NATIONAL MEDICAL OXYGEN & DEVISES SUPPLY PLANNING & FORECASTING TOOL DEVELOPMENT WORKSHOP (FEB 11 – 16, 2023)

DRAFT REPORT

Tesfaye Godana Amare, Jhpiego RISE Ethiopia

ጤና ሚኒስቴር - ኢትዮጵያ
MINISTRY OF HEALTH-ETHIOPIA
የዜጎች ጤና ለሃገር ብልጽግና!
RISE
Reaching Impact, Saturation, and Epidemic Control
USAID

Medical Oxygen & Devises Supply planning and Quantification Tool Development Workshop Report

Table of Contents

Medical Oxygen & Devises Supply planning and Quantification Tool Development Workshop Report

Background

Quantification is the process of estimating quantities and costs of health products required for a specific period and determining when shipments of the products should be delivered to ensure an optimal and uninterrupted supply. It includes forecasting & supply planning.[1] Forecasting is process of estimating the quantities & costs of products required to meet demand for a particular time frame. Supply planning determines which health products should be procured, the amount to be procured, the time at which they should be delivered, and the financial costs to be incurred. It requires data on forecasted amounts, stock on hand, stock on order or pipeline, lead times, wastage, and logistics costs, and minimum and maximum stock levels to estimate the requirements.

Previously, Jhpiego RISE Ethiopia in collaboration MOH developed the national medical oxygen & devises demand five years (2023 to 2027) demand forecast in a workshop held at Adama, from September 05 to 09, 2022. The forecasting was performed by multidisciplinary medical oxygen quantification team established in back in Aug 2022, team is composed of senior supply chain experts, pharmacists, clinicians, biomedical Engineers (BME), and various health program managers.

As next step of the forecasting, Jhpiego RISE Ethiopia in collaboration MOH, UNICEF & CHAI organized a fruitful national medical oxygen & devises supply planning and quantification tool development workshop. The workshop was held in Diredawa city, Yigizu Hotel from Feb 11 to 16, 2023. Senior supply chain experts, pharmacists, clinicians, biomedical Engineers (BME), and health program managers from various MOH Directorates (PMED, CSD & PHCD), EPSA, RISE, CHAI and UNICEF were in attendance.

Objective & Scope

The main objectives of the workshop were the following

1. To review the previous national medical oxygen & devises five-year (2023 to 2027) forecast report and results.
2. To prepare the medical oxygen delivery devises five-year requirements forecast which was missed in previous forecast including CPAP, BiPAP, HFNC, nasal catheter, venturi mask, face Masks etc.
3. To develop national medical oxygen & devises one to two-year supply plan.
4. Develop simple and user-friendly medical oxygen & devises forecasting tool for individual hospitals and health centers use.
5. Use the forecasting and supply planning results to advocate and promote future supply planning, commitment and budgeting.

The scopes of medical oxygen & devices supply planning were

- ❑ Forecasting and supply planning was performed for public health facilities only and all types of public health facility levels were considered.
- ❑ The medical oxygen devices forecasted demand quantity from previous forecast were used in the supply planning.
- ❑ The medical oxygen & devices supply planning covers one year.

[1] JSI Health Commodities Quantification Guide 2017.

Medical Oxygen & Devises Supply planning and Quantification Tool Development Workshop Report

Schedule and Proceedings

The six-day workshop was organized and coordinated with the technical guidance of JHpiego RISE and MOH technical teams. The six-day workshop schedule is annexed in Annex 2. In summary the workshop program was organized in the three thematic areas as indicated below.

Review of Previous Medical Oxygen & Devise Previous Forecast (First 2 days of the workshop)
The previous national medical oxygen & devises 2023 to 2027 forecast report was shared before the workshop for review, and in the first day of the workshop the forecast summary results with the limitations, challenges, and next steps was presented, and discussed. The quantification team were divided in groups to review the facility specific data used in previous forecast, nationally available functional oxygen plants data and to perform medical oxygen delivery devises forecast.

Medical Oxygen & Devise Forecast Supply planning (3rd to 6th day)
introductory presentations on the medical oxygen & devises supply planning steps & approaches was delivered. Discussion was held on the supply planning objectives and scope among the national medical oxygen quantification team. Then after groups were formed with chair & secretary for the supply planning work. The team drafted the national medical oxygen & devises one-year supply plan, presented to the bigger team, was reviewed and feedbacks were incorporated.

Facility level Medical Oxygen & Devise Forecasting Tool Development (3rd to 6th day)
Introductory presentation was delivered, workshop participants were divided into two groups. Purpose was to perform the medical oxygen & devises one-year supply plan and develop excel-based, simple, and user-friendly medical oxygen & devises quantification. Two national medical oxygen & devises excel based quantification tools were drafted one for morbidity based and one for consumption based, they were presented to the bigger team, were reviewed and feedbacks were incorporated.

Major Achievements

The workshop successfully accomplished the workshop intended objectives. The major achievements were the following

- ❑ Previous national medical oxygen & devises (2023 to 2027) forecast was reviewed. Missed/empty, incomplete, incorrect facility specific data were reviewed, and corrected.
- ❑ National medical oxygen delivery devises five-year demand forecast was prepared including forecast for CPAP/BiPAP Machines, HFNC, nasal catheter, venturi mask, face Masks etc.
- ❑ Developed national medical oxygen & devises supply plan for 2015/16 Ethiopian fiscal year.
- ❑ Developed simple and user-friendly excel based medical oxygen & consumables devises forecasting tool for individual health facilities use.
- ❑ In addition, during the workshop, Global Gas Group GGG UAE company delivered presentation about their global experience in scaling up access to medical oxygen through the introduction of economically feasible, quality and cost-effective Liquid oxygen (LOX) bulk production, transport and supply to high demand hospitals and their catchment health facilities in affordable & reasonable price.

Medical Oxygen & Devises Supply planning and Quantification Tool Development Workshop Report

Detail Finding and Results

A. Medical Oxygen 2023 to 2027 Forecast Review

Some of the hospitals specific data entered on UNICEF OSPT forecast tool were empty, incomplete, and inaccurate such as regions/zone/Wereda, and GPS coordinate/distance from the nearest oxygen plants were missing especially for primary hospitals. There were incorrect data entered on the number of patient beds available, and bed occupancy rate (eg outlier more than 100 %). 319 public primary hospitals data entered and some were found to be private, and some were repeated. Some of the nationally available functional oxygen plants data used for forecasting were inaccurate or incomplete, regarding whether they are currently functional or not, actual current oxygen production capacity, and future oxygen plants to be established were considered, which underestimated the future oxygen plants demand forecast.

The purpose of the review was to check & correct incomplete, missed, and correctness of facility specific data used for hospitals demand forecasting, and to review the national **medical oxygen producing public & private plants** data used in forecasting. Therefore, hospital specific data's, and assumptions used in previous national medical oxygen & devises (2023 to 2027) forecasting reviewed. The **nationally available medical oxygen producing public & private plants information** data entered in OSPT forecast tool were revised accordingly.

B. Medical Oxygen Delivery Devises Forecasting

Out of the oxygen delivery devices, UNICEF OSPT Forecast tool only quantifies the consumable nasal cannula however there are other important oxygen delivery devices including mechanical Ventilators, CPAP, BiPAP, HFNC, nasal catheter, face mask, venturi mask, HFNC etc which are not considered by UNICEF OSPT tool and also were not considered in previous medical oxygen devises forecasting. There was a need to develop clear assumptions for medical oxygen delivery equipment's and patient administration consumables devises considering the high flow and low flow requirements.

Table 1. **Lists of Patient Oxygen Delivery/Administration Devises Considered**

Devices Category	Type of Devices
Low Flow Oxygen Delivery Devices (Consumables)	Nasal Cannula (Nasal Prong)
	Nasal catheter (Transtracheal oxygen catheter)
	Simple Face Mask
	Non-rebreather facemask (Face Mask with Reservoir Bags)
High Flow Oxygen Delivery Devices (Consumables)	Venturi Mask
	High-flow nasal cannula (HFNC)
Invasive Oxygen Delivery Devices	Mechanical Ventilator
Non-invasive Oxygen Delivery Devise	HFNC Machine (High Flow Nasal Cannula)
	CPAP Machine
	BiPAP Machine

Medical Oxygen & Devises Supply planning and Quantification Tool Development Workshop Report

General Assumptions

This was a national level quantification for all health tier levels on medical oxygen, and associated supplies, consumables and devices. In order to quantify the appropriate need of the health facilities nationally, the following references & data sources were used:

- NICU Levels & standards document
- Emergency ICU level standard document
- National specialty Roadmap document
- Ethiopian standard agency document on Health facilities requirements
- National training manual on Oxygen therapy in children & adults
- Expert opinion (consultation with senior pediatric emergency & critical care specialist/intensivist, intensivist & Anesthesiologist)
- Morbidity data or case reports
- Number of functional and planned oxygen plants
- The usability of consumables was considered as one time use and throw
- From the total expected hypoxemic cases the following proportion of oxygen delivery devices were used: for Low flow oxygen accounts 80%, high flow for 10%, non- invasive for 8% & for invasive devices 2% based on the practicing clinical expertise opinion.
- Since oxygen concentrator 8 LPM not available at market, instead we used oxygen concentrator 5 LPM and 10 LPM
- The oxygen delivery devices are categorized based on their level of flow rate and invasiveness such as low flow / high flow oxygen, non-invasive / invasive devices.
- The following proportion of patients by age group: Neonate 10%, Pediatric 30%, & Adult 60% was used to quantify the medical oxygen devises.

Table 2: Forecasting assumption made for consideration of medical oxygen delivery devices categories and various specific types proportion.

Oxygen Delivery Devices Category	Expected % of Users Hypoxemic cases	Type of consumable Devices	% from Specific Device Category
Low Flow Oxygen Delivery Devices (Consumables)	80%	Nasal cannula	50%
		Simple Face mask	40%
		Nasal catheter	10%
High Flow Oxygen Delivery Devices (Consumables)	10%	Venturi Mask	30%
		Non-rebreathing mask	70%
Invasive Oxygen Delivery Device	2%	Mechanical Ventilator	100%
Non-invasive Oxygen Delivery Device	8%	HFNC Machine	
		CPAP Machine	
		BiPAP Machine	

Table 3: Low and high flow delivery devices flow rate

Delivery device	Flow rate (LPM)	FiO2 (%)
Nasal cannula	2-6	25-40
Simple face mask	6-10	35-50
Venturi mask	3-10	24-60
Non-rebreather mask	10-15	80-90
High flow nasal cannula	30-60	100

i. Low Flow Oxygen Delivery Devices

Patients with chronic airway disorders, smoke inhalation, carbon monoxide poisoning, and severe hypoxia who are ventilating effectively often utilize these low-flow devices. Low flow nasal oxygen devices include nasal cannula/prong, simple face mask, and nasal catheter. Nasal cannula is the most common type of low flow oxygen delivery system. The flow rate for such kind of delivery system ranges between 0 to 15 Liter/Minute. Generally, these are commonly used by all health facilities across the tier level and have a major share i.e. 80% consumption among the other category of delivery devices and the following assumptions were considered.

- Total number of hypoxemic admissions at all health tier system
- The proportion of oxygen delivery supplies was determined from the total hypoxemic admissions based on practicing expert opinion.
- Based on the care seeking (scope of care) practiced at all level of health tier system

ii. High Flow Oxygen Delivery Devices

High flow systems deliver very accurate oxygen concentration at flow rates that exceed patients' respiratory requirement and provides flows of at least 50-60 Liter per Minute. These delivery devices have 10% consumption compared to the other category and the assumptions used for these commodities are here stated below.

- Total number of hypoxemic admissions from CEMONC health center up to tertiary hospitals
- The proportion of oxygen delivery supplies was determined from the total hypoxemic admissions based on practicing expertise opinion/ consultation.
- Based on the care seeking (scope of care) practiced from CEMONC health center up to tertiary hospitals

iii. Non-invasive Oxygen Devices

Non-invasive devices are estimated to account for 8% of the total oxygen delivery devices category and they are safe and suitable for providing ventilations and oxygen to hypoxemic patients. Non-invasive devices include high flow nasal cannula device, CPAP, BiPAP, oxygen concentrator, oxygen cylinders, oxygen plants, pulse oximeters, and resuscitator - manual. Reference???

iv. Invasive Oxygen Delivery Devices

These devices are minimally invasive in which certain parts of their components are inserted temporarily or permanently into the patient's body (intubation). Invasive medical devices are estimated to have 2% share among the other oxygen delivery devices and include mechanical ventilators.

The following references and source of data have been considered during forecasting:

- NICU Levels & standards document
- Emergency leveling standard document & ICU implementation guideline
- National specialty Roadmap document
- Ethiopian standard agency document
- Expert opinion (consultation with senior pediatric emergency & critical care specialist/ intensivist, intensivist & Anesthesiologist)

Table 4: Low Flow Oxygen Delivery Consumable Devices (80%) Assumptions and Estimated National Annual Demand

Formula to calculate estimated total Forecasted quantity of each oxygen delivery device = Total no. Annual hypoxemic Cases X 80 % X Proportion (%) of Device from their Category X **Scope of Care (%)**

Type of Health Facility	# of Facility	Total no. Annual hypoxemic Cases	No. of nasal prong needed	No. of face mask needed	No. of Nasal catheter needed	nasal catheter (%)	nasal prong/c annula (%)	face mask (%)	Total % Sum	Scope of Care (%) Based on Expert team opinion	Remark
						Proportion (%) from their category based on practicing clinician expert opinion					
Tertiary Hospital	35	120,120	12,012	9,610	2,402	10%	50%	40%	100%	25%	In this tier level have an equal chance of providing service with referral HL
General Hospital	108	156,273	15,627	12,502	3,125	10%	50%	40%	100%	25%	In this tier level have an equal chance of providing service with referral HL
Primary Hospital	319	176,492	16,237	12,990	3,247	10%	50%	40%	100%	23%	
CEmONC HC	265	78,440	4,706	3,765	941	10%	50%	40%	100%	15%	Have high O2 demand, in-patient service,
Non-CEmONC HC with in-patient	1596	338,352	6,767	5,414	1,353	10%	50%	40%	100%	5%	
Non-CEmONC HC without inpatient	1928	383,672	7,673	6,139	1,535	10%	50%	40%	100%	5%	
Comprehensive Health Posts	358	20,406	163	131	33	10%	50%	40%	100%	2%	Service is limited, # of Comprehensive Health Posts (CHPS) are small in Qty
Column Total	**4609**	**1,273,755**	**63,187**	**50,549**	**12,637**					**100%**	

Table 5: High Flow Oxygen Delivery Consumable Devices (10%) Assumptions and Estimated National Annual Demand

Formula to calculate estimated total Forecasted quantity of each oxygen delivery device = Total no. Annual hypoxemic Cases X 10 % X Proportion (%) of Device from their Category X **Scope of Care (%)**

Type of Health Facility	# of Facilities	Total no. Annual hypoxemic Cases	Venturi Mask	Non-rebreathing mask	# of Venturi mask needed	# of non-rebreathing mask needed	Scope of Care (%) Based on Expert team opinion	Remark
			Proportion (%) from their category based on practicing clinician expert opinion					
Tertiary Hospital	35	120,120	30%	70%	1,802	4,204	50.00%	Due to specialist/expert opinion on hospital utilization
General Hospital	108	156,273	30%	70%	1,875	4,376	40.00%	
Primary Hospital	319	176,492	30%	70%	424	988	8.00%	Scope Care: Not included in the Ethiopian Standards, but there will be an expansion of critical care in primary hospital
CEmONC HC	265	78,440	30%	70%	47	110	2.00%	Scope Care: Not included in the Ethiopian Standards, but there will be an expansion of critical care in primary hospital
Non-CEmONC HC with in-patient	1596	338,352	0%	0%	-	-	0.00%	No probability to use high flow
Non-CEmONC HC without inpatient	1928	383,672	0%	0%	-	-	0.00%	
Comprehensive Health Posts	358	20,406	0%	0%	-	-	0.00%	
Total	**4609**	**1,273,755**			**4,148**	**9,678**	**100.00%**	

Table 6: Summary of HFNC, CPAP, BIPAP and Mechanical Ventilators Forecasting Assumptions and 5 Year Forecasted Demand

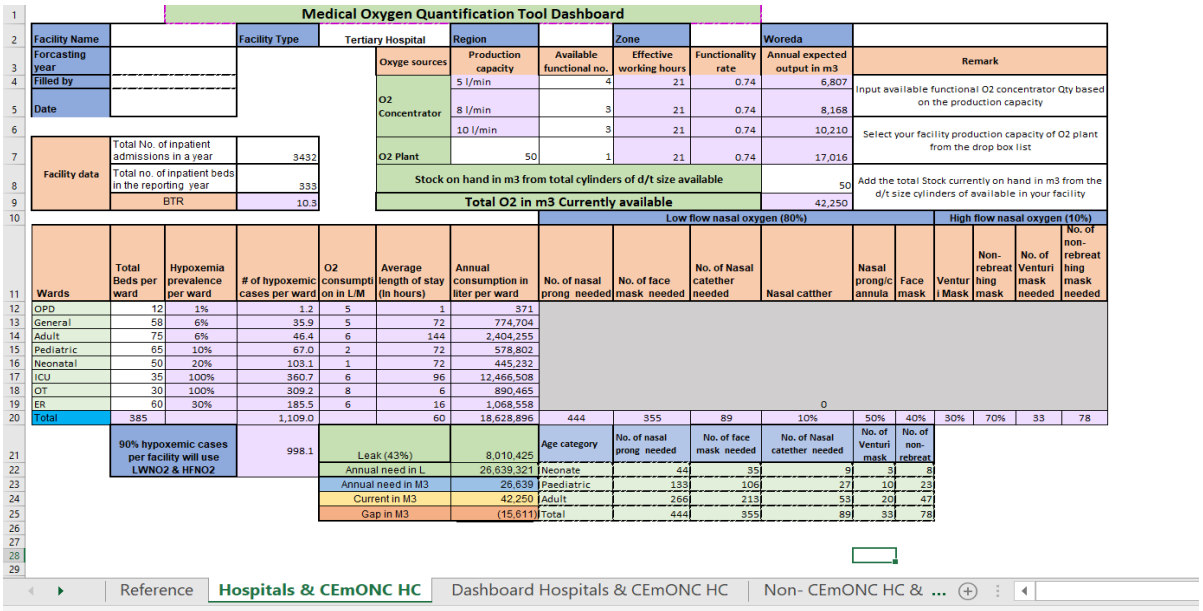
Facility Type	# of HFs	NICU Recommends	EmCC (CPAP/BiPAP), & SP ROADMAP Recommends	Agreed Quantity per Facility	Total # Devices Required 5 Year
HFNC Forecasting Assumptions and Estimated 5 Year Device National Requirements					
Tertiary Hospital	35	0	2	2	70
General Hospital	108	0	1	1	108
Primary Hospital	319	0	0	0	0
CPAP Forecasting Assumptions and Estimated 5 Year Device National Requirements					
Tertiary Hospital	35	10	2	12	420
General Hospital	108	6	1	7	756
Primary Hospital	319	4	1	5	1595
BiPAP Forecasting Assumptions and Estimated 5 Year Device National Requirements					
Tertiary Hospital	35	0	2	2	70
General Hospital	108	0	1	1	108
Primary Hospital	319	0	1	1	319
Mechanical Ventilator Assumptions and Estimated 5 Year Device National Requirements					
Tertiary Hospital	35	4	10	14	490
General Hospital	108	0	8	8	864
Primary Hospital	319	0	6	6	1914

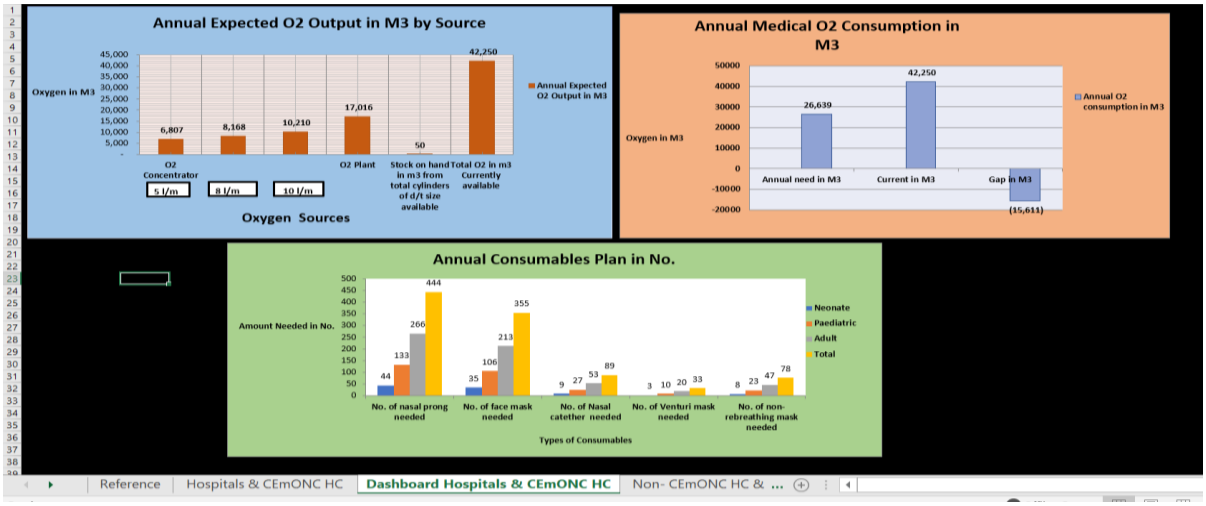
C. Medical Oxygen & Devices Forecasting Tool Development

As part of this workshop, the national medical oxygen quantification team drafted a medical oxygen and consumable oxygen delivery devices forecasting tools based on morbidity and or consumption methods. The aim was to develop simple and user-friendly medical oxygen and devices annual demand forecasting tool for individual health facility level use. medical oxygen and consumable devices. Figure 1 below shows the draft medical oxygen and consumables devises forecasting tool using morbidity methods.

In developing the forecasting tools the team also incorporated a reference section sheet for users on direction for use, definitions of important terminologies, assumptions, limitation of the tool including medical oxygen devices that cannot be forecasted using the tool etc. The tool also incorporated dashboard to show the major forecast results in graphs and charts.

Figure 1: Medical oxygen & Consumables Oxygen Delivery Devises Forecasting Tool (Morbidity method)





Both the morbidity and consumption based draft forecasting tools needs further detail review and development to make it more simple, user-friendly and applicable.

D. Accessories & Spare parts Forecast

The accessories and spare parts for oxygen plant, patient monitor, CPAP, BiPAP, Mechanical ventilators and cylinder filling station were not captured by the OSPT tool. And the team has made some assumptions to estimate the cost of each item for the above-mentioned items. (Summary of the assumption and 5 year forecast demand expected to be revised and developed by Alex and Samuel team)

Table 7: National Level 5 years Spare part quantification

* Determined by expert opinion and device manufacturers

SN	Spare Parts and Accessories	Assumption
1	Pulse Oximeter probe - pediatric	2 per POx
2	Pulse Oximeter probe - neonatal	2 per POx
3	Pulse Oximeter probe – Adult	3 per POx
4	Nasal cannula – pediatric	26 per concentrator and cylinder
5	Oxygen masks – pediatric	26 per concentrator and cylinder
6	Nasal cannula – Adult	26 per concentrator and cylinder
7	Oxygen masks – Adult	1 per 8 concentrators and cylinder
8	4 FT Hose 1/8”	1 per 8 concentrators and cylinder
9	Antibacterial filter for available concentrator	1 per concentrator
10	External intake filter (also gross particle filter)	1 per concentrator
11	Sieve beds for available concentrator	2 per 8 concentrators
12	Compressor for available concentrator	1 per 8 concentrators
13	Compressor kit for available concentrator	4 per 8 concentrators
14	Compressor filter for available concentrator	4 per concentrator
15	Circuit breaker for available concentrator	1 per 4 concentrators
16	Flowmeter for available concentrator	1 per 8 concentrators
17	Capacitors	1 per 4 concentrators (Devilbiss have capacitor)
18	Printed Circuit Board for available concentrator	2 per 8 concentrators
19	Cooling fans for available concentrator	1 per 8 concentrators
20	Exhaust Muffler for available concentrator	1 per 8 concentrators
21	Humidifier bottles for available concentrator	2 per concentrator
22	Check valve	1 per 8 concentrators
23	Rotary valve	1 per 8 concentrators
24	Pressure regulator, gauges (inlet/outlet) and flow meter for cylinders	10 per 1 cylinder
25	Flow splitters AND accompanying flow/regulating nozzles	15 % of the concentrators and cylinders will be at NICU and Pedi ward
26	Oxygen analyzers	1/Hospital
27	Monitor PCB	2 per 8 monitors
28	Monitor battery	2 per 8 monitors
29	Probs_SPO2	3 per 1 monitor
30	Probs_Temp	3 per 1 monitor
31	NIBP/IBP Cuff	3 per 1 monitor
32	ECG lids with connectors	3 per 1 monitor
33	Monitor Modules_SPO2	2 per 8 monitors
34	Monitor Modules_ET CO2	2 per 8 monitors

35	Monitor Modules_NIBP/IBP	2 per 8 monitors
36	Screen	2 per 8 monitors
37	Sampling line for ET CO2 function Module	3 per 1 monitor
38	Filter Element Kit	3
39	Oil Separator Element	1
40	Lubricant Oil	3
41	Belt	1
42	Air Filter Element	3
43	Oxygen Filter Element	1
44	High Pressure Horse	10
45	Check Valve	1
46	Oxygen Sensor	1
47	Pressure Transmitter	2
48	Instrument Light	1
49	Emergency Button	1
50	Power Button	1
51	Pressure Gauge	5

Medical Oxygen & Devises Supply Planning

Supply planning is a process of determining which health products should be procured, the amount to be procured, the time at which they should be delivered, and the financial costs to be incurred. It requires data on forecasted amounts, stock on hand, stock on order, lead times, wastage, and logistics costs, and minimum and maximum stock levels to estimate the requirements.[2] In general, any health commodities supply planning follows the following steps.

Supply Planning Steps

1. Organize, analyze, and adjust data
2. Build supply planning assumptions
3. Calculate total commodity requirements and costs
4. Develop supply plan
5. Compare costs to available funding

Step 1, Organize, Analyze, and Adjust Supply planning Data

To determine the total actual quantities to procure for the established procurement period (one year in this case). The following supply planning data are required, that need to be organized, analyzed, and adjusted depending on data unavailability, incompleteness, unreliableness, or outdated, and assumptions were made. Data required for the supply planning were the following:

[2] John Snow, Inc. 2017. Quantification of Health Commodities: A Guide to Forecasting and Supply Planning for Procurement. Arlington, Va.: John Snow, Inc.

Medical Oxygen & Devises Supply planning and Quantification Tool Development Workshop Report

Supply Planning Data Needs

- **Stock on hand**
- **Expiration dates** for consumables products (oxygen, nasal canula etc) in stock to assess whether they will be used before expiration /**Lifespan for equipment's**
- **Pipeline products quantities**, products in shipment / transport already ordered, but not yet received
- **Established shipment/ transport intervals** and current shipment delivery schedule
- **Established national/ program /facility level**– min & max stock levels for consumables if available
- **Product information** –product specific characteristics (formulations, dosages, number of units per pack size, unit cost, and others) accessories, spare parts, bundling issues etc
- **Supplier information** – prices, packaging, lead times, shipping & handling costs
- **Funding information** –Available funding sources, time commitments, funding disbursement schedules to determine when funding will be available for procurement from each source
- **Distribution information** – customs clearance fees for international procurement, in-country storage and distribution costs, if applicable, in-country sampling/quality testing costs
- **Installation, Commissioning, maintenance costs etc**

Step 2, Supply planning Assumptions Building and Consensus

Assumptions and consensus are made on adjustments to historical program data when data are missing, unreliable, outdated, or incomplete as most often, complete data are not available. Most critical point in the assumptions-building process is to document clearly and specifically the sources of information and the key informant inputs on the assumptions.

Summary of Supply Planning Assumptions

The following key supply planning assumptions were made during the medical oxygen & devices supply planning including the following.

- Historical consumption trend data analysis was used, but the trend data in the typical year of 2020/2021 was not considered due to the prevalence of COVID-19 outbreaks.
- The National Stock on Hand as of yekatit 5, 2015 E. C was considered by adjusting the expiry date and excluded the quantity for products which have less than six months of expiry.
- Pipeline stock on hand was taken in to account
- A buffer stock of six months was considered for consumables

Step 3, Calculating total commodity requirements and costs

To determine the quantity of each product needed to meet the forecasted consumption, and to ensure that the in-country supply pipeline has adequate stock levels to maintain a continuous supply to health facilities. Each product estimated total actual quantity requirements for the forecast period is calculated using the following formula.

Estimated actual total product quantity requirement for the forecast period = (A + B + C) – (D + E)

Where as

- **A** is quantities required as determined by the previous national forecast,
- **B** is additional quantities required to cover procurement and supplier lead times and buffer stocks P
- **C** is any significant quantities that will be removed from inventory due to expiry before usage
- **D** is Quantity of each product already in stock in the country (stock on hand)
- **E** Any quantities that have been ordered but not yet received (quantity on order).

Step 4, Supply Plan Development

In developing the supply plan the following general assumption were considered.

- A shipment should be scheduled to arrive when the national MOS reaches the established minimum stock level.
- The quantity of product to order should bring the national MOS back up to the established maximum stock level.
- Round the quantity to order up to the nearest whole unit of supplier packaging.
- Updated sources of information on drug prices and supplier rates are needed to estimate the cost of the quantities of medicines to be ordered.
- Devices cost includes costs such as insurance and freight, customs clearance and duties, in-country storage and distribution, installation, commissioning, supply of accessories & spare parts

Summary of Medical Oxygen & Devices Supply Plan 2016 EFY

The summary shows general information about the general list of commodities along with their unit and quantity to be procured for 2016 EFY, but the details of the plan have been appended here.

Table 7: Summary of 2016 EFY budget year annual medical oxygen supplies and devices procurement plan

SN	Item Name	Unit	National SOH	Pipeline SOH	Net MOS	Net Qty Requirement	Estimated Unit Price in USD	Estimated Total Price in USD
	Nasal Cannula/Prong – Oxygen							
1	Nasal Cannula/Prong-Oxygen, Adult	Each	1,600	0	0.46	60,824	5.82	353,995.68
2	Nasal Cannula/Prong-Oxygen, Pediatric	Each	600	0	0.35	30,612	4.49	137,447.88
3	Nasal Cannula/Prong-Oxygen, Neonate	Each	0	0	0.00	10,404	3.92	40,783.68
	Face Mask - Oxygen							
4	Face Mask - Oxygen, Adult	Each	112,371	0	50.64	0	0.45	0.00
5	Face Mask - Oxygen, Pediatric	Each	68,430	0	61.68	0	0.413	0.00
6	Face Mask - Oxygen, Infant	Each	0	0	0.00	6,656	0.385	2,562.71
	Nasal Catheter – Oxygen							
7	Nasal Catheter - Oxygen, Adult	Each	11,600	0	8.63	12,592	0.26	3,273.92

8	Nasal Catheter - Oxygen, Pediatric	Each	5,600	0	8.33	6,496	0.22	1,429.12
9	Nasal Catheter - Oxygen, Neonate	Each	0	0	0.00	4,032	0.2	806.40
	Venturi Mask							
10	Venturi Mask - Adult (Large)	Each	590	0	2.84	3,147	0.8	2,517.44
11	Venturi Mask - Pediatric (Medium)	Each	0	0	0.00	1,868	0.64	1,195.78
12	Venturi Mask - Neonate (Small)	Each	150	0	4.34	473	0.51	241.13
	Non-rebreathing Mask							
13	Non-rebreathing Mask - Adult (Large)	Each	4,100	0	17.89	26	0.53	13.57
14	Non-rebreathingMask-Pediatric (Medium)	Each	0	0	0.00	2,063	0.53	1,093.28
15	Non-rebreathing Mask - Infant (Small)	Each	0	0	0.00	688	0.53	364.43
	CPAP Mask							
16	CPAP Mask - Adult (Large)	Each	100	0	0.90	1,898	17.31	32,854.38
17	CPAP Mask - Pediatric (Medium)	Each	202	0	3.64	797	17.31	13,796.07
18	CPAP Mask - Neonate (Small)	Each	0	0	0.00	333	17.31	5,764.23
	Endotracheal Tube Cuffed							
19	Endotracheal Tube Cuffed- 3CH	Each	29,289	0	38.02	0	0.345	0.00
20	Endotracheal Tube Cuffed-3.5CH	Each	8,716	0	14.75	1,921	0.345	662.57
21	Endotracheal Tube Cuffed-4.5CH	Each	1,005	5,250	10.51	4,460	0.361	1,610.06
22	Endotracheal Tube Cuffed-5.5CH	Each	0	12,996	21.62	0	0.372	0.00
23	Endotracheal Tube Cuffed- 6CH	Each	13,693	0	5.76	29,106	0.378	11,002.07
24	Endotracheal Tube Cuffed-6.5CH	Each	93	22,950	15.28	4,099	0.384	1,573.82
25	Endotracheal Tube Cuffed- 7CH	Each	2,537	0	0.95	45,337	0.386	17,499.89
26	Endotracheal Tube Cuffed-7.5CH	Each	0	19,080	34.20	0	0.386	0.00
	Tracheostomy Tube							
27	Tracheostomy Tube - with 90-degree curvature size 3.0	Each	0		0.00	743	1.44	1,069.20
28	Tracheostomy Tube - with 90-degree curvature size 4.5	Each	0		0.00	1,170	1.44	1,684.80
29	Tracheostomy Tube - with 90-degree curvature size 6.0	Each	0		0.00	540	1.44	777.60
30	Tracheostomy Tube 6.5 mm with 90 curvature armored with low Pressure Cuff Universal	Each	0	0	0.00	6,785	1.52	10,313.77

	inflation funnel and pilot balloon plastic							
31	Tracheostomy Tube 7.0 mm with 90 curvature armored with low Pressure Cuff Universal inflation funnel and pilot balloon	Each	0	1,115	0.00	1,734	1.56	2,705.04
32	Tracheostomy Tube 7.5 mm with 90 curvature armored with low Pressure Cuff Universal inflation funnel and pilot balloon	Each	0	0	0.00	2,511	1.61	4,041.91
33	Tracheostomy Tube 8 mm with 90 curvature armored with low Pressure Cuff Universal inflation funnel and pilot balloon metallic	Each	0	0	0.00	2,511	1.68	4,217.64
34	HFNC Machine	Each	0	0		36	1488	53,568.00
35	CPAP Machine	Each	88	0		466	659.96	307,541.36
	CPAP Spare parts for 5 years							
36	Breathing tube (in cm)	Each	0			4,660	12.8	59,648.00
37	BiPAP Machine	Each	0	0		99	1350.78	133,727.22
	Resuscitator – Manual							
38	Resuscitator - Manual, Adult	Each	3,322	0		0	17.5	0.00
39	Resuscitator - Manual, Pediatric	Each	1,239	0		0	17.5	0.00
40	Resuscitator - Manual, Infant	Each	484	0		0	16.6	0.00
41	Resuscitator - Manual, Neonate	Each	0			1,017	16.6	16,882.20
	Oxygen Plants and refilling station							
42	Extra Large 100 Nm3/hr Oxygen Plant	Each	0			0	500,000	0.00
43	Medium (30 Nm3/hr) oxygen plant	Each	0			0	250,000	0.00
44	Oxygen refilling station for medium plant	Each	0			3	100,000	300,000.00
	Oxygen Concentrators							
45	Oxygen Concentrator - 10 LPM	Each	4,899			0	1,780	0.00
46	Oxygen Concentrator - 5 LPM	Each	4,288			0	800	0.00
	Oxygen concentrator accessories							
47	Flow splitters	Each	0	0		680	105	71,400.00
48	Tubing (in cm)	Each	0			7,834	2	15,667.60
49	Surge suppressors	Each	0			2,129	118	251,174.80
50	Voltage stabilizers	Each	0			2,129	75	159,645.00

	Oxygen concentrator spare parts for 5 years							
51	Spare part kit for 10 LPM Concentrator	Kit	0			1,449	100	144,880.00
52	Spare part kit for 5 LPM Concentrator	Kit	0			680	100	67,980.00
53	Oxygen Analyzer	Each				1,032	435.7	449,642.40
	Oxygen Cylinder							
54	Oxygen Cylinder, Size "E" (Gaseous pressure volume 680 L), Liquid volume (10 L)	Each	0	0		527	110.8	58,391.60
55	Oxygen Cylinder, Size "G" (Gaseous pressure volume 3400 L), Liquid volume 30 L	Each	0	0		972	180.56	175,504.32
56	Oxygen Cylinder, Size "J" (Gaseous pressure volume 6800 L), Liquid volume 50 L	Each	0	0		1,466	250	366,550.00
	Cylinder accessories							
57	Regulator	Each	0			1,769	100	176,880.00
58	Flow meter	Each	0			747	90	67,194.00
59	Humidifier	Each	0			1,686	30	50,580.00
60	Pulse Oximeter - Hand Held	Each	5,926	0		0	275.8	0.00
	Pulse oximeter spare parts for 5 years							
61	Adult SPO2 probes	Each	0			14,866	120	1,783,920.00
62	Pediatric SPO2 probes	Each	0			5,574	120	668,880.00
63	Neonatal SPO2 probes	Each	0			5,572	120	668,640.00
64	Battery for handheld	Each	0			3,344	80	267,520.00
65	Pulse Oximeter - Finger Tip	Each	4,631	0		0	221.3	0.00
	Pulse Oximeter spare parts for 5 years							
66	Battery	Each	0			1,818	60	109,104.00
67	Monitor - Patient	Each	367	0		225	5500.49	1,237,610.25
	Patient monitor accessories							
68	ECG cable	Each	0			450	230	103,500.00
69	ECG Lead Electrodes	Each	0			675	145.43	98,165.25
70	SPO2 probe	Each	0			450	132.15	59,467.50
71	NIBP Cuff with cable	Each	0			450	113.65	51,142.50
72	IBP disposable kits	Each	0			1,125	151.46	170,392.50
73	Temperature probe dual	Each	0			225	68.45	15,401.25
74	Ventilator - Mechanical	Each	306	0		348	11,563.99	4,024,268.52
	Ventilator accessories							
75	Disposable adult breathing circuit	Each	0			25,056	15	375,840.00

76	Disposable pediatric breathing circuit	Each	0			13,572	12.8	173,721.60
78	Bacterial filter	Each	0			1,044	3.6	3,758.40
	Ventilator spare parts for 5 years							
79	Oxygen sensor	Each	0			1,044	64.67	67,515.48
80	Battery	Each	0			348	550	191,400.00
Total Price in USD								13,652,401.82
Price contingency							5%	682,620.09
Procurement & Distribution							7%	955,668.13
Freight							10%	1,365,240.18
Insurance							1%	136,524.02
Bank Service							2%	273,048.04
Maintenance							7.00%	955,668.13
Custom Tariff							5.00%	682,620.09
Grand Total Price in USD								**18,703,790.49**

CAPEX & OPEX Cost Summary Breakdown

Note that the national summary forecast cost estimation does not include the following costs including oxygen cylinders refill & transport cost, PSA plants, patient monitor, and filling station accessories and spare part costs, and does not include devises installation, training, maintenance costs. To be developed during the next medical oxygen & devise forecast review and supply planning workshop.

	Pulse oximetry	**Primary Recommendation**	**Secondary Recommendation***
CAPEX			
Initial product cost			
Accessories			
Shipping			
Tariff and customs			
Distribution			
Installation			
Power back up			
OPEX (for 5 years)			
Electricity costs			
Cylinder refill costs			
Transportation costs			
Cylinder rental Cost			
Spare parts			
Consumables			

Operation costs			
Maintenance			
Device replacement			
Training (one-time cost)			
TOTAL			

There is a need to develop the detail CAPEX and OPEX cost based on UNICEF OSPT recommended COSTING OVERHEADS ASSUMPTIONs (indicated in table and also considering country EPSA considered applicable costs.

COSTING OVERHEADS ASSUMPTIONS (According UNICEF OSPT Tool)

These costing overheads are percentages applied as additional costs on top of estimated capital equipment costs. The default %s is based on guidance from How to Plan and Budget for Your Healthcare Technology, in the "How to Manage" Series for Healthcare Technology (2005) and expert input.

Type of Costs	Cylinders	Concentrators	Plant	Pulse Oximeter
	UNICEF OSPT Tool Default Data			
Shipping*	3.0%	10.0%	10.0%	10.0%
Customs and Tariffs*	0.0%	0.0%	0.0%	0.0%
Distribution*	5.0%	5.0%	5.0%	5.0%
Installation*	5.0%	10.0%	15.0%	1.0%
Annual Operational **	2.0%	0.0%	10.0%	0.0%
Annual Maintenance**	1.5%	5.0%	17.0%	1.5%
Training***	5.0%	7.5%	10.0%	5.0%

* Calculated as percent of the equipment purchasing cost. Included in CAPEX. ** Calculated as a percent of the equipment purchasing cost. Included in OPEX. *** Calculated as a percent of the equipment purchasing cost. Included as its own budget item.

Limitation and Challenges

- ✓ UNICEF OSPT forecasting tool does not consider most of the oxygen delivery devices such as mechanical Ventilators, HFNC, CPAP/BiPAP machines, and patient administration consumable devices nasal catheter, simple face masks, venturi mask and nonrebreather masks. Hence, their demand forecast was performed separately making assumptions and calculations in excel.
- ✓ The medical oxygen & devises forecast doesn't consider the needs for possible future emergency covid19 & related pandemic situations, and the quantification team recommended to consider some level of contingency during the one-year supply plan development.
- ✓ Limited or no national studies, literatures, and reports on medical oxygen delivery devices utilization and hypoxemia prevalence and treatment services.
- ✓ Some the medical oxygen devices were not included in national EMLs, STGs and EPSS pharmaceutical procurement list (PPL). The impact of Covid-19 made the procurement trend unreliable with peak procurement and interrupted procurement trend for made the missing stockout data validation and adjustment for the non-PPL medical oxygen items forecasting hardly possible.
- ✓ Consumable oxygen delivery devices reusability factor was not clearly defined in national standards
- ✓ There was no facility level devices inventory data, only the national EPSS & hubs available stock on hand data was used for in the supply planning, which might overestimate the actual devices demands.
- ✓ There was no adequate inventory data on non-functional oxygen plants, their obsoleteness, lifetime, down time, whether they need spare parts or not, so that makes it difficult.
- ✓ As part of the supply planning, available funding sources, and commitment periods, and disbursement schedules were not identified, and the actual demand costs was not compared to available funding.

Recommendations

- ✓ There is a need to establish medical oxygen management information system to track and monitor oxygen, & related devices consumption, proper use, and inventory at facilities to ensure medical oxygen and devices supply chain data visibility and use for decision making at various levels.
- ✓ Half of hospitals data used for forecasting were obtained from national MOH DHIS-2, and MFR. And assumptions were made for remaining hospitals & health centers with no data on total number of beds per facility, OPD visits, inpatient admissions, bed occupancy rates, GPS coordinates etc. There is a need to perform sample facility data verification to check the accuracy of data used for forecasting.
- ✓ As part of the supply planning steps, available funding sources (donor, government, partners etc), time commitments, and disbursement schedules should be clearly identified to determine when funding will be available for procurement from each source.
- ✓ The medical oxygen & devices multiyear forecast and supply plan should be used to advocate for resource mobilization, and allocation adequate resources for future procurement to ensure uninterrupted and adequate supply of quality products and treatment services.
- ✓ Dissemination workshop should be organized with the national MOH, RHBs and higher hospitals officials, to create buy in on medical oxygen public health importance, and facilitate allocation of adequate budget for the procurement.The drafted medical oxygen and devises facility-based quantification tools needs further review and development to ensure their simplicity, user-friendliness and applicability for facility level use.

Medical Oxygen & Devises Supply planning and Quantification Tool Development Workshop Report

Annexes

Annex 1, List of Workshop participants (Diredawa, Feb 11 to 16, 2023)

No	Name	Sex	Profession	Position	Organization	Telephone	E-mail
1	Fayera Tadesse	M	Pharmacist	Officer	MOH	0911896047	fayera.tadesse@moh.gov.et
2	Azeb Demelash	F	Public Health	Officer	MOH	0913837791	azeb.demelash@moh.gov.et
3	Aklog Getnet	M	Public Health	Head	MOH	0913886453	aklog.getnet@moh.gov.et
4	Belayneh Girma	M	pharmacist	Head	EPSS	0976036232	belyaph@gmail.com
5	Addisu Fayera	M	BME	Expert	MOH	0921999951	addisufayera@gmail.com
6	Biniam Bahiru	M	pharmacist	Expert	MOH	0910728925	binipharma@gmail.com
7	Kiflemariam Tsegaye	M	Public Health	Expert	MOH	0913015866	kiflemariam.tsegaye@moh.gov.et
8	Dr Ashenafi Beza	M	Pediatrician	Senior O2 System Advisor	MOH	0912065857	ashenafi.beza@moh.gov.et
9	Dr Yared Tadesse	M	Pediatrician	MCH Advisor	MOH	0911637857	yared.tadesse@moh.gov.et
10	Mahdi Abdella	M	B. Pharm, MPH	Head	MOH	0989920400	mahdi.abdella@moh.gov.et
11	Free Made	F	Public Health	Expert	MOH	0910153113	freesmde@gmail.com
12	Ajeba Hassen	M	Public Health	Expert	MOH	0913703108	ajeb.hassen@gmail.com
13	Binyam Kemal	M	Public Health	Deputy Director	MOH	0962169265	binyam.kemal@moh.gov.et
14	Abrahaley Beyene	M	BME	Senior Officer	EPSS	0914375649	abrhaepsa@gmail.com
15	Regassa Bayisa	M	MSC	Director	MOH	0944303303	regassa.bayisa@moh.gov.et
16	Alemayehu Berhan	M	MPH	Officer	MOH	0912333918	alemayehu.berhan@moh.gov.et
17	Demeru Yeshitla	M	BME	BME Advisor	Jhpiego, RISE	0911652966	Demeru.Yeshitla@jhpiego.org
18	Samuel Tadesse	M	BME (MSc, MA)	BME Advisor	Jhpiego, RISE	0986863213	Samuel.Abebe@jhpiego.org
19	Tesfaye Godana	M	B. Pharm, MPH	Supply Chain STA	Jhpiego, RISE	0911962654	Tesfaye.Amare@jhpiego.org

Medical Oxygen & Devises Supply planning and Quantification Tool Development Workshop Report

Annex 2, Workshop Program (Schedule)

Time Session	Activity	Presenter's	Moderator's
Day One			
8:30 AM to 9:00 AM	Arrival and Registration	Participants	Jhpiego-RISE Team
9:00 AM to 9:15 AM	Opening Remark	Mr Mahdi Abdella,	Jhpiego-RISE Team
9:15 AM to 9:30 AM	Workshop Program & Norms	Samuel Tadesse, Jhpiego, RISE	FMOH Team
9:30 AM to 10:30 AM	National Medical Oxygen & Devises 2023 to 2027 Forecast Results	Tesfaye Godana, Jhpiego RISE	FMOH Team
10:30 AM to 10:45 AM	Group Formation and Tasks Allocation	Tesfaye Godana, Jhpiego RISE	FMOH Team
10:45 AM to 11:00 AM	**Coffee and Tea break**		
11:00 AM to 12:30AM	National Medical Oxygen & Devises 2023 to 2027 Forecast Review (Group	All Participants	Tesfaye Godana/Samuel
12:30 AM to 1:30 PM	**Lunch Break**	participant	
1:30 PM to 3:30 PM	National Medical Oxygen & Devises 2023 to 2027 Forecast Review (Group	participants	Tesfaye Godana/Samuel
3:30 PM to 3:50 PM	**Coffee and Tea break**		
3:50 PM to 5:30 PM	Forecast Review (Presentation & Discussion)	participants	Tesfaye Godana/Samuel
Day Two			
8:30 AM to 9:30 AM	National Medical Oxygen & Devises Supply Planning Introductory	Samuel Tadesse, Jhpiego RISE	EPSA and MOH PMED Technical leads
9:30 AM to 10:00 AM	Group Formation & Tasks Allocation	Samuel Tadesse, Jhpiego RISE	EPSA and MOH PMED Technical leads
10:00 AM to 10:20 AM	**Coffee and Tea break**		
10:20 AM to 12:30 AM	Supply Planning Group Work	All Participant's	EPSA and MOH PMED Technical leads
12:30 AM to 1:30 PM	**Lunch Break**		
1:30 PM to 3:40 PM	Supply Planning Group Work Continued	All Participant's	EPSA and MOH PMED Technical leads
3:40 PM to 4:00 PM	**Coffee and Tea break**		
4:00 PM to 5:30 PM	Supply Planning Group Work Continued	All Participant's	EPSA and MOH PMED Technical leads
Day Three			
8:30 AM to 10:00 AM	Supply Planning Group Work Continued	All Participant's	EPSA and MOH PMED Technical leads
10:00 AM to 10:20 AM	**Coffee and Tea break**		
10:20 AM to 12:30 AM	Supply Planning Group Work Continued	All Participant's	EPSA and MOH PMED Technical leads
12:30 AM to 1:30 PM	**Lunch Break**		
1:30 PM to 3:00 PM	Supply Planning Group Work Continued	All Participant's	EPSA and MOH PMED Technical leads
3:00 PM to 3:20 PM	**Coffee and Tea break**		

3:20 PM to 5:30 PM	Supply Planning Group Work Presentation & Discussions	Groups	EPSA and MOH PMED Technical leads
Day Four			
8:30 AM to 9:30 AM	Medical Oxygen & Devises Facility Forecasting Tool Development	Tesfaye Godana, Jhpiego RISE	Samuel Tadesse, Jhpiego RISE
9:30 AM to 10:00 AM	Group Formation and Tasks Assignment	Tesfaye Godana, Jhpiego RISE	EPSA and MOH PMED
10:00 AM to 10:20 AM	**Coffee and Tea break**		
10:20 AM to 12:30 AM	Forecasting Tool Development Group Work	All Participant's	
12:30 AM to 1:30 PM	**Lunch Break**		
1:30 PM to 3:00 PM	Forecasting Tool Development Group Work	All Participant's	RISE & MOH PMED
3:00 PM to 3:20 PM	**Coffee and Tea break**		
3:20 PM to 5:30 PM	Forecasting Tool Development Group Work	All Participant's	RISE & MOH PMED
Day Five			
8:30 AM to 10:00 AM	Forecasting Tool Development Group Work	All Participant's	RISE & MOH PMED
10:00 AM to 10:20 AM	**Coffee and Tea break**		
10:20 AM to 12:30 AM	Forecasting Tool Development Group Work	All Participant's	RISE & MOH PMED
12:30 AM to 1:30 PM	**Lunch Break**		
1:30 AM to 3:00 PM	Forecasting Tool Development Group Work	All Participant's	RISE & MOH PMED
3:00 PM to 3:20 PM	**Coffee and Tea break**		
3:20 PM to 5:30 PM	Forecasting Tool Development Group Work Update Presentations & Feedbacks	All Participant's	RISE & MOH PMED
Day Six			
8:30 AM to 10:00 AM	Forecasting Tool Development Group Work Finalization	All Participant's	RISE & MOH PMED
10:00 AM to 10:20 AM	**Coffee and Tea break**		
10:20 AM to 12:30 AM	Forecasting Tool Development Group Work Finalization	All Participant's	RISE & MOH PMED
12:30 AM to 1:30 PM	**Lunch Break**		
1:30 AM to 3:30 PM	Forecasting Tool Development Group Work Final Presentation & Discussion	All Participant's	RISE & MOH PMED
3:00 PM to 3:00 PM	Closing Remarks	MOH PMED Representatives	Jhpiego RISE Team