; UadjMC: unadjusted monthly consumption; MD: total number of days in the month; Dstock-out: total number of days of stock-out in the month; MF: monthly forecast
* Forecast accuracy is 0% for instances where % absolute forecast error is >100%.

#	Task/formula		Measles Jan	Measles Feb	Measles Mar
1	Collate monthly forecast and consumption data.	Forecast	9,000,000	9,000,000	9,000,000
		Consumption	3,150,000	2,700,000	3,240,000
2	Adjust consumption data for poor reporting and/or stock-out.	Reporting rate $MC \times \frac{100\%}{100\% - RR}$	3,937,500	3,375,000	4,050,000
		Stock-out $UnadjMC \times \frac{MD}{MD - Dstockout}$	3,937,500	4,108,696	4,050,000
3	Estimate forecast accuracy. $1 - \frac{\lvert MF - MC \rvert}{MC} \times 100$	Forecast error $(MF - MC)$	5,062,500	4,891,304	4,950,000
		Absolute forecast error $\lvert MF - MC \rvert$	5,062,500	4,891,304	4,950,000
		*% Absolute forecast error $\frac{\lvert MF - MC \rvert}{MC} \times 100$	129%	119%	122%
		Forecast accuracy $1 - \frac{\lvert MF - MC \rvert}{MC} \times 100$	0%	0%	0%
4	Determine whether the forecast and actual consumption are well aligned.		No	No	No
5	Determine possible underlying causes of poor forecast accuracy.		Poor demand generation. Forecast accuracy is consistently low.		
6	Develop corrective actions.		Delay confirmed orders. If the programme determines that demand will not improve for the year, consider revising the forecast and re-estimate requirements.		

MC: monthly consumption; RR: reporting rate; UadjMC: unadjusted monthly consumption; MD: total number of days in the month; Dstock-out: total number of days of stock-out in the month; MF: monthly forecast.
* Forecast accuracy is 0% for instances where % absolute forecast error is >100%.

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Key takeaways

- **FSP review is the process by which programmes review the forecast and supply plan,** including previous recommendations, to determine whether corrective actions are required for uninterrupted product availability.
- **The review should take place at least every three months (quarterly)**. The frequency can increase for rapidly changing programmes.
- **Relevant stakeholders should be consulted for inputs throughout the review process when needed.**
- **Through FSP review, programmes can determine the underlying causes of poor performance and identify corrective actions** such as procurement of additional stock, fast-tracking, and delay or cancellation of existing shipments.

Forecasting and supply planning review

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Guidance Manual on Forecasting and Supply Planning
for Vaccines and other Immunization Supplies

August 2023

Forecasting and supply planning performance monitoring

Chapter

9

Guidance Manual on Forecasting and Supply Planning

for Vaccines and other Immunization Supplies

Contents

Forecasting and supply planning performance monitoring

This guidance manual provides an overview as to why it is important to monitor the performance of forecasting and supply planning (FSP), the steps involved in monitoring FSP performance, the key performance indicators (KPIs) that countries can consider, and examples illustrating the steps involved in computing specific KPIs. The chapter is organized into the following sections.

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Why monitor forecasting and supply planning performance?

Monitoring FSP performance helps programmes monitor their progress against set performance targets using pre-identified indicators. Following the estimation of KPIs, programmes should define corrective measures and actions/recommendations for improvement, including clear assignment of responsibilities.

Programmes are heavily encouraged to always assess and identify underlying causes of poor performance and develop an improvement plan to ensure sustained progress towards set targets. KPIs provide an objective basis for this monitoring, as discussed in section 3 of this chapter.

Steps for monitoring forecasting and supply planning performance

The key steps in monitoring FSP performance are summarized in the following table.

#	Task	Description	Guidance	Responsible
1	Planning for the monitoring exercise			
1.1	Decide on the KPIs for monitoring FSP performance.	Ahead of monitoring, the programme should agree on the KPIs that will be used to monitor FSP performance.	Section 3 provides a list of KPIs that countries can adopt. When selecting the KPIs, programmes should ensure that appropriate structures and resources are put in place to guarantee routine tracking. To ensure sustainability, the FSP team should advocate selected FSP KPIs to be integrated into the overall programme performance framework.	– FSP team (technical lead) – Entity responsible for leadership oversight – Expanded Programme on Immunization (EPI) programme
1.2	Establish baseline performance and set performance targets, including timeline and the frequency of monitoring.	The programme should establish baseline performance in order to monitor changes in performance. Programmes should set targets and establish a timeline in order to monitor whether expected progress is being made. Programmes should define how frequently each indicator is measured in order to ensure regular performance monitoring.	When setting performance targets, programmes should consider baseline performance and the resources available to drive improvement. It is recommended that programmes define allowable deviation from set performance targets as a measure to know when to identify underlying causes of suboptimal performance. Section 3 provides a list of recommended KPI targets and monitoring frequency that countries can adapt.	– FSP team (technical lead) – Entity responsible for leadership oversight – EPI programme

#	Task	Description	Guidance	Responsible
1	Planning for the monitoring exercise			
1.3	Define data-collection method, data sources and responsibilities.	Programmes should ensure that measures are put in place for collecting the necessary data to inform the KPIs. Tools and methods for collecting the data should be defined (e.g., using government tools such as the District Health Information System 2 [DHIS2], the logistics management information system [LMIS] and the Stock Management Tool [SMT]). Programmes should define responsibilities for collecting required data.		– FSP team (technical lead) – Entity responsible for leadership oversight – EPI programme
2	Actual tracking of performance			
2.1	Collate required data for KPI computation.	This step involves collating the data required to compute the agreed KPIs.		– FSP team (technical lead) – Entity responsible for leadership oversight – EPI programme
2.2	Adjust data where applicable.	This step is only applicable when there is a need to adjust collated data. For example, there may be a need to adjust consumption for low reporting and stock-out.		– FSP team (technical lead) – Entity responsible for leadership oversight – EPI programme
2.3	Estimate KPI.	At this stage, the KPI is calculated.	Section 3 provides guidance on the steps involved in estimating KPIs.	– FSP team (technical lead) – Entity responsible for leadership oversight – EPI programme
2.4	Determine whether the performance target was met.	This involves comparing the actual performance with the target to determine whether the established benchmark has been met.	If the observed performance is within allowable range, no further action is required. The team should continue regular monitoring activities. When the observed performance is not within the allowable range, the team should proceed with the next steps.	– FSP team (technical lead) – Entity responsible for leadership oversight – EPI programme

#	Task	Description	Guidance	Responsible
2	Actual tracking of performance			
2.5	Determine the underlying causes of not meeting performance.	Identifying the causes of poor performance will help the programme develop an improvement plan.		– FSP team (technical lead) – Entity responsible for leadership oversight – EPI programme
2.6	Develop an improvement plan.	At this stage, an improvement plan is developed based on the underlying reasons for suboptimal performance, as identified.		– FSP team (technical lead) – Entity responsible for leadership oversight – EPI programme
2.7	Implement the improvement plan and continue monitoring.	At this stage, the programme implements the improvement plan and continues to monitor FSP performance.		– FSP team (technical lead) – Entity responsible for leadership oversight – EPI programme

Key performance indicators

The KPIs discussed in this section are listed in Table 9.1. They are broadly classified as input, process and output indicators. However, the list provided is not exhaustive and countries can choose additional indicators based on the needs and their supply chain maturity level.

Table 9.1: Key performance indicators

Indicator type	Name
Input	– Completeness of FSP data
Process	– Frequency of FSP review
Output	– Forecast demand ratio (FDR) or forecast accuracy – Supply plan accuracy – Funding adequacy

Note: Countries can choose to use either FDR or forecast accuracy to monitor the alignment of forecast with actual consumption.

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Each of the indicators is discussed under the following subheadings.

Subheading	Description
Indicator	Name of the indicator
Definition	Definition of the indicator
Purpose	The usefulness of the indicator
Supply chain level	Level of the supply chain at which the KPI should be computed
Frequency	How often the indicator should be computed
Data needed	The data required to estimate the KPI
Data sources	The sources of the data required for estimating the KPI
Formula	The formula for estimating the KPI, including numerator and denominator where applicable
Analysis steps	The key calculation steps involved in estimating the KPI
Interpretation	How KPIs should be interpreted
Performance target	The performance benchmark that countries should aim for. Each country should consider their baseline performance and resources available for improving performance when setting this target.
Potential corrective actions	Actions that can be taken to improve performance

A. Input indicator

Indicator	Completeness of FSP data
Definition	Measures whether the required FSP data set is available
Purpose	Helps the programme improve the quality of FSP output
Supply chain level	National level
Frequency	At least once every three months, preferably during the regular FSP review exercise
Data needed	All FSP data as listed in Chapter 3
Data sources	Multiple sources as listed in Chapter 3
Formula	$\frac{\text{Number of available FSP data}}{\text{Total number of required FSP data}} \times 100$
Analysis steps	I. Count the number of available FSP data. II. Count the total number of required FSP data. III. Divide the number of available FSP data by the total number of required FSP data. IV. Multiply the estimate by 100 per cent.
Interpretation	The closer the estimate is to 100 per cent, the more complete FSP data are. An estimate of 100 per cent indicates that all FSP data are available.
Performance target	100 per cent
Potential corrective actions	Work with the EPI team to put measures in place to ensure that missing data are available for FSP.

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B. Process indicator

Indicator	Frequency of FSP review
Definition	Measures how often FSP is reviewed to determine whether any corrective action(s) is/are required to ensure uninterrupted product availability
Purpose	Helps the programme monitor the performance of FSP, including recommendations from the precedent FSP exercise
Supply chain level	National level
Frequency	At least once every three months (quarter)
Data needed	Number of FSP reviews conducted
Data sources	FSP review report
Formula	Number of FSP reviews conducted with evidence of the report
Analysis steps	Count the number of FSP reviews conducted with evidence of the report
Interpretation	One indicates that FSP review was conducted with evidence of report. Zero indicates that FSP review was not conducted.
Performance target	One per quarter
Potential corrective actions	Work with the EPI team to set up a system for FSP review.

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C. Output indicators

Indicator	Forecast demand ratio (FDR)
Definition	The ratio of actual consumption of a given product during a particular period compared to the consumption forecasted for the same period
Purpose	Helps programmes ascertain whether their forecast and actual consumption are aligned and whether any corrective action is required to prevent stock-out or wastage
Supply chain level	National level
Frequency	Every three months
Data needed	– Forecast by product – Actual consumption by product (opening balance + receipts – closing balance of product) or issues data from the lowest distribution point – Reporting rate – Days of stock-out
Data sources	**Forecast** – FSP report/populated forecasting too **Consumption, reporting rate, days of stock-out** – LMIS – Monthly immunization reports – Stock ledgers/cards
Formula	$\frac{\text{Doses consumed per product in a period}}{\text{Doses forecasted per product for the same period}}$
Analysis steps	I. Collate forecast and consumption data. II. Adjust consumption data for poor reporting and/or stock-out. III. Divide doses consumed per product in a period by doses forecasted per product for the same period.

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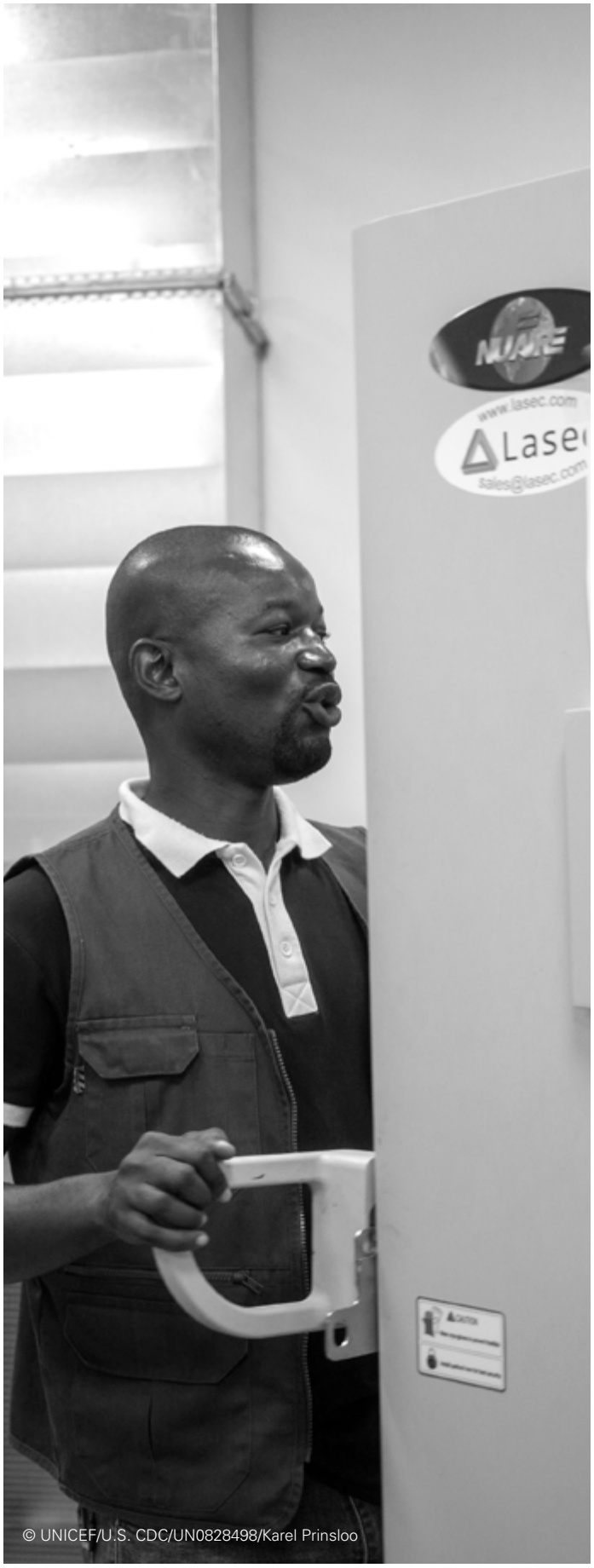
Indicator	Forecast demand ratio (FDR)
Interpretation	– Forecasted demand ratio below 1: actual consumption (through administration and wastage) was less than the forecasted consumption for a given period. – Forecasted demand ratio above 1: actual consumption (through administration and wastage) was more than the forecasted consumption for a given period. – A forecasted demand ratio of 1 implies that the forecasted consumption is the same as actual vaccine consumption.
Performance target	0.8–1.2
Potential corrective actions	Address underlying causes when performance target is not met. Such causes could include inaccurate assumptions (target population, coverage and wastage), e.g., higher wastage than expected due to poor adherence to multidose vial policy or poor maintenance of cold chain equipment. Possible actions include: – Fast-tracking (FDR>1.2) or delay (FDR<0.8) products on order – Revising forecast and supply plan if required



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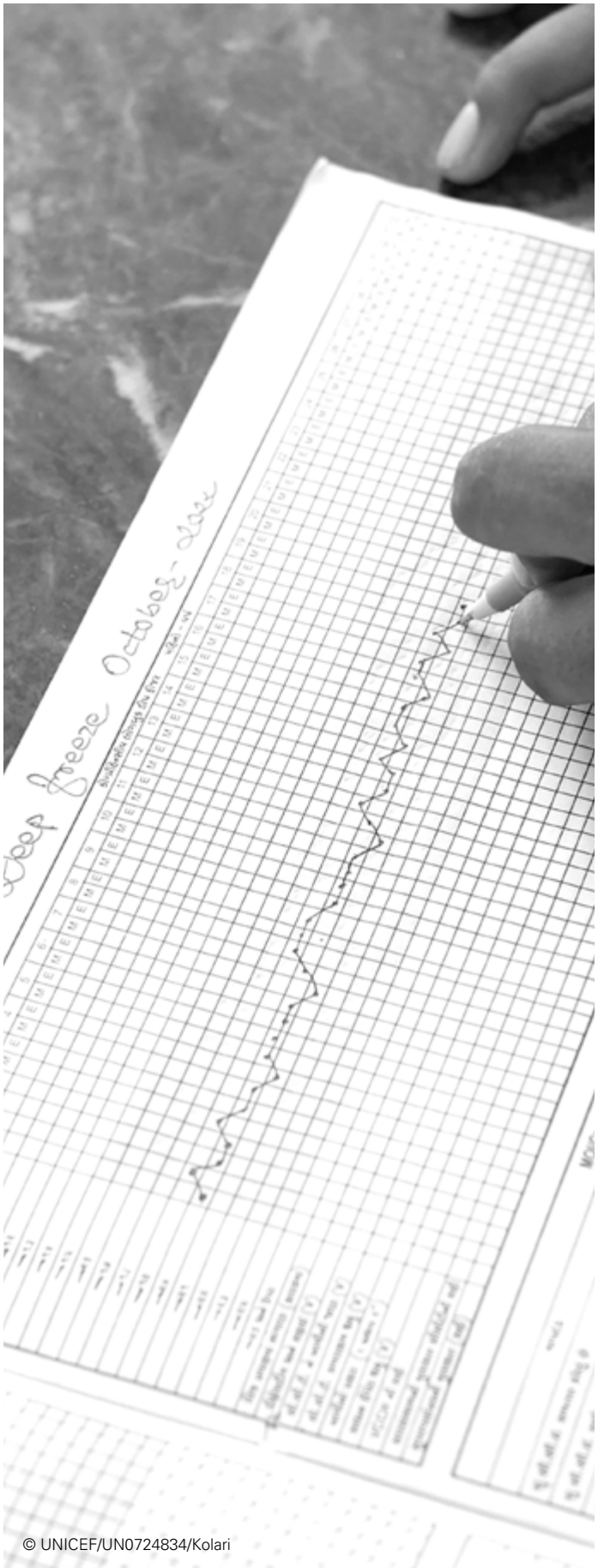
Indicator	Forecast accuracy
Definition	Measures how closely the forecast aligns with actual consumption
Purpose	Helps programmes ascertain whether forecast and actual consumption are aligned and whether any corrective action is required to prevent stock-out or wastage
Supply chain level	National level
Frequency	Every three months
Data needed	– Forecast by product – Actual consumption by product (opening balance + receipts – closing balance of product) or issues data from the lowest distribution point – Reporting rate – Days of stock-out
Data sources	**Forecast** – FSP report/populated forecasting tool **Consumption, reporting rate, days of stock-out** – LMIS – Monthly immunization reports – Stock ledgers/cards
Formula for forecast accuracy*	$1 - \frac{\lvert\text{Forecast} - \text{actual consumption}\rvert}{\text{Actual consumption}} \times 100$



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Indicator	Forecast accuracy
Analysis steps	I. Collate forecast and consumption data. II. Adjust consumption data for poor reporting and/or stock-out. III. Calculate forecast error **(Forecast — actual consumption)** IV. Determine absolute forecast error **|Forecast — actual consumption|** V. Determine absolute percentage forecast error $\frac{\|\text{Forecast} - \text{actual consumption}\|}{\text{Actual consumption}} \times 100$ **Forecast accuracy is 0% if absolute percentage forecast error is >100%* VI. Determine forecast accuracy **100% — % absolute forecast error** *When adjustment is required, adjusted consumption is the same as actual consumption*
Interpretation	The closer the forecast accuracy is to 100%, the more accurate the forecast is.
Performance target	≥80%**
Potential corrective actions	Address underlying causes when performance target is not met. Such causes could be inaccurate assumptions (target population, coverage and wastage), e.g., higher wastage than expected due to poor adherence to multidose vial policy or poor maintenance of cold chain equipment. Possible actions include: – Fast-tracking (forecast error is negative, and forecast accuracy is <80%) or delay (forecast error is positive and forecast accuracy is <80%) products on order – Revising forecast and supply plan if required

* The forecast accuracy method described is only one out of the several methods that can be used to measure forecast error. Each method has its pros and cons, as discussed in Chapter 17 of 'Demand Forecasting for Executives and Professionals'.

** Performance target is context-dependent, and countries should aim to produce more accurate forecasts over time.

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Indicator	Supply plan accuracy
Definition	Measures how closely the quantities in the supply plan align with the commodity quantity in confirmed orders for the product under review
Purpose	Helps programmes ascertain whether orders are being placed in line with the country's supply plan
Supply chain level	National level
Frequency	Every three months
Data needed	– Planned quantity of shipments for the review period – Confirmed quantity of product ordered for the review period
Data sources	– FSP report/populated forecasting tool – Supply plan – Procurement tracker – Purchase orders
Formula	$1 - \frac{\lvert \text{Planned shipments} - \text{actual quantity ordered} \rvert}{\text{Actual quantity ordered}} \times 100$

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Indicator	Supply plan accuracy
Analysis steps	I. Collate planned and actual order quantities by product. II. Calculate supply plan error **(Planned shipments – actual quantity ordered)** III. Determine absolute supply plan error **|Planned shipments – actual quantity ordered|** IV. Determine absolute percentage supply plan error $\frac{\text{\|Planned shipments – actual quantity ordered\|}}{\text{Actual quantity ordered}} \times 100$ *Supply plan accuracy is 0% if absolute percentage supply plan error is >100% V. Determine supply plan accuracy **100% – absolute % supply plan error**
Interpretation	The closer the supply plan accuracy is to 100%, the more accurate the forecast is.
Performance target	≥80%
Potential corrective actions	Address underlying causes when performance target is not met. Such causes could be a delay in fund release. Possible actions include: – Advocating for timely fund release

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Indicator	Funding adequacy
Definition	Measures how closely the funding from both government and various donors/ funding institutions aligns with the total commodity funding requirements for the review period and how timely it is
Purpose	Helps programmes ascertain whether all commodity requirements are fully and timely funded
Supply chain level	National level
Frequency	Every three months
Data needed	– Total cost of commodities required for the review period – Actual funding available for procurement for the review period
Data sources	– FSP report – Budget tracker/financing document for procurement
Formula	$\frac{\text{Actual funding available for the review period}}{\text{Total commodity funding requirement for the review period}} \times 100$
Analysis steps	I. Collate the actual funding available for commodity procurement for the review period. II. Collate the total amount of funding required for commodity procurement for the review period. III. Divide the actual amount available by the total amount of funding required for commodity procurement.
Interpretation	– Funding adequacy below 100%: inadequate funding for a given period – Funding adequacy above 100%: more funding than needed for a given period – Funding adequacy of 100% implies that the exact amount of funding for a given period is available.
Performance target	≥100%
Potential corrective actions	Address underlying causes when performance target is not met. Such causes could be a delay in fund release. When funding is inadequate, possible actions can include advocating for more resources and/or timely release.


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Illustrative examples

This section contains practical examples for estimating FDR, forecast accuracy, supply plan accuracy and funding adequacy.

Forecast demand ratio and forecast accuracy

Country J plans to determine how well the forecast for pentavalent vaccine and pneumococcal conjugate vaccine (PCV) align with actual consumption for the first quarter of the year. The FSP team has collated the required data as shown in Table 9.2. Following the steps discussed in section 3, estimate (1) the FDR; (2) forecast accuracy. For each month, indicate whether the respective performance targets of 0.8–1.2 and ≥80 per cent for FDR and forecast accuracy were met.

Table 9.2: Collated data for Country J

	Jan	Feb	Mar
Pentavalent vaccine			
Forecast	25,000,000	25,000,000	25,000,000
Consumption	22,000,000	24,000,000	28,000,000
Reporting rate	85%	85%	85%
Days of stock-out	0	0	0
PCV			
Forecast	20,000,000	20,000,000	20,000,000
Consumption	5,000,000	10,150,000	12,200,000
Reporting rate	85%	85%	85%
Days of stock-out	10	0	0

Solution: FDR

#	Task/Formula		Pentavalent vaccine		
			Jan	Feb	Mar
1	Collate monthly forecast and consumption data.	Forecast	25,000,000	25,000,000	25,000,000
		Consumption	22,000,000	24,000,000	28,000,000
2	Adjust consumption data for poor reporting and/or stock-out.	Reporting rate $MC \times \frac{100\%}{100\% - RR}$	25,882,353	28,235,294	32,941,176
		Stock-out $UnadjMC \times \frac{MD}{MD - Dstockout}$	25,882,353	28,235,294	32,941,176
3	Estimate FDR. $\frac{\text{Doses consumed per product in a period}}{\text{Doses forecasted per product for the same period}}$		1.04	1.13	1.32
4	Performance target met?		Yes	Yes	No

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#	Task/Formula		PCV		
			Jan	Feb	Mar
1	Collate monthly forecast and consumption data.	Forecast	20,000,000	20,000,000	20,000,000
		Consumption	5,000,000	10,150,000	12,200,000
2	Adjust consumption data for poor reporting and/or stock-out.	Reporting rate $MC \times \frac{100\%}{100\% - RR}$	5,882,353	11,941,176	14,352,941
		Stock-out $UnadjMC \times \frac{MD}{MD - Dstockout}$	8,683,473	11,941,176	14,352,941
3	Estimate FDR. $\frac{\text{Doses consumed per product in a period}}{\text{Doses forecasted per product for the same period}}$		0.43	0.60	0.72
4	Performance target met?		No	No	No

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Solution: Forecast accuracy

#	Task/Formula		Pentavalent vaccine		
			Jan	Feb	Mar
1	Collate monthly forecast and consumption data.	Forecast	25,000,000	25,000,000	25,000,000
		Consumption	22,000,000	24,000,000	28,000,000
2	Adjust consumption data for poor reporting and/or stock-out.	Reporting rate $MC \times \frac{100\%}{100\% - RR}$	25,882,353	28,235,294	32,941,176
		Stock-out $UnadjMC \times \frac{MD}{MD - Dstockout}$	25,882,353	28,235,294	32,941,176
3	Estimate forecast accuracy. $1 - \frac{\lvert Forecast - actual\ consumption \rvert}{Actual\ consumption} \times 100$	Forecast error	–882,353	–3,235,294	–7,941,176
		Absolute forecast error	882,353	3,235,294	7,941,176
		% absolute forecast error*	3%	11%	24%
		Forecast accuracy	97%	89%	76%
4	Performance target met?		Yes	Yes	No

MC: monthly consumption; RR: reporting rate; UadjMC: unadjusted monthly consumption; MD: total number of days in the month; Dstock-out: total number of days of stock-out in the month
* Forecast accuracy is 0% for instances where % absolute forecast error is >100%.

#	Task/Formula		PCV		
			Jan	Feb	Mar
1	Collate monthly forecast and consumption data.	Forecast	20,000,000	20,000,000	20,000,000
		Consumption	5,000,000	10,150,000	12,200,000
2	Adjust consumption data for poor reporting and/or stock-out.	Reporting rate $MC \times \frac{100\%}{100\% - RR}$	5,882,353	11,941,176	14,352,941
		Stock-out $UnadjMC \times \frac{MD}{MD - Dstockout}$	8,683,473	11,941,176	14,352,941
3	Estimate forecast accuracy. $1 - \frac{\lvert Forecast - actual\ consumption \rvert}{Actual\ consumption} \times 100$	Forecast error	11,316,527	8,058,824	5,647,059
		Absolute forecast error	11,316,527	8,058,824	5,647,059
		% absolute forecast error*	130%	67%	39%
		Forecast accuracy	0%	33%	61%
4	Performance target met?		No	No	No

MC: monthly consumption; RR: reporting rate; UadjMC: unadjusted monthly consumption; MD: total number of days in the month; Dstock-out: total number of days of stock-out in the month.
* Forecast accuracy is 0% for instances where % absolute forecast error is >100%.

Supply plan accuracy

Country J also plans to determine how well quantities in the supply plan for the pentavalent vaccine, PCV and measles vaccine align with confirmed orders for the year's first quarter. The FSP team has collated the required data, as shown in Table 9.3. Following the steps discussed in section 3, estimate the quarterly supply plan accuracy. Indicate whether the performance target of ≥80 per cent for supply plan accuracy was met for each vaccine.

Table 9.3: Collated data for supply plan accuracy

Quarter 1	Penta	PCV	Measles
Planned shipment quantity	7,000,000	6,000,000	2,000,000
Actual quantity ordered	6,000,000	5,500,000	500,000

Solution

#	Task/Formula		Penta	PCV	Measles
1	Collate monthly forecast and consumption data.	Planned shipment quantity	7,000,000	6,000,000	2,000,000
		Actual quantity ordered	6,000,000	5,500,000	500,000
3	Supply plan accuracy $1 - \frac{\lvert\text{Planned order quantity} - \text{actual order quantity}\rvert}{\text{Actual order quantity}} \times 100$	Supply plan error	1,000,000	500,000	1,500,000
		Absolute supply plan error	1,000,000	500,000	1,500,000
		% absolute supply plan error*	17%	9%	300%
		Supply plan accuracy	83%	91%	0%
4	Performance target met?		Yes	Yes	No

* Supply plan accuracy is 0% for instances where the % absolute error is >100%.

Funding adequacy

Country J plans to determine funding adequacy for the first quarter of the year. The FSP team has collated the funding details as shown in Table 9.4. Following the steps discussed in section 3, estimate the funding adequacy for the quarter. Also, determine whether the performance target of 100 per cent was met for the quarter.

Table 9.4: Collated data for supply plan accuracy

Quarter 1	Vaccines ($)	Immunization supplies ($)	Total ($)
Total funding required	20,000,000	2,000,000	22,000,000
Actual funding available	15,000,000	500,000	15,500,000

#	Task/Formula		Quarter 1
1	Collate monthly forecast and consumption data.	Total funding required	22,000,000
		Total funding available	15,500,000
3	Estimate funding adequacy. $\frac{\text{Total funding available}}{\text{Actual funding required}} \times 100$		$\frac{15{,}500{,}000}{22{,}000{,}000} \times 100 = 70.5\%$
4	Performance target met?		No

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Key takeaways

- By monitoring FSP performance, **programmes can monitor their progress against set performance targets** using pre-identified indicators.
- To ensure sustainability, **the FSP team should advocate for selected FSP KPIs to be integrated into the overall programme performance framework.**
- **When setting performance targets, countries should consider their baseline performance and the resources available** for improving performance.

August 2023

Assessing forecasting and supply planning and planning for improvements

Chapter 10

Guidance Manual on Forecasting and Supply Planning

for Vaccines and other Immunization Supplies

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for every child

Contents

Assessing forecasting and supply planning and planning for improvements

This guidance manual provides an overview of the steps involved in assessing forecasting and supply planning (FSP) and developing an improvement plan. It also introduces UNICEF's FSP assessment tool. The chapter is organized into the following sections.

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Overview of forecasting and supply planning assessment and improvement planning

Assessing FSP can help countries identify FSP strengths and weaknesses, including underlying causes for observed performance. This may enable them to leverage existing strengths and strategically direct resources for improvement. The assessment should inform improvement planning and can be used to monitor progress following the implementation of an improvement plan. Programme managers can use various tools – which vary in their comprehensiveness and product specificity – for this purpose.

The assessment scope (for example, central-level-focused versus all supply chain levels) and frequency will depend on factors including the country's context, funding, and timeliness of implementing activities/interventions in the improvement plan. It is recommended that FSP are assessed at least every three years with a fixed timeline such that:

- Critical stakeholders that will facilitate the implementation of recommendations are available
- Other programmatic activities, such as effective vaccine management assessment and supportive supervision, can be leveraged
- Recommendations are ready for inclusion in the programme work plan and budget.

The improvement plan's implementation should be monitored every three months (quarterly).

Forecasting and supply planning assessment

The three key phases of conducting FSP assessment are summarized in the following table. They are discussed in more detail in the following subsections.

#	Phase	Description
1	Plan for assessment.	The planning phase covers all activities that should be completed before data collection. These include but are not limited to: – Establishing the purpose and scope of assessment – Securing relevant budgetary approval – Assigning roles and responsibilities – Training assessors, including on the use of the assessment tool.
2	Conduct the assessment.	During this second phase, the chosen assessment tool is administered to collect relevant data.
3	Develop and disseminate results and recommendations.	Involves analysis of the assessment data, following which the resultant findings and recommendations are presented to national stakeholders for discussion and ratification.

Plan for assessment

The steps involved in planning for FSP assessment are discussed in the following table.

#	Activity	Description	Guidance	Responsible
1	Identify FSP planning assessment as a priority.	For FSP assessment to be impactful, stakeholders must identify it as a priority.	In some instances, the assessment can be ad hoc or triggered by findings from other assessments such as the effective vaccine management assessment (EVMA) and supply chain maturity model assessment. Institutionalization of regular assessment is also recommended (for example, adding FSP assessment to the programme's strategic plan).	FSP team Entity responsible for leadership oversight Expanded Programme on Immunization (EPI) team
2	Define the objective of the assessment.	The objective of the assessment should also be clarified. FSP assessment can be conducted to identify FSP strengths and weaknesses, including underlying causes for observed performance.	The team can use the results of the assessment to support funding applications or decisions on funding allocation.	FSP team Entity responsible for leadership oversight
3	Determine the assessment scope.	The scope of the assessment should also be clear, i.e., whether to conduct a central-level-focused assessment or an assessment that covers all supply chain levels or focus on specific aspect of FSP function. The team should also agree on the number of facilities and the data-collection method.	When the assessment includes visits to all levels of the supply chain, the team can use the effective management assessment (EVMA) approach to determine the number of facilities. Finally, countries can choose between a manual and electronic data collection method. The electronic data collection method is advantageous when conducting a full-scale assessment as it eliminates manual entry of collected data and can also facilitate quality checks while data collection is still ongoing. However, electronic data collection may not confer a considerable advantage for the central-level focused assessment.	FSP team Entity responsible for leadership oversight
4	Develop and secure required budgetary approval.	Based on the purpose and scope of the assessment, a budget should be developed and approval secured.	This should include considerations around whether an external consultant will be engaged.	FSP team Entity responsible for leadership oversight

#	Activity	Description	Guidance	Responsible
5	Assign roles and responsibilities.	Key responsibilities should be assigned to all personnel that will be involved in the assessment (see Annex 2 for a sample).	Government should be fully involved in coordinating the assessment to ensure ownership. The competencies of personnel should be considered while assigning these roles.	FSP team Entity responsible for leadership oversight
6	Agree on the assessment tool, including quality control measures.	It is also important to agree on the assessment tool (see the subsection on UNICEF's FSP assessment tool) and establish the quality control measures that will guarantee the quality of collected data.	Some of quality control measures that can be built into tool design when an electronic data collection approach is used include: – Ensuring that electronic reports are transmitted with sites' geocoordinates as this can help establish whether the right sites were visited – Developing an operational guide that can be consulted while in the field and providing contacts of individuals who can provide clarification	FSP team Entity responsible for leadership oversight
7	Identify required background/source documents.	All required background documents should also be identified, especially for the central level assessment (see Annex 3 for potential documents).		FSP team Entity responsible for leadership oversight
8	Develop training materials and train assessors/data collectors.	For a central-level-focused assessment, training may not be required. However, for a comprehensive assessment that involves all levels of the supply chain, training/orientation will be required to introduce data collectors to the assessment tool and the data-collection process.	Potential training materials are available in Annex 4. This training should cover: – The purpose of the assessment – Introduction to the assessment tool – The data-collection process – Resources that can be consulted for clarification When an electronic approach is used, participants should be supported to install the relevant applications, and the data-collection process should be simulated during the training. A pilot assessment that involves a site visit can also be built into the training to enable assessors to apply the assessment tool in real programme settings. This will not only boost assessors' confidence but can also prompt the identification and resolution of previously unanticipated issues.	FSP team Entity responsible for leadership oversight

#	Activity	Description	Guidance	Responsible
9	Make other necessary logistics arrangements.	All key stakeholders should be given sufficient notice to ensure they are available and can participate.	For an assessment that involves all supply chain levels, this includes informing relevant administrative units well ahead of time, including sharing the site details and schedule of the visit to ensure that appropriate staff are available. This approach can also facilitate local supervisors' participation in the assessment, enabling prompt resolution of the gaps observed. Assessors should also be informed of the security situation of the locations they are visiting and other cultural issues that should be considered while interacting with respondents and other community members. There should also be an established medium for regular updates.	FSP team Entity responsible for leadership oversight

Conduct the assessment

During this second phase, the chosen assessment tool is administered, and relevant local authorities are debriefed in instances where a comprehensive assessment (all levels of the supply chain) is conducted.

#	Task	Description	Guidance	Responsible
1	Administer assessment tool.	Involves administering the assessment tool chosen by the country		Assessor
2	Submit responses.	Involves transmitting collected data	This could be daily when an electronic data collection method is used or at the end of the assessment if a manual method is adopted.	Assessor
3	Identify data-quality issues.	Involves identification of data-quality issues that require the attention of the assessor for rectification/clarification		Data manager/analyst
4	Address any data-quality issues.	Involves addressing the data-quality issues raised by the data manager/analyst		Assessor
5	Debrief relevant local authorities.	When a full-scale assessment is conducted, it is important to debrief local authorities on its key findings, including recommendations to address gaps.		Assessor

Steps 2 to 4 primarily apply to an electronic-device-enabled comprehensive assessment that enables daily transmission of data and covers all supply chain levels.

Develop and disseminate results and recommendations

During this step, the assessment responses are analysed, and resultant findings – including recommendations – are presented to stakeholders for discussion and ratification.

The ratified recommendations inform the development of the improvement plan.

#	Task	Description	Guidance	Responsible
1	Enter all collected data.	This step applies when manual data collection is used.		Data manager/ analyst
2	Identify any (outstanding) data-quality issues.	This involves identifying any outstanding data-quality issues (when data quality is assessed daily) or all data-quality issues when a manual data-collection approach is used.		Data manager/ analyst
3	Analyse results and compute relevant indicators.	During this step, the cleaned data are analysed to synthesize key findings and compute relevant indicators.		Data manager/ analyst
4	Interpret results and develop key findings and recommendations.	Working with the rest of the FSP team, results are interpreted and key findings and recommendations are identified for presentation to all relevant stakeholders.		FSP team Entity responsible for leadership oversight
5	Develop presentation to debrief stakeholders.	The presentation for the debrief should cover: – The country context, including the overall structure of the supply chain system – The purpose of the assessment An update on the progress of implementation of recommendations from previous assessment(s) – for follow-up assessments only – Key findings from the current assessment, including strengths and weaknesses – Recommendations to address observed gaps		FSP team Entity responsible for leadership oversight

#	Task	Description	Guidance	Responsible
6	Debrief stakeholders.	During the debrief, key findings and recommendations are presented to stakeholders for their feedback using the presentation developed in step 5.	Depending on the country's context, the following can be the presentation's target audience: – The national logistics working group (NLWG) or any other government-led (integrated) procurement and supply management technical working group (PSM TWG) or a designated unit within the Ministry of Health (MOH) – Any relevant working group at the EPI level – Any other stakeholder, organization or coordination platform as determined by the entity responsible for leadership oversight and/or EPI, including programme managers, policymakers and funders	FSP team Entity responsible for leadership oversight
7	Revise recommendations using feedback from debriefing and develop the final assessment report.	The feedback from the stakeholders should inform the revision of recommendations where applicable, following which the final report should be developed.	FSP team Entity responsible for leadership oversight	

UNICEF'S Forecasting and Supply Planning Assessment Tool

Currently, none of the existing supply chain assessment tools provide comprehensive and immunization-specific coverage of all FSP-related issues. To bridge this gap, UNICEF developed the Forecasting and Supply Planning Assessment Tool (FSPAT), which can be used to assess FSP, from planning to monitoring the implementation of the improvement plan.

The tool evaluates and monitors both capability maturity and performance of the FSP function. These aspects define its ability to produce high-quality and more accurate forecasts in the future and to help improve access to vaccines and other immunization supplies by those who need them.

- Capability maturity defines the state of human resources, policy and processes, and the tools and technologies available across the function.
- Performance defines the performance of the function, as determined by selected key indicators.

As shown in Annex 5 and Annex 6, the assessment tool has central-level-focused (qualitative) and data-quality check/key performance indicators (KPIs)/quantitative components. In addition to the general questions, the qualitative component covers five themes:

- Leadership and coordination
- Strategic planning and integration
- Assessments and improvement planning
- Implementation
- Performance monitoring

This component is designed for administration at the central or national level. It can be completed in one to three days, depending on the country's context and the availability of relevant stakeholders and documents, among other factors. On the other hand, the quantitative component is intended for administration across all levels of the supply chain, including stores and health facilities.

The results of this assessment will reveal the current situation of the country's FSP function, hence serving as a baseline for improvement monitoring.

Forecasting and supply planning improvement planning

The last procedural step is the development of an improvement plan. This plan articulates actionable activities to address the identified weakness and strengthen best practices. The EVMA guide has detailed instructions on how to develop an improvement plan. It is, however, important to note that the improvement plan should include the following details, which should be integrated into the relevant work plan, and its implementation tracked routinely:

- Goal/objective
- Specific activities
- Priority level of each activity
- Timelines
- Responsible individuals
- Resources required
- KPI(s)


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Key takeaways

- **The assessment of FSP can help countries identify FSP strengths and weaknesses**, including underlying causes for observed performance. **This can enable them to leverage existing strengths and strategically direct resources** for improvement.
- **The key phases of the assessment include planning, conducting the assessment, and developing and disseminating results and recommendations.**
- **The improvement plan should be informed by the findings and recommendations from the assessment**, which should be integrated into the relevant work plan, and its implementation tracked routinely.
- **UNICEF's FSPAT can be used for as a comprehensive assessment tool for FSP** – from planning to monitoring the implementation of the improvement plan.

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References and annexes

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Annexes

Annex 1: Key forecasting and supply planning inputs

Forecasting			Supply planning
Demographic	Vaccination session	Consumption	
Target population[+]	Target population	Historical consumption	Stock on hand – quantities, including expiry dates – as available from the most recent logistics reports
Target coverage	Target coverage	Historical reporting rate[*]	Expected product shipments (stock on order)
Dropout rate	Dropout rate	Historical stock-out days[*]	Projected consumption for the remainder of the implementation year
Number of doses per person	Number of doses per person	Projected growth rate	Maximum and minimum inventory control level, or buffer rate
Wastage rate	Number of vaccination sessions per period		Established shipment intervals
	Number of weeks per period		Product information: – Registration status – Status on national essential medicines list – Prices – Vial size – Number of units per pack size
	Number of doses per vial		Supplier information and cost: – Product prices – Pack size – Lead time – Shipping and handling cost (such as freight)
	Number of weeks of reuse for opened multidose vial		Funding information: – Funders/sources – Funding commitment – Fund disbursement schedule
	Number of supply chain levels		Procurement mechanism and lead time
	Closed vial wastage		Distribution cost: – Customs clearance fees, including taxes – In-country distribution costs
	Avoidable opened vial wastage		Storage and other in-country costs: – In-country storage costs – In-country sampling and quality assurance (QA) costs – Insurance costs

Note: Some of the data are required for individual products.
[+] Usually estimated as a percentage of the total population, i.e., the total population multiplied by A% where A% represents the proportion of the total population that is eligible for the vaccine.
[*] Required for adjustment of historical consumption, where indicated.

Annex 2: Roles and responsibilities for personnel involved in the assessment

#	Role	Description
1	Assessment Manager	– Leads, coordinates and manages all aspects of the assessment, including administrative, technical and operational aspects – Receives the reports from assessors and can be an assessor – Presents findings and develops final report writing
2	Assessor	Administers the questionnaire
3	Data Manager	– Assesses data quality – Collates and analyses collected data
4	Observer (if needed)	Sees/receives/interprets or decides on the assessment findings

Annex 3: Documents required for assessment

S/N	Required documents	S/N	Required documents
1	Terms of reference for FSP team	11	FSP standard operating procedures (SOP)
2	Minutes of FSP team	12	FSP tool
3	Human resource policy or guidelines	13	FSP presentations and report
4	Supply chain management training report	14	Populated FSP tool
5	Supply chain management training materials	15	Stock allocation assumptions
6	Multi-year strategic plan, e.g., cMYP	16	Data-quality assessment report
7	Supply chain strategy document	17	List of FSP KPIs
8	Annual work plan for the EPI programme, MOH, NLWG	18	KPI estimates
9	Supply chain assessment report, e.g., EVMA report	19	Reports or minutes of FSP review
10	Supply chain improvement plan		

Annex 4: Resources required for forecasting and supply planning training

Training resources
Meeting and/or training venue
Audiovisual and flip chart
Refreshments (tea break and lunch)
Consultancy fees – if an external consultant is engaged
Daily subsistence allowance
Transport
Printing facility or printing budget
Electronic devices – if electronic data collection is used
Meeting and/or training venue
Audiovisual and flip chart

The resources required will vary depending on whether the assessment is focused on the central level.

Annex 5: Background information and central level (qualitative) questions

Thematic area	Description
Background questions	
General questions	Background information on the overall supply chain architecture, including the various stakeholders involved in supply chain management. Key details include: – Existing supply chain coordination unit – Organizations involved in SCM – Number of SCM levels and health facilities – Overarching description of SCM processes, including FSP – Information flow within the system – Main SCM challenges
Qualitative questions	
Leadership and coordination	Assesses: – Existence of a multidisciplinary FSP team with clearly defined terms of reference in place – Availability of capacity-building policy and plan backed up by requisite training materials – Implementation of the training plan
Strategic planning and integration	Verifies if the following are up to date: – Programmatic strategic plan – Supply chain strategic plan – Annual work plan that includes and/or informs FSP activities
Assessments and improvement planning	Confirm if there is: – Any recent supply chain assessment that includes FSP and an improvement plan that was developed based on the findings
Implementation	Assesses whether: – Policies, procedures, roles and responsibilities for FSP are documented – There are comprehensive/standardized tools for FSP – There are necessary supporting technologies for FSP – The implementation of FSP is data-driven, with appropriate documentation of the entire process – The team responsible for FSP is functional
Performance monitoring	Ascertains whether: – Improvement plan, data quality and KPIs for FSP are monitored – Underlying causes of poor FSP performance are identified and used to inform continuous improvement

Annex 6: Indicators assessed by UNICEF's forecasting and supply planning assessment tool

Category	S/N	Indicator	Functional definition	Supply chain level	Significance
Data quality/forecasting assumptions	1.0	Accuracy of stock information	Consistency of physical stock with stock balance on record	All levels	Helps verify the validity of stock balance – one of the key supply planning inputs
	1.1	Accuracy of LMIS report	Consistency of essential supply chain data documented in source documents with the aggregated report	All levels[+]	Helps verify the validity of LMIS reports – data source for generation and monitoring of forecast and supply plan
	1.2	Accuracy of information on issues and receipts	Consistency of quantity issued by the higher level with quantity documented as receipts by the lower level	All levels	Helps verify the validity of a potential proxy for consumption
	1.3	Timelines of reporting	Submission of LMIS reports by the reporting deadline	All levels[+]	Helps verify if LMIS data will be available on time for decision-making
	1.4	Completeness of LMIS report	Inclusion of all essential logistics data on LMIS report	All levels[+]	Helps verify if all the required supply chain data will be available for decision-making
	1.5	Open vial wastage	Proportion of opened vaccine vials that are lost due to reasons other than administration to recipients	Health facility	Helps programmes verify one of the key FSP assumptions
	1.6	Closed vial wastage	Proportion of unopened products that are lost due to reasons other than opening for usage	All levels	Helps programmes verify one of the key FSP assumptions
Performance indicators	2.1	Forecast accuracy	Consistency of forecasted consumption with actual consumption	National, regional	Helps ascertain whether the forecast reflects actual programme performance
	2.2	Supply plan accuracy	Consistency of planned shipments with actual orders placed	National	Helps establish adherence to the supply plan

[+] Does not apply to the national level if this level does not generate aggregated report

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