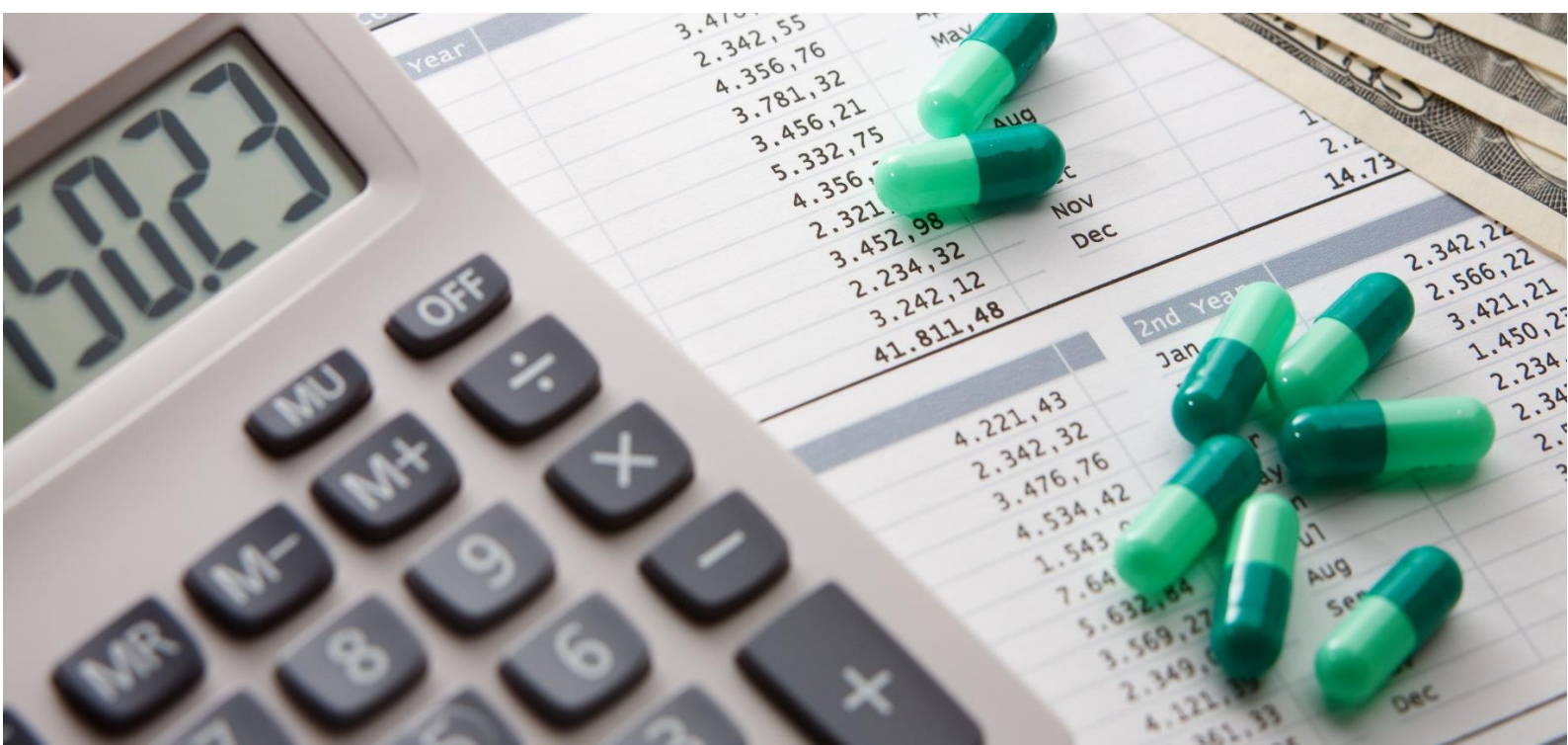


FIRST FORECASTING EXERCISE FOR THE VERY ESSENTIAL MNCH COMMODITIES PRIORITIZED BY THE DEPARTMENT OF HEALTH GOVERNMENT OF PUNJAB

2017-18 to 2022-23



Department of Health
Government of Punjab



This is a living document and will be updated on regular basis as and when required

**First Forecasting Exercise for the Very Essential Maternal, Newborn, and Child
Health Commodities Prioritized by the Department of Health, Govt. of Punjab**

March 2018

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With the technical support of United States Agency for International Development (USAID), Global Health Supply Chain Program - Procurement and Supply Management (GHSC-PSM) Project, the Department of Health, Government of Punjab has developed a province-focused forecast for the MNCH commodities listed in the Very Essential Medicines List (VEML) of Punjab.

As per the mandate of USAID, GHSC-PSM Project continues to lend its technical expertise to support forecasting and supply planning of MNCH commodities in Punjab. This forecast is a result of a close coordination between Department of Health and GHSC-PSM Project, hence proving to be a stepping stone towards the capacity building of the human resource of DOH-Punjab. In addition, it is aimed at the successful transition of all forecasting and supply planning activities to provincial governments which can lead towards the achievement of global supply planning benchmarks.

We would like to express our deepest appreciation to all the relevant public-sector stakeholders, development partners, experts and medical professionals for reviewing, contributing, guiding and supporting the Forecasting of MNCH commodities for Punjab.

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ACRONYMS

ANCS	Antenatal corticosteroids
ARI	Acute respiratory infection
PBS	Pakistan Bureau of Statistics
PDHS	Pakistan Demographic and Health Survey
CHX	Chlorhexidine
DHIS	District Health Information System
ECP	Emergency contraceptive pill
EML	Essential Medicines List
VEML	Very Essential Medicines List
EPI	Expanded Program on Immunization
FIGO	Federation of Gynecology and Obstetrics
PWD	Population Welfare Department
TWG	Technical Working Group
GDP	Gross domestic product
GOP	Government of Pakistan
HDI	Human Development Index
ICM	International Confederation of Midwives
IM	Intramuscular
IV	Intravenous
MMR	Maternal mortality rate
MNCH	Maternal, neonatal, and child health
DOH	Department of Health
MWRA	Married women of reproductive age
NGO	Non-governmental organization
ORS	Oral rehydration salts
PE/E	Preeclampsia and eclampsia
PHC	Primary health care center
PPH	Postpartum hemorrhage
UN	United Nations
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization
WRA	Women of reproductive age

INTRODUCTION

In May 2018, the Integrated Reproductive, Maternal, Newborn & Child Health (IRMNCH) & Nutrition Program, Department of Health, Punjab notified its first ever MNCH very essential medicines list for improving access to 17 priority commodities across the Maternal, Newborn, and Child Health (MNCH) continuum. As per mandate, the first ever Technical Working Group (TWG) on Forecasting and Supply Planning (FASP) was also notified in May 2018. The terms of reference for TWG focuses on developing institutional FASP capacity for these commodities; strengthening provincial supply chains; and improving data quality and availability. One of the supply chain areas for these commodities that was identified as particularly weak was forecasting and supply planning. For several of these commodities, the data required to estimate needs accurately are unavailable in many countries and national forecasts are based on unsubstantiated assumptions and often on data from past procurements. This is the case for many commodities procured by the IRMNCH & Nutrition Program, Department of Health (DOH) Punjab.

The Department of Health (DOH) Punjab requested USAID Global Health Supply Chain Program, Procurement and Supply Management (GHSC-PSM) Project, Pakistan, implemented by Chemonics International, to address supply chain management issues related to essential medicines, especially tracer drugs with maternal, new-born, and child health (MNCH) products, helping the Government of Punjab and other key provincial stakeholders to improve the security of essential health medicines in the province, strengthen the distribution and management information systems in place and build local capacity to strengthen health systems. As part of this effort, USAID GHSC-PSM Project has been working with relevant DOH, to improve forecasting and supply planning of MNCH commodities.

BACKGROUND

Punjab is Pakistan's second largest province by area and its most populous province; with an estimated population of 110,012,442 as of 2017. Among those, an estimated 35% live in rural areas. The population growth rate is 2.13% per annum (PBS) while it accounts for 59% of Pakistan's GDP.

http://www.finance.gov.pk/survey/chapters_17/Economic_Indicators.pdf

Taking into account the current annual population growth rate, the projections suggest that the population of Pakistan will go beyond 300 million by 2050. According to 2017 Population Census and 2017-18 economic survey of Pakistan, Punjab has the highest share of population of 52.9 percent in population pie but its share has declined as compared to 1998. The share of urban population in Punjab has increased from 31.27 percent in 1998 to 36.71 percent in 2017.

PDHS 2012-13 shows that Pakistan has a high infant and child mortality rate. Infant and under-five mortality rates in the past five years were 74 and 89 deaths per 1,000 live births respectively. At these mortality levels, 1 in every 14 Pakistani children die before reaching age 01, and 1 in every 11 does not survive to their 5th birthday.

According to PDHS 2012-13, Neonatal mortality remained unchanged for the last 20 years, whereas infant mortality has decreased by 19 percent and under-five mortality has decreased by 24 percent over the same period.

Deaths of newborns are mainly due to prematurity, asphyxia, and infections. Most of these deaths could have been prevented if newborns had adequate access to resuscitation devices, appropriate umbilical cord care, and timely treatment for sepsis. Substantial presence of acute respiratory infections and diarrhea also contribute to the elevated mortality rates for children.

The current estimated maternal mortality ratio (MMR) is 178 per 100,000 live births (WHO 2015), one of the highest rates in the world. One of the many factors that contribute to maternal mortality is the inadequate use of health services. Fifty-five percent of pregnant women deliver at health facilities, and skilled attendance at birth remains low at 52%. Most of the women die at the time of the birth because of postpartum hemorrhage, eclampsia and other indirect obstetric causes.

As the challenges cited above have demonstrated, strengthening the planning, procurement, and information management of maternal, newborn, and child health (MNCH) life-saving commodities is critical to the survival and quality of care for millions of women and children in Pakistan. The country has made commendable progress in the prevention and control of pneumonia and diarrhea-related complications despite many challenges and now must strive to build on that progress and reinvigorate efforts to address other causes of maternal and child mortality. To this end, it is essential that life-saving commodities be available when and where they are needed.

Current landscape:

Forecasting and supply planning (FASP) is the foundation for all other functions further down the supply chain as over estimation or underestimation of commodities can have serious implications on health delivery systems. It is a highly scientific and complex process, wherein numerous factors must be considered including demographics, morbidity rates, service data sets, and logistics data and requires a specialized skill set. Currently, FASP for a complete range of FP products for both departments and 17 MNCH commodities as per Very

Essential Medicines List (VEML) for health department is being undertaken with technical assistance from the GHSC-PSM project on the basis of logistics, demographic and morbidity indicators and enhancement in service delivery. Availability of qualified and experienced human resources, structures, and tools remains a challenge for improved accuracy and timeliness of forecasting and supply planning for all medicines and supplies. Due to gaps identified in FASP projections, serious anomalies persist in district demand (mainly in FP and MNCH products). Both departments realize the need for having a structured mechanism for accurate FASP with dedicated trained staff as part of the Integrated Supply Chain Management and Coordination Cell at DOH.

FASP Roadmap

The objective of this roadmap is to establish a fully functional and structured FASP mechanism that systematically determines province specific FP and MNCH commodity requirements, estimates their financial costs, and coordinates fulfillment of projected needs to support the continuous availability of commodities.

- Institutionalization of FASP through capacity building of provincial departments on accurate and timely forecasting quantification of FP & MNCH commodities and identification of champions form technical working groups (to be formulated) under the ISCM&CC. As FP supply chain has higher maturity than MNCH with respect to procurement planning and monitoring functions, it is expected that, modelling FASP for MNCH supply chain will help in attaining departmental capacity within 2-3 years.
- Three data sets: logistics, services, and morbidity will be considered for forecasting and quantification of MNCH commodities depending upon availability of data and its quality. Knowledge and information of health departments’ programmatic strategies will be important for accurate forecast and quantification of MNCH commodities. This needs to be ensured through document review and consultations with key stakeholders and / or focal points within the department.
- A forecasting exercise for FP and MNCH VEML will be done for three to five years and reviewed annually for adjustments, as per recommended models (Figure 1&2).

Priority areas for improvement

- Reliable and quality data sets (demographic, disease prevalence/morbidity, and logistics) for accurate forecasting
- Dedicated resources (financial & trained HR) for FASP

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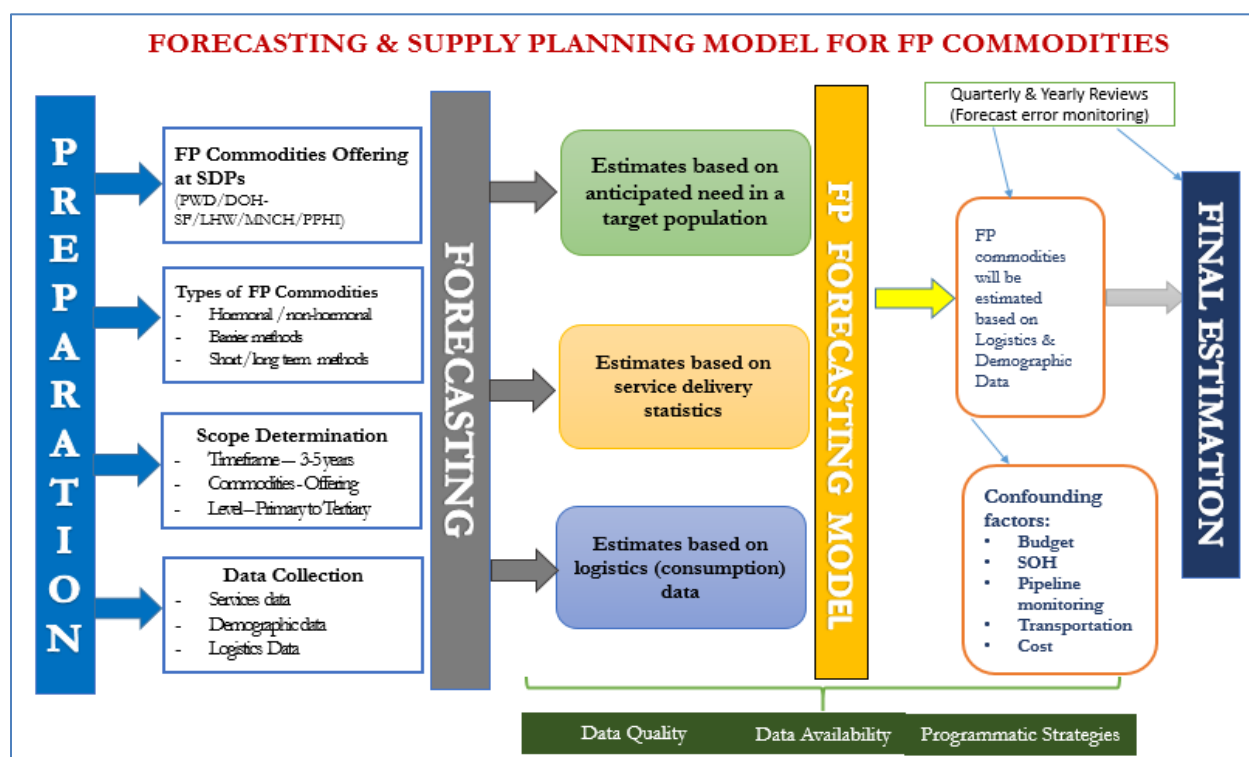


Figure 2: FASP Model for FP commodities

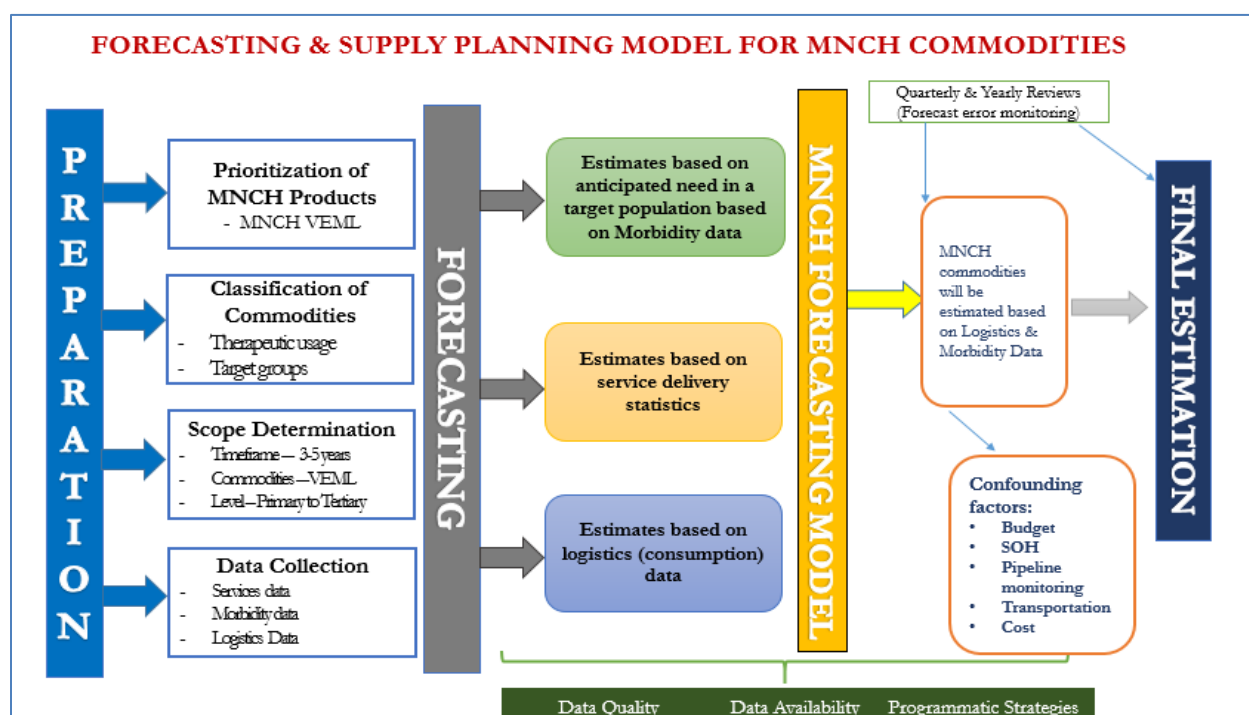


Figure 1: FASP Model for MNCH VEML

Implementation plan:

The health and population welfare departments of the Provincial Governments will carry out following activities to achieve articulated objectives.

- **Formation of Forecasting & Quantification Technical Working Group (TWG) at Provincial Level**
Both health and population welfare departments will establish and notify a forecasting and quantification TWG at the provincial level under Procurement and FASP unit of ISCM&CC. The TWG will systematically determine provincial FP and MNCH commodity requirements, estimate their financial costs, and coordinate fulfillment of projected needs to support the continuous availability of commodities. The TWG will also analyze quantification figures related to MNCH commodity security issues and improve provincial capacity to perform this task independently. Improved inter-departmental coordination will facilitate consensus building on scope and assumptions for forecasting and quantification. It will also minimize duplication of efforts and wastage of resources.
- **Create Professionalized and Trained Human Resources at the Provincial and District Levels**
At the provincial level, the capacity of the Procurement and FASP unit of the ISCM&CC will be trained in forecasting and quantification of FP and MNCH commodities. Pre-and in-service training courses will be organized / arranged that will contribute and ultimately lead to building of institutional capacity on forecasting and quantification within the provincial government.
- **Automation of Forecasting and Quantification Function into Integrated Web-based MIS**
To reduce the likelihood of computational inaccuracies, forecasting and supply planning functions will be automated incrementally and made part of the integrated supply chain management information system. The province will design an EML forecasting and supply planning module in the web-based integrated MIS and will train users on the module. Thus, forecasting and supply planning will be graduated from manual to automated computation. The automation will help in timely and accurate forecasting and supply planning, which will, in turn, assist in procurement and commodity security.

RATIONALE FOR UNDERTAKING THIS EXERCISE

The Department of Health, Government of Punjab has documented the limited capacity within its structure to conduct the forecast for essential MNCH commodities. This lack of capacity has compelled the provincial health department and MNCH program to rely on the use of past distribution data and estimates of patient flows at facilities to calculate the need for MNCH commodities. The respective officials develop medicine requirements that are not scientifically appropriate to meet the current needs, thus making it difficult to maintain appropriate inventory to meet the needs of clients in the province. This current practice sometimes yields stock imbalances, stock-outs of some important medicines, and a preponderance of emergency orders, which in the end have been threatening the integrity of the MNCH programs. However, with the technical Assistance of GHSC-PSM project, the Directorate General of Health (DOH) of Punjab has established mechanisms to undertake the forecasting exercise of MNCH commodities through a Forecasting and Supply Planning Technical Group (FASP-TWG) comprised of technical experts and FASP champions. This approach helps to improve the forecasting and supply planning functions.

The need for a comprehensive harmonized and coordinated forecasting exercise (first of its kind) in the DOH is heightened by a number of factors including:

- The lack of a formalized provincial coordinated system mechanism for forecasting and supply planning of MNCH commodities
- The need to identify the current funding gap for the needed commodities to ensure efficient allocation of financial resources by the DOH, Government of Punjab.
- The introduction of new commodities for MNCH for which no distribution or consumption data are available

This activity is aimed at developing a long term (five-year) provincial forecasting collaboration with the Directorate General of Health (DOH) of Punjab, which will better inform procurement decisions for the MNCH commodities. The exercise will also help DOH Punjab to populate a framework for computing the requirements for the MNCH products during the plan period and to take future procurement actions. Basically, the goal of this forecasting exercise is to optimize a data-driven procurement system and minimize losses through expiry by over stocking. The report will essentially guide the decision makers in setting up a provincial system for regular updates of the forecasts and introduce supply planning process for MNCH commodities.

GOALS AND OBJECTIVES

Goal

Determine the provincial needs for prioritized MNCH commodities

Objectives

1. Prepare the provincial forecast for 17 very essential MNCH commodities for the period 2017-22
2. Discuss data sources and data gaps to support regular forecasting and supply planning and ways to address those gaps
3. Develop recommendations for institutionalization of a formal MNCH forecasting and pipeline monitoring system within Department of Health, Punjab which is capable of conducting updates on the forecast and supply plan

METHODOLOGY

The GHSC-PSM project worked in close coordination with the department of health, Punjab to develop the forecast. Initially, the scope, purpose and period of the forecast were defined. Then, GHSC-PSM project collected and reviewed existing documents to define assumptions and make adjustments based on recent demographic data. GHSC-PSM project then developed the algorithms of the forecasting process for each commodity. These were then reviewed by key stakeholders. The steps of the process are detailed below.

Scope:

The forecast was meant to cover the notified very essential MNCH commodities (Table 1) prioritized by the department of health, Punjab and the estimated requirements of these commodities for health services provided at public health facilities in the province. The estimates included requirements for district and sub-district levels of health care system. The agreed upon time frame is 2017-18—2022-23. However, through discussions with the department / program and upon review of existing data, forecasting was done for very essential commodities.

Table 1. Very Essential MNCH Commodities, prioritized by Department of Health, Punjab

Continuum of Care	Commodity	Use
Maternal Health	Misoprostol	Postpartum Hemorrhage
	Oxytocin	
	Sodium Lactate	
	Dinoprostone (prostaglandin E2) Vaginal gel	Induction of Labor
	Magnesium Sulphate	Pre-Eclampsia / Eclampsia
	Hydralazine (Hydrochloride)	Hypertension
	Methyldopa	
	Ampicillin (as sodium salt)	Maternal Sepsis
	Metronidazole	
	Gentamycin	
	Iron isomaltoside	Anemia
	Ferrous salt + folic acid	
Child and Newborn Health	Dexamethasone	Fetal Lung Maturity
	Low Osmolarity Oral Rehydration Salts	Diarrhea
	Zinc Sulphate	
	Amoxicillin	Pneumonia
	Chlorhexidine Digluconate	Antiseptics for Cord Care

Forecasting Options

Estimates of commodity needs for multi-year planning are based on population data and linked to defined Provincial MNCH strategies and plans. Three methods of estimating commodity needs are commonly used:

- Estimates based on anticipated need in a target population based on morbidity data (more appropriate at the national and provincial levels);
- Estimates based on previous consumption of a commodity (more appropriate at the provincial level);
- Estimates based on the service delivery statistics (more appropriate at the service delivery level).

Whichever method is used, the accuracy of the estimate depends on the availability and quality of data used as well as the forecasting team's knowledge of the specific conditions of the program. Due to the absence of reliable consumption and service data for the commodities mentioned in Table 1 above, the morbidity method is used for this forecasting.

Four basic sets of data are required for the morbidity method of forecasting commodity requirements:

1. Medicine lists with packaging and price data
2. Budgets in operational plans/procurement plans
3. Standard treatment guidelines in which the recommended treatment regimen is defined
4. A complete morbidity profile of the conditions for which the commodities are used.

The basic formula used in the morbidity method is:

$$\begin{array}{lcl} \text{Total quantity of a} & & \text{Quantity of the commodity} \\ \text{commodity required for} & = & \text{specified for a standard} \\ \text{a given health problem} & & \text{course of treatment} \end{array} \times \begin{array}{l} \text{Number of expected} \\ \text{treatment episodes of} \\ \text{the health problem} \end{array}$$

The first element in the formula requires agreement on an average standard treatment regimen for each health problem. Since this average treatment will be multiplied by the total number of treatment episodes for that particular health problem, it is necessary to define an average quantity per course of treatment. Average drug treatment schedules also need to accommodate a system for specifying selection and dosage of drugs for patients of different age and disease severity.

Data and Review of Documents

As part of the forecasting exercise, we considered factors such as the estimated current need, provincial program strategies. This forecast is based on various assumptions regarding MNCH commodity needs. This process included a review of provincial policy and technical documents; we familiarized ourselves with the recommended treatment guidelines and previous activities that could impact the forecasting. In addition, we viewed policy documents to assess information provided on other major policy decisions that may affect the MNCH program. Several of these documents are listed in bibliography.

Data Analysis

We used basic Excel to forecast the requirements for the MNCH commodities. The target population for respective commodities was determined which will help to analyze, plan, and advocate for improved programming. Excel facilitates the process of determining the quantities of medicines that are required for any health program. For each condition, we used incidence / prevalence / frequency rates obtained from literature to determine the total number of patients who required treatment for one year. We then entered information on all medicines and added the total requirement and costs by the maternal, newborn, and child categories. The specific forecasting methodologies, key assumptions, and forecasting results for each commodity category are included in the corresponding subsections presented in the quantification results.

Steps Used in Forecasting

The following steps were used to forecast the need for each commodity:

1. Calculate the target population (i.e., pregnant women or children) who will require very essential medicines (VEM).
2. Calculate the amount of very essential medicines needed in each case to manage the condition (i.e., prevention or treatment/establish standard or average treatment regimen)
3. Calculate the quantity of VEM needed for the forecast period
4. Adjust for programmatic changes
5. Adjust for losses (i.e., expiry and wastage)

Target Population

We estimated the target population based on recent population census (Census 2017) results. We obtained other information required to estimate this population from the Pakistan Demographic Health Surveys, Multiple Indicator Cluster Survey and Pakistan Bureau of Statistics website. For population projection for 2017–2018 to 2022-23, we used the growth rate of 2017 census. From this, we determined that our estimated total population would be 110.01 million, 3.1 million births, 3.7 million pregnant women and just under 15 million under 5 children in 2017. (Table 2).

Table 2. Estimated Target Population (Population, Births, Pregnant Women and Under-Five Children)

Year	Population	Births (2.9%)	Pregnant Women (3.4%)	Children U5 (13.3%)
2017	110,012,442	3,190,361	3,740,423	14,631,655
2018	112,355,707	3,258,316	3,820,094	14,943,309
2019	114,748,884	3,327,718	3,901,462	15,261,602
2020	117,193,035	3,398,598	3,984,563	15,586,674
2021	119,689,246	3,470,988	4,069,434	15,918,670
2022	122,238,627	3,544,920	4,151,113	16,257,737

Treatment Protocols

To obtain an accurate estimate of provincial needs for MNCH commodities, it is important to have specific treatment protocols for the dosage, frequency of administration and duration of treatment. To estimate a standard list of medicines, we assumed that treatment in primary and secondary health care centers follows the recommendations / standard treatment guidelines of WHO. If no such guideline exists, treatment followed the international best practice guidelines.

Calculation of MNCH Commodities

The calculation of MNCH commodities depends on the provincial MNCH guidelines. This is calculated by multiplying the number of cases requiring the medicines by the amount needed per case.

Consultative Meeting with Different Stakeholder

After completing the forecast, we will conduct consultative technical sessions with the FASP TWG, Punjab including DOH, IRMNCH program and development partners i.e. WHO, UNFPA, TRF and UNICEF. The objectives of the consultative meeting were to:

- Present and jointly review forecast.
- Review different data sources and ensure data is sufficient and of high-quality in order to build up the forecast
- Review and validate the available data and methodologies
- Review existing assumptions and adjustments based on recent demographic, logistics and services data.
- Discuss data sources and data gaps to support regular forecasting and supply planning, and ways to address gaps
- Reach consensus and agree upon assumptions, data, methodologies, and current forecasting findings

RESULTS

Forecasted Need for Oxytocin - Management of PPH

Postpartum hemorrhage (PPH), *defined as a blood loss of 500 ml or more within 24 hours after birth (WHO)*, is a major cause of mortality, morbidity and long-term disability related to pregnancy and childbirth.

In Pakistan every year around 7% of women suffer from PPH and it accounts for more maternal deaths than any other cause. Most deaths resulting from PPH occur during the first 24 hours after birth; the majority of these could be avoided through the use of prophylactic uterotonics during the third stage of labor and by timely and appropriate management.

Oxytocin is the medicine that is most effective in preventing and treating postpartum hemorrhage. Oxytocin is most often available in 1ml glass vials, containing 10 IU, and is administered by injection into a woman's vein or muscle. All women giving birth should be offered uterotonics during the third stage of labor for the prevention of PPH; doses range between 10 IU for prevention of postpartum hemorrhage and up to 40IU for treatment of PPH. The following input data are used to estimate the required oxytocin for the forecasting period 2018-2023 in the public sector.

Summary of Data Needed for Forecasting Oxytocin

- Target population (Expected pregnancies)
- Prevalence of PPH in Pakistan
- Percent deliveries in public health facilities of Punjab
- Number of public health facility deliveries
- Number of public facility deliveries requiring oxytocin for treatment of PPH
- Standard or average treatment regimen (i.e., 40 IU of Oxytocin required for PPH)
- Expected projected changes in consumption (potential losses or scale-up in use)

The formula used for this calculation of oxytocin is:

$$\begin{array}{ccccccc} \text{Oxytocin} & & & & & & \\ \text{Need for PPH} & = & \text{Total} & & \text{Proportion of} & & \text{Proportion of} & & \text{Dose per} \\ \text{treatment} & & \text{expected} & \times & \text{public facility} & \times & \text{women who} & \times & \text{case for PPH} \\ & & \text{pregnancies} & & \text{deliveries} & & \text{require treatment} & & \text{treatment} \\ & & & & & & \text{for PPH} & & \end{array}$$

Oxytocin requires storage at between 2 and 8 °C, with possible excursions to room temperature for brief time periods (up to four weeks). In practice, in countries where the average temperature is above 30 °C and where adequate infrastructure for cold chain management is often lacking, maintaining the required storage conditions for oxytocin is a challenge. As a result, compromising its effectiveness and shelf life.

The associated summary outputs for oxytocin are shown in Table 3. By applying the different attributes and assumptions the forecasted number of pregnancies for the year 2017-18 and 2022-23 are estimated at 3.7 million and 4.1 million, respectively. We have estimated (by trend analysis) that 18% of women will receive public facility delivery service in 2017-18. Thus, the total number of estimated facility deliveries in the public sector based on this assumption will be 43,763 and 62,134 in 2017-18 and 2022-23, respectively. Applying these parameters, we estimate the number of doses (10 IU) of oxytocin that needs to be procured for public facilities is 183,804 for 2017-18 and 260,962 for 2022-23

Table 3. Forecasted Oxytocin Requirements

Total Population (GR 2.13% - Census 2017)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Total Pregnancies (3.4%) DHIS 2016 Annual Report Punjab	3,740,423	3,820,094	3,901,462	3,984,563	4,069,434	4,156,113
B) Prevalence of PPH	7%	7%	7%	7%	7%	7%
(C) Number of PPH cases (C = A × B)	243,127	248,306	253,595	258,997	264,513	270,147
(D) % of public health facilities deliveries (18% MICS Punjab) assuming 1% annual increase	18%	19%	20%	21%	22%	23%
E) Number of PPH Cases seeking treatment from public health facilities	43,763	47,178	50,719	54,389	58,193	62,134
F) Requirement of Oxytocin (40 IU= 4 x 10 IU vial) for treatment of PPH	175,052	188,713	202,876	217,557-	232,772	248,536
G) 5% Wastage	8,753	9,436	10,144	10,878	11,639	12,427
H) Total requirement of Oxytocin (10 IU/1 ml vial) to procure including wastage	183,804	198,148	213,020	228,435	244,410	260,962

Forecasted Need for Misoprostol - Prevention of PPH

While oxytocin is the recommended choice for prevention and treatment of postpartum hemorrhage, use of oxytocin may not be feasible in low-income settings, where most births occur at home with untrained birth attendants.

Misoprostol has been suggested as an alternative to oxytocin since it has been proven to act as an effective uterotonic. It is inexpensive, can be taken orally, does not need refrigeration, and has a long shelf-life. The International Federation of Gynecology and Obstetrics (FIGO) and the International Confederation of Midwives (ICM) jointly recommended that where home births occur without a skilled birth attendant, misoprostol may be the only available technology to control PPH. Misoprostol is new in Pakistan and the feasibility of scaling up PPH prevention intervention is being assessed. Recognizing a need for strategies to prevent PPH among women who give birth at home without a skilled provider, three 200 µg tablets of misoprostol to women immediately after delivery under the direct supervision of a community midwife / lady health worker should be provided. It should be noted that the current recommendation of the World Health Organization is also for three 200 µg tablets dose. Women should be counseled on the use of misoprostol during antenatal visits.

Summary of Data Needed for Forecasting Misoprostol

- Target population (Expected number of pregnancies)
- Percent deliveries in public health facilities of Punjab
- Number of pregnant women attending public health facility for delivery
- Number of pregnant women attending public facility for delivery given Misoprostol for PPH prevention
- Standard or average treatment regimen (i.e. three 200 µg misoprostol tablets needed for each pregnant woman to prevent risk of PPH)
- Expected projected changes in consumption (potential losses or scale-up in use)

The formula used for this calculation of misoprostol tablets is:

$$\begin{array}{ccccccc} \text{Total misoprostol} & & & & & & \\ \text{tablets needed for} & = & \text{Expected} & \times & \text{Proportion of} & \times & \text{Dose per Pregnant} \\ \text{PPH prevention} & & \text{Pregnancies} & & \text{Pregnant women} & & \text{women for PPH} \\ & & & & \text{attending public health} & & \text{prevention} \\ & & & & \text{facility} & & \end{array}$$

Table 4 shows the amount of misoprostol required during the forecast period. The trend analysis shows that the number of home births is declining (DHIS reports). The estimated number of public health facility deliveries in 2017-18 is 0.67 million and in 2022-23 is 0.95 million, respectively. The total number of misoprostol tablets required is 1.6 million during the forecast period 2017-18 and 2.4 million during 2022-23. We assume that eighty percent pregnant women will receive three 200 µg misoprostol tablets.

Table 4. Forecasted Number of Misoprostol Tablets Required for Prevention of PPH

Total Population (projected based on 2017 Census GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Expected Pregnancies (3.4%) DHIS 2016 Annual Report Punjab	3,740,423	3,820,094	3,901,462	3,984,563	4,069,434	4,156,113
B) % of public facility deliveries (18%-MICS Punjab 2014 (Assuming an increase of 1% per yr.)	18%	19%	20%	21%	22%	23%
C) Number of pregnant women attending health facility for delivery ($C = A \times B$)	673,276	725,818	780,292	836,758	895,276	955,906
D) Assuming 80% of pregnant women attending health facility for delivery given Misoprostol for prevention of PPH. $D = C \times 80\%$	538,621	580,654	624,234	669,407	716,220	764,725
E) Requirement of Misoprostol (3 x 200µg tablets) for prevention of PPH in public health facility deliveries ($E = D \times 3$)	1,615,863	1,741,963	1,872,702	2,008,220	2,148,661	2,294,175
5% Wastage	80,793	87,098	93,635	100,411	107,433	114,709
G) Total requirement of tablet Misoprostol (200 µg) to procure including wastage	1,696,656	1,829,061	1,966,337	2,108,631	2,256,094	2,408,883

Forecasted Need for Magnesium Sulfate - Management of Eclampsia

Hypertensive disorders of pregnancy affect about 10% of all pregnant women around the world and are an important cause of severe acute morbidity, long term disability and death among mothers and babies. This group of diseases and conditions includes pre-eclampsia and eclampsia, gestational hypertension and chronic hypertension.

Pre-eclampsia is characterized by presence of hypertension, proteinuria and maternal organ dysfunction, while Eclampsia is characterized by the occurrence of generalized seizures in women with pre-eclampsia, provided that the tonic-clonic seizures are not attributable to other causes (e.g. epilepsy).

Magnesium sulfate is a lifesaving drug and should be available in all health-care facilities throughout the health system. It is recommended for the prevention and treatment of pre- and eclampsia in preference to other anticonvulsants. Magnesium sulfate (injection 500 mg/ml in 2 ml ampoule) is needed at every level of the health care system where deliveries occur, from urban hospitals to rural clinics [WHO 2012].

Summary of Data Needed for Forecasting Magnesium Sulfate

- Target population (Expected number of pregnancies)
- Percent deliveries in public health facilities of Punjab
- Number of public health facility deliveries
- Number of pregnancies complicated by PE/E
- Standard or average prevention/treatment regimen (i.e., amount of magnesium sulfate needed for management of each case of PE/E (magnesium sulfate injection: 500 mg/ml in 2-ml ampoule)
- Expected projected changes in consumption (potential losses or scale-up in use)

The formula used for this calculation of magnesium sulfate is:

$$\begin{array}{ccccccc} \text{Magnesium Sulfate Need} & & & & & & \\ \text{for PPH treatment} & & & & & & \\ \text{(500mg/ml)} & = & \text{Total expected} & \times & \text{Proportion of} & \times & \text{Treatment dose per PPH} \\ & & \text{pregnancies} & & \text{public facility} & & \text{case (2 ml ampoule = 1} \\ & & & & \text{deliveries} & & \text{gm MgSO}_4\text{)} \end{array}$$

By applying the information on pregnancy complication (3% pregnancies are complicated), we estimated the number of women who require magnesium sulfate during pregnancy. Out of total of 112,213 pregnancies complicated with pre-/eclampsia, 20,198 pregnant women are estimated to visit public facility for prevention /treatment of PE/E during the forecasting period of 2017/18. A total of 933,161 gm (2 ml Ampoule) magnesium sulfate is required for 2017/18 while a total of 186,632 gm (10 ml Ampoule) is required for the same year, which is to be administered using Pritchard Regime. Table 5 shows the complete factorization for the forecast of Magnesium sulfate.

Table 5. Forecasted Number of Doses of Magnesium Sulfate Required for Prevention of Pre-Eclampsia/Eclampsia

Total Population (projected based on 2017 Census - GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Expected Pregnancies (3.4%) DHIS 2016 Annual Report Punjab	3,740,423	3,820,094	3,901,462	3,984,563	4,069,434	4,156,113
B) # of Pregnancies estimated to be complicated with PE/E (3%)	112,213	114,603	117,044	119,537	122,083	124,683
(C) % of public health facility deliveries (18% Punjab MICS 2014) assuming 1% annual increase	18%	19%	20%	21%	22%	23%
(D) # of deliveries in public health facility ($D = B \times C$)	20,198	21,775	23,409	25,103	26,858	28,677
(E) Requirement of MgSO ₄ (in GMs) for treatment of Eclampsia (Pritchard Regime= 44gm /case) ($E = 44 \times D$)	888,725	958,080	1,029,986	1,104,521	1,181,764	1,261,796
(F) 5% wastage in GMs	44,436	47,904	51,499	55,226	59,088	63,090
(G) Total Requirement of MgSO ₄ (in GMs) for Eclampsia treatment including wastage ($G = E + F$)	933,161	1,005,984	1,081,485	1,159,747	1,240,852	1,324,886
(H) Requirement of Inj. MgSO ₄ (2 ml Ampoule --500 mg /ml) $H = G \times 1$ ampoule	933,161	1,005,984	1,081,485	1,159,747	1,240,852	1,324,886
(I) Requirement of Inj. MgSO₄ (10 ml ampoule --500 mg /ml) $I = G / 5$ gm	186,632	201,197	216,297	231,949	248,170	264,977

Forecasted Need for Dinoprostone (Prostaglandin E2) – Induction of Labor

Induction of labor (IOL) is a commonly performed obstetric procedure. It is indicated in cases where waiting for spontaneous onset of labor can jeopardize the maternal or fetal health. Over recent decades, more and more pregnant women around the world have undergone induction of labor (artificially initiated labor) to deliver their babies. In developed countries, up to 25% of all deliveries at term now involve induction of labor. In developing countries, the rates are generally lower, but in some settings, they can be as high as those observed in developed countries.⁶

Induction of labor: Induction of labor is defined as the process of artificially stimulating the uterus to start labor²⁸. It is usually performed by administering oxytocin or prostaglandins to the pregnant woman or by manually rupturing the amniotic membranes. Over the past several decades, the incidence of labor induction for shortening the duration of pregnancy has continued to rise. In developed countries, the proportion of infants delivered at term following induction of labor can be as high as one in four i.e. 25% deliveries.²⁹⁻³⁰

Induction of labor is not risk-free and many women find it to be uncomfortable. Induction of labor should be performed only when there is a clear medical indication for it and the expected benefits outweigh its potential harms. Induction of labor is recommended for women with pre-labor rupture of membranes at term. Low doses of vaginal prostaglandins are recommended for induction of labor.

Increase in rate of Induction of labor is related to a rise in the number of medically and obstetrically indicated inductions, however, it appears that marginally indicated and elective inductions account for a large proportion of IOL. One of the other contributing factors for increasing rate of IOL is the concern of the patients and healthcare providers about the possible risk of fetal demise at term or post term with the expectant management.

Summary of Data Needed for Forecasting Dinoprostone Gel

- Target population (Expected pregnancies)
- Incidence of labor induction in pregnant women
- Number of pregnant women who will require Dinoprostone gel
- Standard or average treatment regimen (i.e., amount of gel needed for induction of labor)
- Expected projected changes in consumption (potential losses or scale-up in use)

The formula for calculation of Dinoprostone Gel is:

$$\begin{array}{ccccccc} \text{Forecasted Need} & & & & & & \\ \text{for Dinoprostone} & = & \text{Expected} & \times & \text{Proportion of} & \text{Number of pregnant} & \text{Dose} \\ \text{2 mg Gel} & & \text{Pregnancies} & & \text{pregnancies that need} & \text{women at risk given} & \text{required} \\ & & & & \text{induction of labor} & \text{Dinoprostone gel} & \text{per case} \end{array}$$

By applying the related information provided above, we estimated that approximately 176,735 Dinoprostone gel would be required for induction of labor in approximately 168,319 pregnant women visiting public health facilities during the forecast period of 2017-18.

Table 6: Forecasted Number of Dinoprostone Gel

Total Population (projected based on 2017 Census - GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Number of Pregnancies (3.4%) DHIS 2016 Annual Report Punjab	3,740,423	3,820,094	3,901,462	3,984,563	4,069,434	4,156,113
B) Rate of Induction of Labor in pregnant women (WHO recommendations for Induction of labor)	25%	25%	25%	25%	25%	25%
C) # of pregnant women that may require induction of labor ($C = A \times B$)	935,106	955,024	975,366	996,141	1,017,359	1,039,028
D) % of public health facility deliveries (18% MICS 2014 Punjab) assuming an increase by 1% annually	18%	19%	20%	21%	22%	23%
E) # of pregnant women attending public facility that may require induction of labor ($E = C \times D$)	168,319	181,454	195,073	209,190	223,819	238,977
F) Requirement of Dinoprostone Gel (2mg) for public health facility ($F = E \times 1$ /pregnant women)	168,319	181,454	195,073	209,190	223,819	238,977
G) 5% Wastage	8,416	9,073	9,754	10,459	11,191	11,949
H) Total Requirement of Dinoprostone Gel for induction of labor in public health facilities $H = G + F$	176,735	190,527	204,827	219,649	235,010	250,925

Forecasted Need for Antenatal Corticosteroids

Preterm birth is a leading cause of perinatal death and disability and is an important global public health problem. Preterm birth accounts for approximately 6–7% of all births (WHO 2012). It is also the leading cause of neonatal mortality both in developed and developing countries, accounting for an estimated 24% of neonatal deaths. Preterm birth occurs most often in economically disadvantaged communities and those with high rates of urinary and genital tract infection. The administration of certain corticosteroids to women at risk of preterm birth yields a considerable reduction in risk of complications of prematurity, such as respiratory distress syndrome, intraventricular hemorrhage, and perinatal death.

Dexamethasone is a fluorinated glucocorticoid steroid that is administered through intramuscular injections to prevent these complications—with the greatest effect seen when there is a 24-48-hour time span between the first dose and birth. According to the WHO, 7% of pregnant women are assumed to be at risk of preterm delivery (WHO 2012), whereas in Pakistan studies shows 16% of pregnant women are at risk of preterm delivery. An injection of 4 mg dexamethasone phosphate (as disodium salt) in a 1ml ampoule is needed to promote fetal lung maturation before preterm delivery.

Summary of Data Needed for Forecasting Antenatal Corticosteroid (ANCS)

- Target population (Expected Pregnant women)
- Number of pregnant women at risk of preterm birth
- Proportion of public health facility deliveries
- Standard or average treatment regimen (i.e., amount of dexamethasone needed for each case to prevent risks of preterm birth)
- Expected projected changes in consumption (potential losses or scale-up in use)

The formula for calculation of dexamethasone is:

$$\begin{array}{ccccccc} \text{Total Need} & & & & & & \\ \text{of Inj.} & = & \text{Total} & \times & \text{Proportion of} & \times & \text{Proportion of} \\ \text{dexamethasone} & & \text{Pregnancies} & & \text{pregnant women} & & \text{pregnant women} \\ \text{(ampoule of 1 ml)} & & & & \text{at risk of} & & \text{attending} \\ & & & & \text{preterm delivery} & & \text{public health} \\ & & & & & & \text{facility} \\ & & & & & & \text{Dose} \\ & & & & & & \text{per case} \end{array}$$

Approximately 107,724 pregnant women are at risk of preterm birth during the forecast period, 2017-18 and 152,945 in 2022-23. To prevent the risks of preterm delivery a total of 678,662 ampoules for 2017-18 and 963,553 ampoules of dexamethasone (1 ml each) for 2022-23 should be procured during the forecast period, as depicted in Table 7.

Table 7. Forecasted Need for Dexamethasone

Total Population Projected based on Census 2017 GR 2.13%	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Number of Pregnancies (3.4%) DHIS 2016 Annual Report Punjab	3,740,423	3,820,094	3,901,462	3,984,563	4,069,434	4,156,113
B) Percentage of pregnant women at risk of preterm delivery (Meta-Analysis 2017 /Every Preemie Scale-Pakistan Profile / WHO 2015 Updated Recommendations	16%	16%	16%	16%	16%	16%
C) Number of pregnant women at risk of preterm delivery ($C = A \times B$)	598,468	611,215	624,234	637,530	651,110	664,978
D) Percent of public health facility deliveries (18% MICS 2014 Punjab) assuming 1% annual increase	18%	19%	20%	21%	22%	23%
E) Number of pregnant women at risk administered dexamethasone ($E = C \times D$)	107,724	116,131	124,847	133,881	143,244	152,945
F) Requirement for dexamethasone ampoules (4mg in 1-ml amp) ($F = E \times 6$ amp) WHO recommend 24 mg in divided doses	646,345	696,785	749,081	803,288	859,465	917,670
G) 5% Wastage	32,317	34,839	37,454	40,164	42,973	45,883
H) Adjusted amount of Inj. dexamethasone needed (plus wastage 5%) $H = G + F$	678,662	731,624	786,535	843,452	902,438	963,553

Forecasted Need for Sodium Lactate Compound Solution (Ringer's Lactate)

Ringer's lactate solution (RL), also known as sodium lactate compound solution, is an infusion-based mixture of sodium chloride (6gm), sodium lactate (3.1gm), potassium chloride (0.3gm), and calcium chloride (0.2gm) in sterile water. It is infused for replacing fluids and electrolytes in those who have low blood volume when treating for PPH.

During PPH, a patient can lose significant amount of blood leading to imbalances in the blood chemistry. This compound could significantly help restore the electrolyte balance as well as the blood loss that can otherwise prove fatal to their life.

Summary of data needed for forecasting of Ringer's Lactate

- Target population (Expected pregnancies)
- Prevalence of PPH in Pakistan
- Number of PPH cases
- Percent deliveries in public health facilities of Punjab
- Number of public facility deliveries requiring Ringer's Lactate for management of PPH
- Standard or average management regimen
- Expected projected changes in consumption (potential loss or scale-up in use)

Formula used for the calculation of Ringer's Lactate;

$$\begin{array}{ccccccc} \text{Ringer's Lactate} & & \text{Total} & & \text{Proportion} & & \text{Proportion of women} & & \text{Dose per} \\ \text{Need for PPH} & = & \text{Pregnancies} & \times & \text{of facility} & \times & \text{requiring RL for PPH} & \times & \text{PPH case for} \\ \text{Management} & & & & \text{deliveries} & & \text{management} & & \text{management} \end{array}$$

The associated summary outputs for Ringer's Lactate are shown in Table 8. By applying the different attributes and assumptions, the forecasted number of pregnancies for the year 2017-18 and 2022-23 are estimated at 3.7 million and 4.1 million, respectively. Thus, the total number of estimated facility deliveries in the public sector based on this assumption will be 43,763 in 2017-18 and 62,134 in 2022-23, respectively. Applying these parameters, we estimate the number of Ringer's Lactate injections that needs to be procured for public facilities is 91,902 for 2017-18 and 130,481 for 2022-23 as shown in the table below.

Table 8: Forecasted Injection Ringer's Lactate Requirement

Total Population (projected, based on 2017 census-GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Total Pregnancies (3.4%) DHIS 2016 Annual Report Punjab	3,740,423	3,820,094	3,901,462	3,984,563	4,069,434	4,156,113
B) Prevalence of PPH	7%	7%	7%	7%	7%	7%
(C) Number of PPH cases (C = A × B)	243,127	248,306	253,595	258,997	264,513	270,147
D) Percent public health facility deliveries (18% MICS 2014 Punjab) assuming 1% increase annually	18%	19%	20%	21%	22%	23%
E) Number PPH Cases seeking treatment from health facilities	43,763	47,178	50,719	54,389	58,193	62,134
(F) Requirement of Inj. Ringer's Lactate for PPH cases (2 Inj. per PPH case)	87,526	94,356	101,438	108,779	116,386	124,268
(G) 5% Wastage	4,376	4,718	5,072	5,439	5,819	6,213
(H) Net Requirement of Inj. Ringer's Lactate for PPH cases including wastage	91,902	99,074	106,510	114,218	122,205	130,481

Forecasted Need for Hydralazine - Management of Severe Hypertension

Hydralazine is used with or without other medications to treat high blood pressure. It works by relaxing blood vessels (vasodilator) so blood can flow through the body more easily. It is a drug of choice for gestational hypertension or pregnancy-induced hypertension (PIH) which is the development of new hypertension in a pregnant woman after 20 weeks' gestation without the presence of protein in the urine or other signs of pre-eclampsia. Anti-hypertensive drugs should be given if the diastolic blood pressure is 110mm Hg or more. The aim is to keep the diastolic blood pressure between 90–100mm Hg to prevent cerebral hemorrhage.

Summary of Data Needed for Forecasting Hydralazine

- Target population (total expected pregnancies)
- Number of pregnancies complicated by Hypertensive disorders of pregnancy (HDP)
- Percent deliveries in public health facilities of Punjab
- Number of public facility deliveries requiring Hydralazine management of HDP
- Standard or average treatment regimen i.e., amount of hydralazine needed for each case to manage hypertension (hydralazine injection 20 mg powder or 25 mg and 50 mg tablets).
- Expected projected changes in consumption (potential loss or scale-up in use)

The formula used for this calculation of Hydralazine is:

$$\begin{array}{ccccccc} \text{Hydralazine Need} & & & & & & \\ \text{for management of} & = & \text{Expected} & \times & \text{Proportion} & \times & \text{Proportion of women} \\ \text{hypertension} & & \text{pregnancies} & & \text{of facility} & & \text{who require Hydralazine} \\ & & & & \text{deliveries} & & \text{for management of} \\ & & & & & & \text{hypertension} \\ & & & & & & \text{Dose per} \\ & & & & & & \text{case of} \\ & & & & & & \text{hypertension} \end{array}$$

By applying the information on pregnancies complicated with hypertensive disorders of pregnancy (5% pregnancies are complicated), we estimated the number of women who require hydralazine during pregnancy. A total of 33,664 pregnant women are estimated to require hydralazine for the treatment of hypertension during the forecasting period (2017/18). A total of 35,347 injections of hydralazine would be required for 2017/18 which is to be administered intravenously Table 9 shows the complete factorization for hydralazine forecast.

Table 9: Forecasted Hydralazine Injections to manage Hypertensive Disorders of Pregnancy (HDP)

Total Population (projected based on 2017 census - GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Expected Pregnancies (3.4%) DHIS 2016 Annual Report Punjab	3,740,423	3,820,094	3,901,462	3,984,563	4,069,434	4,156,113
B) Pregnancies (5%) estimated to develop hypertensive disorders of pregnancy	187,021	191,005	195,073	199,228	203,472	207,806
(C) Percent public health facility deliveries (18% MICS 2014 Punjab - assuming 1% increase / year	18%	19%	20%	21%	22%	23%
(D) Pregnant women with HDP seeking care from public health facilities	33,664	36,291	39,015	41,838	44,764	47,795
(E) Requirement of Inj. hydralazine HCl (ampoule of 20 mg) for management of HDP (E= B x 1 Ampoule)	33,664	36,291	39,015	41,838	44,764	47,795
(D) 5% Wastage -in Ampoules	1,683	1,815	1,951	2,092	2,238	2,390
(E) Total Requirement of Hydralazine HCl for management of HDP G= E+F	35,347	38,105	40,965	43,930	47,002	50,185

Forecasted Need for Chlorhexidine -- Cord Care in Newborns

Pakistan has one of the highest newborn mortality rates in the world and up to a third are because of infections. Unsafe conventions, such as cutting the birth cord with un-sterilized instruments, and the application of substances such as ash, surma, oil and even cow dung are practiced in many rural areas of Pakistan, and often associated with an increased risk of cord infection and death. A baby's newly cut umbilical cord can be an entry point for bacteria, which can lead to cord infection and potentially life-threatening sepsis. WHO recommends daily application of chlorhexidine (7.1% chlorhexidine digluconate aqueous solution or gel, delivering 4% chlorhexidine) application to the umbilical cord stump during the first week of life for newborns who are born at home in settings with high neonatal mortality (30 or more neonatal deaths per 1000 live births).

Summary of Data Needed for CHX Forecasting

- Target population (total births)
- Standard or average treatment regimen (i.e. of CHX needed per treatment) (single dose 5 ml Gel)
- Expected projected changes in consumption (potential losses or scale-up in use)

The formula for calculation of Chlorhexidine is:

Total Need (Chlorhexidine) = Total birth $\times$ Dose (5 ml) Gel per birth

According to the current provincial guidelines, Chlorhexidine will be used for all births. Table 10 shows the forecasted amount of Chlorhexidine gel by year. A total of 602,978 gel tubes of 5 ml (7.1% CHX digluconate) will be procured for public health facilities to implement the provincial policy guidelines during the forecast period (2017-18) Table10.

Table 10: Forecasted Number of Chlorhexidine Gel Required for Cord Care

Total Population (projected, based on 2017 census -GR 2.13)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Total live births (2.9%) DHIS 2016 Annual Report Punjab	3,190,361	3,258,316	3,327,718	3,398,598	3,470,988	3,544,920
(B) Percent public health facility births (18% MICS 2014 Punjab - assuming 1% increase annually	18%	19%	20%	21%	22%	23%
(C) Number of health facility live births ($C = A \times B$)	574,265	619,080	665,544	713,706	763,617	815,332
(D) Requirement of Chlorhexidine Gel (Assuming 100% newborns given Chlorhexidine) $D = C \times 1$	574,265	619,080	665,544	713,706	763,617	815,332
(E) 5% Wastage	28,713	30,954	33,277	35,685	38,181	40,767
(F) Total Requirement of Chlorhexidine Gel for Prevention of cord infection $G = E + F$	602,978	650,034	698,821	749,391	801,798	856,098

Forecasted Need for Amoxicillin - Management of Pneumonia in 0-59 Months Children

Childhood pneumonia is among the leading causes of death in low-income countries, causing 18% of deaths in children under 5 years of age. With an estimated 10 million cases occurring each year, childhood pneumonia is a primary cause of under-five mortality in Pakistan (Black *et al.* 2010, Rudan *et al.* 2008). Amoxicillin is recommended by WHO for the treatment of pneumonia in children less than five years of age. The forecast below shows estimated requirement of Amoxicillin for treatment of pneumonia in children under five years of age.

Summary of Data Needed for Forecasting of Amoxicillin for Pneumonia in Children

- Target Population -- Number of children under five years of age
- Incidence of pneumonia in 0-59 months of children
- Standard or average treatment regimen (dose of amoxicillin per case of pneumonia)
- Expected projected changes in consumption (potential losses or scale-up in use)

The formula for calculation of Amoxicillin is:

$$\begin{array}{ccccccc} \text{Total Need} & & \text{Estimated} & & \text{Incidence of} & & \text{Percent pneumonia} \\ \text{for} & = & \text{Number of under} & \times & \text{pneumonia in} & \times & \text{patients attending} \\ \text{Amoxicillin} & & \text{five children} & & \text{under five children} & & \text{public health facility} \\ & & & & & & \times \text{Dose per} \\ & & & & & & \text{episode} \end{array}$$

Table 11 shows the forecasted number of Amoxicillin required for the management of childhood pneumonia. A total of 10.7 million dispersible tablets, 1.43 million bottles of syrup (125 mg; 250 mg) and 10.78 million injections (250 mg; 500 mg) of Amoxicillin are required to treat childhood pneumonia during the period (2017-2018). Pakistan Bureau of Statistics and PDHS 2012-13 data were used to estimate this drug.

Table 11. Forecasted Number of Amoxicillin for Management of Pneumonia in 0-59 Months Children

Total Population (projected, based on 2017 census--GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Percent 0-59 months children in Punjab PBS 2012-13	13.3%	13.3%	13.3%	13.3%	13.3%	13.3%
B) Estimated Population of 0-59 months (2017 Pop x A)	14,631,655	14,943,309	15,261,602	15,586,674	15,918,670	16,257,737
C) Incidence of pneumonia in 0-59 months (# episodes / child / year)	0.26	0.26	0.26	0.26	0.26	0.26
D) Number of pneumonia episodes (D= B x C)	3,804,230	3,885,260	3,968,016	4,052,535	4,138,854	4,227,012
E) Percent deliveries in public health facility	18%	19%	20%	21%	22%	23%
F) 0-59 months seeking treatment at public health facilities	684,761	738,199	793,603	851,032	910,548	972,213
G) Percentage receiving Antibiotics (42% PDHS 2012-13)	100%	100%	100%	100%	100%	100%
H) 0-59 months patients provided with Amoxicillin	684,761	738,199	793,603	851,032	910,548	972,213
I) Requirement of Amoxicillin 250mg tablets (I = H x 15 tablets /episode)	10,271,422	11,072,992	11,904,049	12,765,486	13,658,219	14,583,190
J) 5% Wastage	513,571	553,650	595,202	638,274	682,911	729,160
K) Total Requirement of Amoxicillin 250 mg tablets K= I+J	10,784,993	11,626,642	12,499,252	13,403,760	14,341,130	15,312,350
L) Requirement of Amoxicillin Syrup 125 / 250mg (L = H x 2 bottle /episode)	1,369,523	1,476,399	1,587,207	1,702,065	1,821,096	1,944,425
M) 5% Wastage	68,476	73,820	79,360	85,103	91,055	97,221
N) Total Requirement of Amoxicillin Syrup 250/125 mg bottles N= L+M	1,437,999	1,550,219	1,666,567	1,787,168	1,912,151	2,041,647
O) Requirement of Amoxicillin Inj. 250/500 mg (O = H x 15 Injs. /episode)	10,271,422	11,072,992	11,904,049	12,765,486	13,658,219	14,583,190
P) 5% Wastage	513,571	553,650	595,202	638,274	682,911	729,160
Q) Total Requirement of Amoxicillin Inj. 250/500 mg Q= O+P	10,784,993	11,626,642	12,499,252	13,403,760	14,341,130	15,312,350

Forecasted Need for Oral Rehydration Salts - ORS

Diarrheal disease is the second leading cause of death in children under five years old. Loss of water and salts resulting from diarrhea can result in severe dehydration which results in severe morbidity and mortality. In Pakistan, on an average each child under the age of 5 years, gets 3-4 episodes of diarrhea per year.

Although the total number of deaths globally from diarrheal diseases remains high, the overall mortality rate has steadily declined over the last few decades. This decline especially in developing countries is largely due to the use of early and appropriate oral rehydration therapy (ORT) with oral rehydration salt (ORS) being its main component as well as improved nutrition and water sanitation measures.

ORS is the non-proprietary name for a balanced glucose-electrolyte mixture, approved, recommended and distributed by WHO and UNICEF as a drug for the treatment of clinical dehydration throughout the world. Oral rehydration therapy (ORT) is a type of fluid replacement used to prevent and treat dehydration, especially that due to diarrhea.

Oral rehydration salts (ORS) when properly mixed with safe water can help rehydrate the body when a significant amount of fluid has been lost due to diarrhea. An ORS estimate is provided for children under 5. Assuming two packs per case, the total number of ORS is estimated at 6.9 million for the forecast period 2017-18 and 11.0 million for 2022-23 (Table 12).

Summary of Data Needed for Forecasting of ORS

- Target Population -- estimated number of children less than 5 years of age
- Incidence of diarrhea -- episodes of diarrhea per child per year
- Percent seeking diarrhea treatment from public health facility
- Standard or average treatment regimen (i.e., two packs per episode)
- Expected projected changes in consumption (potential losses or scale-up in use)

The formula used for the calculation of ORS need is;

$$\begin{array}{ccccccc} \text{Need} & & \text{Estimated} & & \text{Incidence} & & \text{Proportion of} & & \text{Percent <5} & & \\ \text{for} & = & \text{Population} & \times & \text{of diarrhea} & \times & \text{<5 children} & \times & \text{children seeking} & \times & \\ \text{ORS} & & \text{of <5} & & \text{in <5} & & \text{who received} & & \text{ORS from public} & & \\ & & \text{children} & & \text{children} & & \text{ORS} & & \text{health facility} & & \\ & & & & & & & & & & \text{2 packets} \\ & & & & & & & & & & \text{per} \\ & & & & & & & & & & \text{episode} \end{array}$$

Table 12 shows that there will be 43.8 million estimated number of diarrhea episodes in 2017-18 and out of these 18.4 million will be treated with ORS. Out of 18.4 million, 3.3 million will seek ORS from public health facility. This means that a total of 6.9 million ORS is required for the year 2017-18 to treat diarrhea episodes. Pakistan Bureau of Statistics and PDHS data were used to estimate the need for ORS.

Table 12. Forecasted Number of ORS Needed During the Period (2017/18-2022/23)

Total Population (projected based on 2017 census - GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) % under 5 children in Punjab -- PBS 2012-13	13.3%	13.3%	13.3%	13.3%	13.3%	13.3%
B) Population of < 5 children (2017 Pop x A)	14,631,655	14,943,309	15,261,602	15,586,674	15,918,670	16,257,737
C) Incidence of Diarrhea in < 5 Children (episodes / child /year) -- study in Lahore	3	3	3	3	3	3
D) Total number of Diarrhea Episodes (BxC)	43,894,964	44,829,927	45,784,805	46,760,021	47,756,009	48,773,212
E) Percentage who received ORS (38% PDHS 2012-13) assuming 1% increase annually	42%	43%	44%	45%	46%	47%
F) Number of diarrhea patients treated with ORS	18,435,885	19,276,869	20,145,314	21,042,009	21,967,764	22,923,410
G) % of patients seeking ORS from public health facilities (18% MICS 2014 Punjab) assuming Public HF utilization increases by 1% annually	18%	19%	20%	21%	22%	23%
H) Number of patients seeking ORS from public health facilities (H=FxG)	3,318,459	3,662,605	4,029,063	4,418,822	4,832,908	5,272,384
I) Requirement for ORS packets (I = H x 2 packet/episode)	6,636,919	7,325,210	8,058,126	8,837,644	9,665,816	10,544,769
J) 5% Wastage	331,846	366,261	402,906	441,882	483,291	527,238
K) Total Requirement of ORS packets K= I+J	6,968,765	7,691,471	8,461,032	9,279,526	10,149,107	11,072,007

Forecasted Need for Zinc Sulphate

Every year more than a million children under five years of age succumb to the fluid loss and dehydration associated with the majority of diarrhea related deaths. Diarrhea is second only to pneumonia as the leading cause of death globally among children under 5. There are two simple and effective treatments recommended by WHO for the clinical management of acute diarrhea:

- use of low concentration oral rehydration salts (ORS)
- routine use of zinc supplementation, at a dosage of 20 milligrams per day for children older than six months or 10 mg per day in those younger than six months, for 10–14 days.

Zinc supplementation has been found to reduce the duration and severity of diarrheal episodes and likelihood of subsequent infections for 2–3 months (WHO) Zinc is essential for the normal growth and development of children and is naturally found in the diet, mainly in foods of animal origin. Dietary deficiency of zinc can lead to an increased risk of gastrointestinal infections and impaired gastrointestinal and immune function.

Summary of Data Needed for Forecasting of Zinc

- Target population – estimated number of children 0-59 months
- Incidence of diarrhea -- episodes of diarrhea per child per year
- Percent seeking diarrhea treatment from public health facility
- Standard or average treatment regimen (i.e., 5 Zinc Sulphate tablets per episode in 0-6 and 10 tablets per episode in 6-59 months children)
- Expected projected changes in consumption (potential losses or scale-up in use)

The formula used for Zinc Sulphate forecast calculation is;

$$\begin{array}{ccccccccc} \text{Total Need} & & \text{Estimated} & & \text{Incidence of} & & \text{Percent 0-59} & & \text{Percent 0-59} & & \\ \text{for Zinc} & & \text{number of} & & \text{diarrhea in} & & \text{months who} & & \text{months} & & \\ \text{Sulphate} & = & \text{0-59 months} & \times & \text{under-5 children} & \times & \text{received Zinc} & \times & \text{seeking Zinc} & \times & \text{Dose} \\ \text{tablets} & & \text{children} & & \text{(case/child/year)} & & \text{Sulphate} & & \text{Sulphate from} & & \text{per} \\ & & & & & & \text{tablets} & & \text{public facility} & & \text{episode} \end{array}$$

Considering that the number of diarrhea episodes per child per year are 3 with other fixed parameters, we estimated the total zinc sulphate 20 mg tablet requirement for 2017-18 is 4,210,451 for 0-6 months and 78,751,031 for 6-59 months children, respectively. (Table 13).

Table 13. Forecasted Number of Zinc Sulphate Needed During the Period (2017/18-2022/23)

Total Population (Projected, based on 2017 census GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
A) % of 0-6 Month children IFE Core Grp	1.35%	1.35%	1.35%	1.35%	1.35%	1.35%
B) Population of 0-6 months children	1,485,168	1,516,802	1,549,110	1,582,106	1,615,805	1,650,221
C) Incidence of diarrhea in 0-6 months children	3	3	3	3	3	3
D) Number of diarrhea episodes in 0-6 months	4,455,504	4,550,406	4,647,330	4,746,318	4,847,414	4,950,664
E) % seeking Zinc Sulphate from public health facilities	18%	19%	20%	21%	22%	23%
F) Number seeking Zinc Sulphate from public health facilities (H=FxG)	801,991	864,577	929,466	996,727	1,066,431	1,138,653
G) Requirement of Zinc Sulphate 20 mg tablet (10 mg/day x 10 days)	4,009,954	4,322,886	4,647,330	4,983,634	5,332,156	5,693,264
H) 5% Wastage	200,498	216,144	232,366	249,182	266,608	284,663
I) Total Requirement (0- 6m) ZS tablet I= G+H	4,210,451	4,539,030	4,879,696	5,232,815	5,598,764	5,977,927
A) % under 5 children in Punjab -- PBS 2012-13	13.3%	13.3%	13.3%	13.3%	13.3%	13.3%
B) Population of 6-59 months children (2017 Pop x A - 0-6 month Pop.)	13,146,487	13,426,507	13,712,492	14,004,568	14,302,865	14,607,516
C) Incidence of Diarrhea in 6-59 months children	3	3	3	3	3	3
D) Total number of Diarrhea episodes (BxC)	39,439,460	40,279,521	41,137,475	42,013,703	42,908,595	43,822,548
E) % seeking Zinc SO4 from public health facilities	18%	19%	20%	21%	22%	23%
F) Number seeking Zinc Sulphate from public health facilities (F=ExD)	7,099,103	7,653,109	8,227,495	8,822,878	9,439,891	10,079,186
G) Requirement of Zinc SO4 20 mg tablet (G = F x 10 tablets/episode)	70,991,029	76,531,090	82,274,950	88,228,776	94,398,909	100,791,860
H) 5% Wastage	3,549,551	3,826,554	4,113,747	4,411,439	4,719,945	5,039,593
I) Total Requirement (6- 59 months) of Zinc Sulphate tablets I= G+H	74,540,580	80,357,644	86,388,697	92,640,215	99,118,854	105,831,453

Forecasted Need for Ampicillin - Treatment of Maternal Sepsis

WHO estimates that the global prevalence of maternal sepsis is 4.4% among livebirths, representing more than 5.7 million cases per year. Important variations exist between regions, with higher incidence in low-income and middle-income countries (up to 7%) compared with high-income countries (1–2%). Despite the relative low prevalence and the availability of interventions for its prevention and treatment, maternal sepsis remains a life-threatening condition and one of the leading direct causes of maternal mortality worldwide, accounting for up to 10% of maternal deaths.

The new WHO definition of maternal sepsis says, “Maternal sepsis is a life-threatening condition defined as organ dysfunction resulting from infection during pregnancy, childbirth, post-abortion, or postpartum period”. Undetected or poorly managed maternal infections can lead to sepsis, death or disability for the mother and increased likelihood of early neonatal infection and other adverse outcomes.

Several factors have been associated with increased risk of maternal peripartum infections, including pre-existing maternal conditions (e.g., malnutrition, diabetes, obesity, severe anemia, bacterial vaginosis) and spontaneous or provider-initiated conditions during labor and childbirth (e.g., prolonged rupture of membranes, multiple vaginal examinations, manual removal of the placenta, caesarean section). Strategies to reduce maternal peripartum infections and their complications have been largely directed at preventive measures where such risk factors exist.

Globally, the most common intervention for preventing morbidity and mortality related to maternal infection is the use of antibiotics for prophylaxis and treatment. Ampicillin is recommended as first line antibiotic for prevention and treatment of peripartum infections.

Summary of Data Needed for Forecasting Ampicillin

- Target population (total expected live births)
- Number of deliveries complicated by Maternal Sepsis
- Percent deliveries in public health facilities of Punjab
- Number of public facility deliveries requiring Ampicillin for treatment of Maternal Sepsis
- Standard or average treatment regimen (i.e., amount of Ampicillin needed for each case to treat maternal sepsis)
- Expected projected changes in consumption (potential loss or scale-up in use)

The formula used for this calculation of Ampicillin is:

$$\begin{array}{l} \text{Ampicillin} \\ \text{Need of for} \\ \text{Maternal Sepsis} \\ \text{Treatment} \end{array} = \begin{array}{l} \text{Expected} \\ \text{Live births} \end{array} \times \begin{array}{l} \text{Proportion of} \\ \text{public facility} \\ \text{deliveries} \end{array} \times \begin{array}{l} \text{Proportion of} \\ \text{deliveries complicated} \\ \text{with maternal sepsis} \\ \text{and requires Ampicillin} \\ \text{for treatment} \end{array} \times \begin{array}{l} \text{Dose per} \\ \text{case for} \\ \text{treatment} \end{array}$$

By applying the information on pregnancy/deliveries complication (10% pregnancies/deliveries are complicated), we estimated the number of women who require Ampicillin for the treatment of maternal sepsis. A total of 319,036 pregnant women are estimated to require Ampicillin for the treatment of

maternal sepsis during the forecasting period (2017/18). Out of these, 57,426 pregnant women are estimated to seek treatment from public health facility. A total of 1,171,500 injections of Ampicillin are required for 2017/18 which are to be administered intravenously. Table 14 shows the complete factorization for the estimated forecast of ampicillin.

Table 14: Forecasted Number of Doses of Ampicillin Required for the Treatment of Maternal Sepsis

Total Population (projected, based on 2017 census - GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Live births (2.9%) DHIS 2016 Annual Report Punjab	3,190,361	3,258,316	3,327,718	3,398,598	3,470,988	3,544,920
B) Incidence of Maternal Sepsis WHO	10%	10%	10%	10%	10%	10%
C) Number of Maternal Sepsis cases (C= BxA)	319,036	325,832	332,772	339,860	347,099	354,492
D) Percent deliveries in public health facility (18% MICS 2014 Punjab) assuming 1% increase annually	18%	19%	20%	21%	22%	23%
E) Number of Maternal Sepsis cases seeking treatment from public health facilities	57,426	61,908	66,554	71,371	76,362	81,533
F) Requirement of Ampicillin 500mg Injections (F= E x 20 injections- 4 injections daily x 5 days)	1,148,530	1,238,160	1,331,087	1,427,411	1,527,235	1,630,663
G) 2% Wastage	22,971	24,763	26,622	28,548	30,545	32,613
H) Total Requirement of Ampicillin 500mg Injections for Maternal Sepsis treatment H= F+G	1,171,500	1,262,923	1,357,709	1,455,959	1,557,779	1,663,277

Forecasted Need for Metronidazole - Management of Maternal Sepsis

Bacterial infections around the time of childbirth account for about one tenth of the global burden of maternal death. Apart from severe morbidity and death, women who experience peripartum infections are also prone to long-term disabilities such as chronic pelvic pain, fallopian tube blockage and secondary infertility. Maternal infections before or during childbirth are also associated with an estimated 1 million newborn deaths annually.

Several factors have been associated with increased risk of maternal peripartum infections, including pre-existing maternal conditions (e.g., malnutrition, diabetes, obesity, severe anemia, bacterial vaginosis) and spontaneous or provider-initiated conditions during labor and childbirth (e.g., prolonged rupture of membranes, multiple vaginal examinations, manual removal of the placenta, caesarean section). Strategies to reduce maternal peripartum infections and their complications have been largely directed at preventive measures where such risk factors exist.

Globally, the most common intervention for preventing morbidity and mortality related to maternal infection is the use of antibiotics for prophylaxis and treatment. Metronidazole is recommended for prevention and treatment of peripartum infections.

Summary of Data Needed for Forecasting Metronidazole

- Target population (total live births)
- Number of deliveries complicated by Maternal Sepsis
- Percent deliveries in public health facilities of Khyber Pakhtunkhwa
- Number of public facility deliveries requiring Metronidazole for treatment of Maternal Sepsis
- Standard or average treatment regimen (i.e., amount of Metronidazole needed for each case to treat maternal sepsis)
- Expected projected changes in consumption (potential loss or scale-up in use)

The formula used for this calculation of Metronidazole is:

$$\begin{array}{ccccccc} \text{Metronidazole} & & & & & & \\ \text{Need for} & & & & & & \\ \text{Treatment of} & = & \text{Total} & \times & \text{Proportion} & \times & \text{Dose per} \\ \text{Maternal Sepsis} & & \text{Expected} & & \text{of facility} & & \text{Maternal} \\ & & \text{Live Births} & & \text{births} & & \text{Sepsis case for} \\ & & & & & & \text{treatment} \\ & & & & \text{Proportion of women} & & \\ & & & & \text{requiring} & & \\ & & & & \text{Metronidazole for} & & \\ & & & & \text{Maternal Sepsis} & & \\ & & & & \text{treatment} & & \end{array}$$

By applying the information on pregnancy/deliveries complication (10% pregnancies/deliveries are complicated), we estimated the number of women who require Metronidazole for the treatment of maternal sepsis. A total of 319,036 pregnant women are estimated to require Metronidazole for the treatment of maternal sepsis during the forecasting period (2017/18). Out of these, 57,426 pregnant women are estimated to seek treatment from public health facility. A total of 1,171,500 injections of Metronidazole are required for 2017/18 which are to be administered intravenously. Table 15 shows the complete factorization for the forecast of Metronidazole.

Table 15: Forecasted Number of Doses of Metronidazole Required for Management of Maternal Sepsis

Total Population (projected, based on 2017 census - GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Live births (2.9%) DHIS 2016 Annual Report Punjab	3,190,361	3,258,316	3,327,718	3,398,598	3,470,988	3,544,920
B) Incidence of Maternal Sepsis	10%	10%	10%	10%	10%	10%
C) Number of Maternal Sepsis cases (C= BxA)	319,036	325,832	332,772	339,860	347,099	354,492
D) Percentage of deliveries at public health facility (18% MICS 2014 Punjab) assuming 1% increase annually	18%	19%	20%	21%	22%	23%
E) Maternal Sepsis cases seeking treatment from public health facility	57,426	61,908	66,554	71,371	76,362	81,533
F) Requirement of Metronidazole 500mg Injections (F= E x 15 (4x5days) Injs. /patient)	1,148,530	1,238,160	1,331,087	1,427,411	1,527,235	1,630,663
G) 2% Wastage	22,971	24,763	26,622	28,548	30,545	32,613
H) Total Requirement of Metronidazole 500mg Injections for Maternal Sepsis patients H= F+G	1,171,500	1,262,923	1,357,709	1,455,959	1,557,779	1,663,277

Forecasted Need for Ferrous salt + Folic Acid Tablets

It is estimated that 41.8% of pregnant women worldwide are anemic. At least half of this anemia burden is assumed to be due to iron deficiency. Daily oral iron and folic acid supplementation is recommended by WHO as part of the antenatal care to reduce the risk of low birth weight, maternal anemia and iron deficiency. Ferrous salt in combination with Folic acid is a supplement used to prevent iron deficiency and folic acid deficiency during pregnancy. It can also be used to treat iron deficiency anemia. It is a fixed dose combination of ferrous salt and folic acid. It is taken by mouth. Ferrous salt + folic acid was approved for medical use in the United States as early as 1946. It is on the World Health Organization's list of Essential Medicines, the most effective and safe medicines needed in a health system.

WHO suggested scheme for daily iron and folic acid supplementation in pregnant women is;

- i. Iron: 30–60 mg of elemental iron
- ii. Folic acid: 400 µg (0.4 mg)

Summary of Data Needed for Forecasting Ferrous Salt + Folic Acid (FS+FA) Tablets

- Target population (total expected pregnancies)
- Proportion of pregnant women receiving Ante Natal Care (ANC).
- Percent deliveries in public health facilities of Punjab
- Number of public facility pregnancies requiring FS+FA tablets for prevention & treatment of anemia
- Standard or average treatment regimen (i.e., amount of FS+FA tablets needed for each case to treat and prevent anemia)
- Expected projected changes in consumption (potential loss or scale-up in use)

The formula for calculation of ferrous salt/folic acid is:

$$\begin{array}{ccccccc} \text{Need for Ferrous salt} & & & & & & \\ \text{+ folic acid tablets to} & & & & & & \\ \text{prevent/ treat anemia} & = & \text{Total} & \times & \text{Proportion} & \times & \text{Dose per} \\ \text{in pregnancy} & & \text{expected} & & \text{of women} & & \text{pregnant} \\ & & \text{pregnancies} & & \text{who received} & & \text{women to} \\ & & & & \text{ANC} & & \text{prevent/ treat} \\ & & & & & & \text{anemia} \\ & & & & & & \\ & & & & & & \text{anemia prevention /} \\ & & & & & & \text{treatment from} \\ & & & & & & \text{public health facility} \end{array}$$

Table 16 shows the forecasted quantities of ferrous salt + folic acid tablet for the forecasted period 2017-18 to 2022-23. A total of 530,542 pregnant women are estimated to visit public health facilities during 2017-18, and 100.27 million tablets of Ferrous salt + Folic acid tablets are estimated to be required to prevent / treat anemia in these pregnant women for the year 2017-18. Table 16 shows the complete factorization for the forecast of ferrous salt + folic acid tablet.

Table 16: Forecasted Number of Ferrous Salt + Folic Acid Tablets

Total Population (projected, based on 2017 census -GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Expected pregnancies (3.4%) DHIS 2016 Annual Report Punjab	3,740,423	3,820,094	3,901,462	3,984,563	4,069,434	4,156,113
B) Percentage of pregnant women receiving ANC from a skilled provider (79% -MICS Punjab -2014 - assuming 1% increase annually	79%	80%	81%	82%	83%	84%
C) Number pregnant women received ANC from a skilled provider (C = A × B) Skilled provider include doctor, nurse, midwife, and lady health visitor	2,947,453	3,048,435	3,152,381	3,259,373	3,369,492	3,482,823
(D) % health facilities deliveries (18% MICS 2014 Punjab) assuming 1% annual increases	18%	19%	20%	21%	22%	23%
E) # pregnant women received ANC at public health facilities (E = C × D)	530,542	579,203	630,476	684,468	741,288	801,049
F) Requirement of Ferrous salt + Folic Acid Tablets (recommend dose is 1 tablet daily x Pregnancy (Average taken= 6 months= 30 tablets x 6 =180 tablets / pregnant woman)	95,497,488	104,256,478	113,485,728	123,204,287	133,431,870	144,188,871
G) 5% Wastage	4,774,874	5,212,824	5,674,286	6,160,214	6,671,593	7,209,444
H) Total Requirement of Ferrous salt + Folic Acid tablets H= G+F	100,272,363	109,469,302	119,160,014	129,364,502	140,103,463	151,398,315

Forecasted Need for Methyldopa

Methyldopa is used with or without other medications to treat high blood pressure. It works by relaxing blood vessels (vasodilator) so blood can flow through the body more easily. It is a drug of choice for Gestational hypertension or pregnancy-induced hypertension (PIH) which is the development of new hypertension in a pregnant woman after 20 weeks gestation without the presence of protein in the urine or other signs of pre-eclampsia. Anti-hypertensive drugs should be given if the diastolic blood pressure is 110mm Hg or more. The aim is to keep the diastolic blood pressure between 90–100mm Hg to prevent cerebral hemorrhage.

Summary of Data Needed for Forecasting Methyldopa

- Target population (total expected pregnancies)
- Number of pregnancies complicated by Hypertension Disorders of Pregnancy(HDP)
- Percent deliveries in public health facilities of Punjab
- Number of pregnancies complicated with HDP seeking treatment at public health facility
- Standard or average treatment regimen (i.e. 2 x 250mg tablets per day per case)
- Expected projected changes in consumption (potential loss or scale-up in use)

The formula used for this calculation of Methyldopa is

$$\begin{array}{ccccccc} \text{Methyldopa Tablet} & & & & & & \\ \text{Need for Hypertensive} & = & \text{Expected} & \times & \text{Percent} & \times & \text{Dose of} \\ \text{Disorders of Pregnancy} & & \text{pregnancies} & & \text{pregnancies} & & \text{Methyldopa} \\ & & & & \text{complicated} & & \text{tablets per} \\ & & & & \text{with HDP} & & \text{HDP case} \\ & & & & & & \\ & & & & & & \text{Percent} \\ & & & & & & \text{deliveries in} \\ & & & & & & \text{public health} \\ & & & & & & \text{facility} \end{array}$$

Table 17 shows the forecasted amount of Methyldopa yearly. A total of 127,249 packs of Methyldopa are forecasted for the period (2017/18).

Table 17: Forecasted Number of Methyldopa Tablets

Total Population (projected, based on 2017 census -GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Expected pregnancies (3.4%) DHIS 2016 Annual Report Punjab	3,740,423	3,820,094	3,901,462	3,984,563	4,069,434	4,156,113
B) # of pregnancies estimated to develop Hypertensive Disorders of Pregnancy (5% pregnancies)	187,021	191,005	195,073	199,228	203,472	207,806
C) % deliveries at public health facilities (18% MICS 2014 Punjab - assuming 1% increase / year)	18%	19%	20%	21%	22%	23%
D) # of pregnant women with HDP seeking treatment from public health facilities	33,664	36,291	39,015	41,838	44,764	47,795
E) Requirement of Methyldopa tablets (2 x 250 mg tablets per day per case x 180 days) (E= B x 360 Tablets)	12,118,971	13,064,722	14,045,263	15,061,649	16,114,960	17,206,309
F) 5% Wastage -(Tablets)	605,949	653,236	702,263	753,082	805,748	860,315
G) Total Requirement of Methyldopa 250mg tablet for prevention/treatment of HDP G= E+F	12,724,919	13,717,958	14,747,527	15,814,731	16,920,708	18,066,625
H) Total packs (1 Pack = 100 tablets)	127,249	137,180	147,475	158,147	169,207	180,666

Forecasted Need for Gentamycin for the Treatment of Maternal Sepsis

WHO estimates that the global prevalence of maternal sepsis is 4.4% among livebirths, representing more than 5.7 million cases per year. Important variations exist between regions, with higher incidence in low-income and middle-income countries (up to 7%) compared with high-income countries (1–2%). Despite the relative low prevalence and the availability of interventions for its prevention and treatment, maternal sepsis remains a life-threatening condition and one of the leading direct causes of maternal mortality worldwide, accounting for up to 10% of maternal deaths.

The new WHO definition of maternal sepsis says, “Maternal sepsis is a life-threatening condition defined as organ dysfunction resulting from infection during pregnancy, childbirth, post-abortion, or postpartum period”. Undetected or poorly managed maternal infections can lead to sepsis, death or disability for the mother and increased likelihood of early neonatal infection and other adverse outcomes.

Several factors have been associated with increased risk of maternal peripartum infections, including pre-existing maternal conditions (e.g., malnutrition, diabetes, obesity, severe anemia, bacterial vaginosis) and spontaneous or provider-initiated conditions during labor and childbirth (e.g., prolonged rupture of membranes, multiple vaginal examinations, manual removal of the placenta, caesarean section). Strategies to reduce maternal peripartum infections and their complications have been largely directed at preventive measures where such risk factors exist.

Globally, the most common intervention for preventing morbidity and mortality related to maternal infection is the use of antibiotics for prophylaxis and treatment. Gentamycin, is recommended as first line antibiotic for prevention and treatment of peripartum infections

Summary of Data Needed for Forecasting Gentamycin

- Target population (expected live births)
- Number of deliveries complicated by Maternal Sepsis
- Percent deliveries in public health facilities of Punjab
- Number of public facility deliveries requiring Gentamycin for treatment of Maternal Sepsis
- Standard or average treatment regimen (i.e. 3mg/kg/dayx5days=3x70kg=210mg/40mg = 5 Injs. approx.)
- Expected projected changes in consumption (potential loss or scale-up in use)

The formula used for forecasting Gentamycin is:

$$\begin{array}{ccccccc} \text{Gentamycin} & & & & & & \\ \text{Need for} & & & & & & \\ \text{Treatment of} & = & \text{Expected} & \times & \text{Proportion} & \times & \text{Proportion of} \\ \text{Maternal Sepsis} & & \text{Live Births} & & \text{of public} & & \text{deliveries} \\ & & & & \text{facility} & & \text{complicated with} \\ & & & & \text{deliveries} & & \text{maternal sepsis and} \\ & & & & & & \text{requires Gentamycin} \\ & & & & & & \text{Dose per} \\ & & & & & & \text{case for} \\ & & & & & & \text{treatment} \end{array}$$

By applying the information on births /deliveries complication (10% pregnancies/deliveries are complicated), we estimated the number of women who require Gentamycin for the treatment of maternal sepsis. A total of 57,426 pregnant women with maternal sepsis seeking treatment from public health facility are estimated to require Gentamycin injection for the treatment of maternal sepsis during the forecasting period (2017/18). A total of 1.4 million injections of Gentamycin are required for 2017/18 which are to be administered intravenously. Table 18 shows the complete factorization for the forecast of Gentamycin.

Table 18: Forecasted Number of Doses of Gentamycin Required for Treatment of Maternal Sepsis

Total Population (projected, based on 2017 census - GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Live births (2.9%) DHIS 2016 Annual Report Punjab	3,190,361	3,258,316	3,327,718	3,398,598	3,470,988	3,544,920
B) Incidence of Maternal Sepsis (average preg + postpartum sepsis) WHO definition	10%	10%	10%	10%	10%	10%
C) Number of Maternal Sepsis cases (C= BxA)	319,036	325,832	332,772	339,860	347,099	354,492
D) Percent deliveries in public health facility (18% MICS 2014 Punjab -assuming 1% increase annually)	18%	19%	20%	21%	22%	23%
E) Number of Maternal Sepsis patients visiting public health facilities	57,426	61,908	66,554	71,371	76,362	81,533
F) Requirement of Gentamicin 40mg Injections for M/Sepsis patients (F= E x 25 (3mg/kg/dayx5days= 3x70kg=210mg/40mg Inj.=5 injs. approx./patient)	1,435,662	1,547,700	1,663,859	1,784,264	1,909,043	2,038,329
G) 2% Wastage	28,713	30,954	33,277	35,685	38,181	40,767
H) Total Requirement of Gentamicin 40mg Injections for Maternal Sepsis Patients H= F+G	1,464,376	1,578,654	1,697,136	1,819,949	1,947,224	2,079,096

Table 19: Forecasted Number of Injection Iron Isomaltoside

Total Population (projected, based on 2017 census - GR 2.13%)	110,012,442	112,355,707	114,748,884	117,193,035	119,689,246	122,238,627
Parameters	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
A) Expected number of pregnancies (3.4%) DHIS 2016 Annual Report Punjab	3,740,423	3,820,094	3,901,462	3,984,563	4,069,434	4,156,113
B) Prevalence of anemia among pregnant women of Pakistan	51%	51%	51%	51%	51%	51%
C) Number of pregnant women with anemia ($C = A \times B$)	1,918,837	1,959,708	2,001,450	2,044,081	2,087,620	2,132,086
D) % of deliveries in public health facility	18%	19%	20%	21%	22%	23%
E) Number of pregnant women seeking anemia treatment from public health facility ($E = C \times D$)	345,391	372,345	400,290	429,257	459,276	490,380
F) Requirement of Injection Iron Isomaltoside (5 Injections / anemic pregnant woman)	1,726,953	1,861,723	2,001,450	2,146,285	2,296,382	2,451,899
G) 5% Wastage	86,348	93,086	100,073	107,314	114,819	122,595
H) Total Requirement of Inj. Iron Isomaltoside 100mg/ml $H = G + F$	1,813,301	1,954,809	2,101,523	2,253,599	2,411,201	2,574,494

Adjust for Losses and Programmatic Changes

The proportion of patients likely to be treated with the product depends on programmatic factors. This adjustment is made either before or after converting the number of episodes to products. For example, if the number of episodes of diarrhea is expected to change, these adjustments are made when estimating the number of episodes. For forecasting and budgetary purposes, we are adding a percentage for uncertainties in demand to avoid stock-outs. It is also important to stress, that in these forecasts, the whole target population was considered, without taking into account the existing programmatic status (rate of scale up). When actual procurement of these commodities is being planned, DOH, PUNJAB will need to assess the status of implementation, particularly of new commodities such as Misoprostol and Chlorhexidine, and adjust the target population as relevant.

Forecast Limitations

Producing accurate forecasts of these MNCH commodities remains a challenge in Punjab because of unavailable consumption and stock-on-hand data. Some of the other challenges or limitations faced in producing this forecast include the following:

- To conduct the forecasting exercise, 2017 census data is used for projections of the target population (births and pregnancies), while under 5 children percentages are of either PDHS 2012-13 or PBS website, leaving a chance of error regarding the actual number of the target population. Obtaining information on the different treatment regimens was a challenge in carrying out the exercise since standardized national treatment protocols do not currently exist for most of the conditions.
- The lack of a coordinated/unified provincial procurement and supply system within DOH and IRMNCH Program for a specific MNCH commodity still remains a challenge. For example, both entities are procuring Misoprostol to distribute at the community level using their own field network, which opens a window of targeting same women.
- Information on the number of days of stock-outs of products at the district and sub-district levels is not available.
- Information on the minimum and maximum stock levels at different levels of supply chain and buffer stock for MNCH commodities is not available.
- The official unit cost for different MNCH commodities is not available for costing purposes.
- The accuracy of this exercise fully depends on the full implementation of IRMNCH program strategies and policies.
- In some cases, the recommended product is not yet available in the market or is produced by a very small number of manufacturers.

RECOMMENDATIONS

- Since there is no information and data on the actual consumption of essential medicines, IRMNCH program, DOH, Punjab should develop a mechanism for collecting logistics data on a routine basis from the health facilities to enable expeditious determination of provincial requirements of very essential medicines.
- DOH and IRMNCH program should include these very essential MNCH commodities in their logistics reporting forms and take necessary steps to make the logistics data available in their existing MIS and ensure the ultimate availability of the necessary data in web based Pakistan LMIS.
- The technical capacity of the DOH staff for conceptualizing the forecasting methodology, assumptions data validation process, and for undertaking the overall forecasting and supply planning exercise, must be strengthened. Quantification can be institutionalized in DOH by establishing a unit of relevant technical personnel across the entities that can sensitize and transfer skills to the lower levels.
- Coordination among the stakeholders is essential before MNCH commodities are procured.
- DOH can consider disseminating the forecasting report to the drug manufacturers to inform them of the quantity of commodities needed for the whole province so they too can plan accordingly.
- This forecasting exercise should be reviewed annually by the entities and adjusted to account for changes in the assumptions or data in accordance with strategic plans and new data.
- District Managers can use the forecasting algorithms for each commodity presented in this document for their local procurement planning using their own routine health information systems and population data.
- Different stakeholders should maintain an effective coordination mechanism during procurement planning, particularly for items procured at provincial and district levels. This effort will minimize the over stocking and potential wastage of commodities.

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