



**ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF PHARMACY**

**ASSESSMENT OF ESSENTIAL MEDICINES SHORTAGES AND
CONTRIBUTING FACTORS IN PUBLIC HEALTH FACILITIES IN
SOUTHERN NATION, NATIONALITIES AND PEOPLES' REGION OF
ETHIOPIA**

By

DARGICHO AHMED MOSSA

**AUGUST, 2021
ADDIS ABABA, ETHIOPIA**

Addis Ababa
University

(Since 1950)



Addis Ababa University
College of Health Sciences
School of Pharmacy
Department of Pharmaceutics and Social Pharmacy

Assessment of Essential Medicines Shortages and Contributing Factors in
Public Health Facilities in Southern Nation, Nationalities and Peoples'
Region of Ethiopia

By:- Dargicho Ahmed Mossa

A Thesis Submitted to The Department of Pharmaceutics and Social Pharmacy, School of
Pharmacy, College of Health Sciences, Addis Ababa University in Partial Fulfillment of
The requirements for the Degree of Master of Sciences in Health Supply Chain
Management

August, 2021
Addis Ababa
Ethiopia

Assessment of Essential Medicines Shortages and Contributing Factors in
Public Health Facilities in Southern Nation, Nationalities and Peoples'
Region of Ethiopia

Advisor: - Prof. Teferi Gedif Fenta (B.pharm,MPH,PhD)

Co-Advisor:- Arebu Issa Bilal (B.Pharm, MSc, Ass Professor)

August , 2021

Addis Ababa

Ethiopia

THESIS APPROVAL SHEET

As a member of the board of Examiners of Master of Sciences (MSs) thesis open defense examination, we have read and evaluated this thesis prepared by Dargicho Ahmed Mossa entitled “Essential Medicines Shortages and Contributing Factors in Public Health Facilities in Southern Nation and Nationalities Region ” We hereby certify that, the thesis is accepted for fulfilling the requirements for the award of the degree of Master of Science (MSc) in “Health Supply Chain Management”

Board of Examiners:

Tesfaye Seifu Sahledingel	_____	_____
Name of External Examiner	Signature	Date
Dr. Eskinder Eshetu Ali	_____	_____
Name of Internal Examiner	Signature	Date
_____	_____	_____
Name of Chairperson	Signature	Date

DECLARATION

This is to certify that the thesis entitled “Essential Medicines Shortages and Contributing Factors in Public Health Facilities in Southern Nation, Nationalities Peoples’ Region of Ethiopia ”submitted in partial fulfillment of the requirements for the award of the degree of Master of Sciences in “Health Supply Chain Management” to the Graduate Program of College of Health Sciences, Addis Ababa University by Dargicho Ahmed Mossa (ID. No.GSR 2818/09) is an original work carried by him under my guidance. The matter embodied in this project work has not been submitted earlier for award of any degree or diploma.

Name of the student:

Dargicho Ahmed Mossa

Signature_____Date: _____

Name of the Supervisors:

Professor Teferi Gedif Fenta

Signature _____ Date:_____

Mr. Arebu Issa Bilal

Signature_____Date:_____

Abstract

Background: Essential medicines shortages pose a serious challenge for health care facilities in Southern Nations, Nationalities and Peoples' Region, often affecting health care system. The objectives of the study were to identify the causes of essential medicines shortages and to point out solutions to prevent this problem in public health facilities of the Region.

Methods: A mixed methods design was applied to assess stock outs of essential medicines and its contributing factors in 30 public health facilities. The quantitative data were analyzed using SPSS version 20; while the qualitative data was categorized into themes based on the study objectives and analyzed manually.

Results: The average stock out on the day of visit was 9(30%) with the 4(24%) of the items were with below minimum stock level., 6(38%) were in safe stock level ,and 3(16%) were in overstock level. The average stock out duration of selected essential medicines was 74 days. Sub-optimal use of the Logistics information system, poor quantification and distribution practices, limited number of human resources for supply chain management and inadequate skills, insufficient budget and irrational prescribing and dispensing practices were raised by the key informants as contributing factors for the medicines shortages in the Region.

Conclusion: - Southern Nations, Nationalities and Peoples' Region has experienced shortages of essential medicines. Factors such as poor logistic management information system, lack of skill in logistics activities, less commitment, weak monitoring and evaluation systems, irrational prescribing and dispensing practices and insufficient budget allocation and its mismanagement contributed to the shortages.

Key words: - Contributing factors, Essential Medicines, Shortage, stock out, Public health facilities

Acknowledgement

My special thanks go to my advisors Professor Teferi Gedif and Mr Arebu Issa for their advice and guidance in my thesis work. I am grateful to Addis Ababa University, School of Pharmacy, Department of Pharmaceutics and Social Pharmacy staffs for their technical support in evaluating proposal preparation. Finally I would like to acknowledge the SNNP RHB, for sponsoring me to study post graduate training in Health Supply Chain Management. Ethiopian Pharmaceuticals Supply Agency Hawassa hub staffs are acknowledged for sharing health facilities' profile data useful for the proposal development.

Abbreviations and Acronyms

AIDS	Acquired Immune Deficiency Syndrome
ART	Anti-Retroviral Therapy
CSHs	Comprehensive Specialized Hospitals
EAHP	European Association of Hospital Pharmacists
EDHS	Ethiopian Demographic and Health Survey
EFMHACA	Ethiopian Food, Medicines, and Healthcare Administration and Control Authority
EMs	Essential Medicines
EPHI	Ethiopian Public Health Institute
EPSA	Ethiopian Pharmaceuticals Supply Agency
FDRE	Federal Democratic Republic of Ethiopia
GHs	General Hospitals
HCs	Health Centers
HCMIS	Health Commodities Management Information System
HIV	Human Immunodeficiency Virus
HSCM	Health Supply Chain Management
HSTP	Health Sector Transformation Plan
IPLS	Integrated Pharmaceuticals Logistics System
IRP	International Reference Price
JSI	John Snow Incorporated
LMIS	Logistics Management Information System
MDGs	Millennium Development Goals
MOH	Ministry of Health
MPR	Median Price ratio
PHs	Primary Hospitals
RDF	Revolving Drug Fund
RRF	Report and Requisition Form
SDGs	Sustainable Development Goals
SNNPR	Southern Nations, Nationalities, and Peoples' Region

SNNPRHB	Southern Nations, Nationalities and Peoples' Regional Health Bureau
STI	Sexually Transmitted Infection
STV	Stock Transfer Voucher
TB	Tuberculosis Bacillus
UN	United Nations
USAID	United States Agency for International Development
WHO	World Health Organization

TABLES OF CONTENTS

LIST OF TABLES.....	X
1 LIST OF FIGURES.....	XI
1. INTRODUCTION	- 1 -
1.1 . BACKGROUND OF THE STUDY	- 1 -
1.2 .STATEMENTS OF THE PROBLEM.....	- 3 -
1.3 . SIGNIFICANCE OF THE STUDY	- 4 -
2 . LITERATURE REVIEW	- 6 -
2.1 . ESSENTIAL MEDICINES AVAILABILITY	- 6 -
2.1.1 . <i>Magnitude of essential medicines Shortages in Ethiopia</i>	- 7 -
2.1.2 . <i>Magnitude of essential medicines shortages in SNNP, Ethiopia</i>	- 8 -
2.2 . FACTORS AFFECTING ESSENTIAL MEDICINES AVAILABILITY	- 8 -
2.2.1 . <i>Logistics management information system (LMIS)</i>	- 8 -
2.2.2 . <i>Organization and Staffing</i>	- 9 -
2.2.3 . <i>Quantification and Demand</i>	- 10 -
2.2.4 . <i>Budget and management</i>	- 10 -
2.2.5 . <i>Distributions</i>	- 11 -
2.2.6 . <i>Health System Capacity</i>	- 11 -
2.3 . IMPACTS OF THE SHORTAGES AND STOCK OUT OF THE ESSENTIAL MEDICINES.....	- 12 -
2.4 . CONCEPTUAL FRAMEWORK	- 12 -
2.5 . RESEARCH QUESTIONS	- 13 -
3 OBJECTIVES.....	- 14 -
3.1 . GENERAL OBJECTIVE	- 14 -
3.2 . SPECIFIC OBJECTIVES	- 14 -
4 . METHODS.....	- 15 -
4.1 . STUDY AREA.....	- 15 -
4.2 . STUDY DESIGN	- 16 -
4.3 . POPULATION	- 16 -
4.3.1 . <i>Source population</i>	- 16 -
4.3.2 . <i>Study population</i>	- 16 -
4.3.2.1 <i>INCLUSION AND EXCLUSION CRITERIA FOR INSTITUTIONS</i>	- 16 -
4.3.2.2 <i>INCLUSION AND EXCLUSION CRITERIA FOR AN INDIVIDUALS</i>	- 17 -
4.4 . SAMPLE SIZE AND SAMPLING TECHNIQUE	- 17 -
4.4.1 . <i>Sampling health facilities</i>	- 18 -

4.4.2	. <i>Selecting Key informants</i>	- 19 -
4.4.3	. <i>Selecting a key medicines for this study</i>	- 19 -
4.5	. DATA COLLECTION INSTRUMENT AND DATA COLLECTION PROCEDURES.....	- 20 -
4.5.1	. <i>Quantitative data collection procedure</i>	- 21 -
4.5.2	. <i>Qualitative data collection procedure</i>	- 21 -
4.6	. DATA QUALITY ASSURANCE	- 21 -
4.7	. DATA PROCESSING AND ANALYSIS	- 22 -
4.7.1	. <i>Quantitative data analysis</i>	- 22 -
4.7.2	. <i>Qualitative data analysis</i>	- 23 -
4.8	. ETHICAL CONSIDERATIONS.....	- 23 -
5	. RESULTS	- 25 -
5.1	. QUANTITATIVE FINDINGS	- 25 -
5.1.1	. <i>Characteristics of studied facilities</i>	- 25 -
5.1.2	. <i>Availability of Pharmacy department manpower</i>	- 25 -
5.1.3	. <i>Pharmacy department manpower trainings and experiences</i>	- 26 -
5.1.4	. <i>Logistics data recording in the study health facilities</i>	- 27 -
5.1.5	. <i>Stock out of Essential Medicines</i>	- 28 -
5.2	. QUALITATIVE FINDINGS	32
5.2.1	. <i>LMIS related factors</i>	33
5.2.2	. <i>Quantification and demand projection related factors</i>	33
5.2.3	. <i>Distribution related factors</i>	34
5.2.4	. <i>Health System Capacity Related factors</i>	35
5.2.5	. <i>Dispensing and prescribing related factors</i>	38
5.2.6	. <i>Strategies used to manage shortages of essential medicines in the facilities</i>	39
6	. DISCUSSION	41
6.1	. LIMITATIONS OF THE STUDY	47
6.2	. CONCLUSION	48
6.3	. RECOMMENDATIONS	48
7	REFERENCES.....	50
8	. DATA COLLECTION INSTRUMENT.....	55
8.1	. QUANTITATIVE DATA COLLECTION INSTRUMENT	55
8.2	. KEY INFORMANT INTERVIEW GUIDE	61
9	. ANNEXES.....	63
9.1	ANNEX 1:- SELECTED SITES WITH SAMPLE HEALTH FACILITIES SNNP,ETHIOPIA,JULY 2019	63

9.2	ANNEX 2:- PHARMACY AND OTHER MANPOWER AVAILABLE IN THE STUDY HEALTH FACILITIES DISAGGREGATED BY THE LEVEL OF HEALTH FACILITIES, SNNP, JULY 2019.....	64
9.3	ANNEX-3. THE STOCK STATUS OF THE STUDY HEALTH FACILITIES WITH MINIMUM, APPROPRIATE (SAFE) AND OVER STOCKING FOR THE SELECTED ITEMS AT THE DAY OF THE VISIT, SNNP, ETHIOPIA, JULY 2019	66
9.4	ANNEX 4: FACTORS FOR MEDICINES SHORTAGES SNNPR, ETHIOPIA, JULY 2019.	67
9.5	ANNEX 5 : ERB AND OTHER THESIS APPROVALS	68

List of tables

TABLE 4-1: GEOGRAPHIC AREAS AND SELECTED SITES FOR THE STUDY SNNPR, ETHIOPIA, JULY 2019 ...	- 18 -
TABLE 4-2: KEY SAMPLE MEDICINES, SNNPR, ETHIOPIA, JULY 2019.	- 20 -
TABLE 5-1: CHARACTERISTICS OF SURVEYED PUBLIC HEALTH FACILITIES IN SNNPR, ETHIOPIA, JULY, 2019. (N=30)	- 25 -
TABLE 5-2: PHARMACY DEPARTMENT HUMAN RESOURCES BY HFs LEVEL, SNNP, ETHIOPIA, JULY 2019. -	26
TABLE 5-3. PHARMACY DEPARTMENT MANPOWER TRAININGS AND EXPERIENCES, SNNP, ETHIOPIA, JULY 2019.....	- 26 -
TABLE 5-4: PERCENTAGE OF FACILITIES WITH AN UPDATED BIN CARDS BY PRODUCT IN PUBLIC HEALTH FACILITIES OF SNNPR, ETHIOPIA, JULY 2019(N= 30).....	- 28 -
TABLE 5-5: ESSENTIAL MEDICINES THAT ARE STOCK OUT, SNNP, ETHIOPIA, JULY 2019.....	- 29 -
TABLE 5-6: AVERAGE STOCK OUT DURATION OF ESSENTIAL MEDICINES IN PUBLIC HEALTH FACILITIES IN SNNPR, ETHIOPIA, JULY 2019.....	31
TABLE 5-7: CHARACTERISTICS OF KEY INFORMANTS, PUBLIC HEALTH FACILITIES IN SNNPR, ETHIOPIA, JULY, 2019.....	32

1 List of figures

FIGURE 2:1-CONCEPTUAL FRAMEWORK FOR THE INDEPENDENT AND DEPENDENT VARIABLES, SNNP, ETHIOPIA, JULY 2019	- 13 -
FIGURE 4:1: ADMINISTRATIVE MAP OF STUDY AREAS, SNNPR, ETHIOPIA, JULY 2019.	- 15 -
FIGURE 5:1: LOGISTICS RECORDING SYSTEM IN PUBLIC HEALTH FACILITIES OF SNNP, ETHIOPIA JULY, 2019..	- 28 -

1. Introduction

1.1 . Background of the Study

Essential medicines can be defined as medicines that are required to fulfill the basic healthcare needs of the communities, which can be selected based on the disease prevalence, efficacy and safety, and cost-effectiveness which should be available all the times within the appropriate formulations and quality (World Health Organization, 2007).

National government's accepted in the national laws availing essential medicines as the exercise of all citizens right to health (WHO, 2010). Government is responsible to ensure essential medicines security for all the communities who are prescribed to use them. This provision is also preserved in international human rights. Therefore, governments are indulged to procure in the public sector (World Health Organization, 2007; WHO, 2011)

Shortages of medicines increasing in European continent in which that 75% of study participant reported suffering either weekly or daily medicine shortages which results in direct harm to patients including with the high costs of medicines under shortages. And also most of the medicines under the shortage were antimicrobials which may causes for antimicrobial resistance (Miljković *et al.*, 2019).

Study conducted in Ethiopia shows that stock out of maternal and child health commodities were high ranging from 77% for misoprostol 200 mcg tabs to 9% for oxytocin (Woinshet *et al.*, 2018). Essential medicines shortages pose a serious challenge for health care facilities in SNNPRS, often affecting health care system. In health facilities excluding health posts, on average the stock out of essential medicines items

was 77% in 89 public and private health facilities of SNNPR (FMOH Ethiopia, 2018). Stock out of basket of medicines in public health facilities in SNNP was also 34% (WHO, 2017).

One of the limiting factors in obtaining essential medicines for low-income families in developing countries is the prices of essential medicines which tend to be the multiple of international reference prices, and global financial crisis (United Nations, 2012). Lack of skilled and trained human resources also affected the essential medicines availability. Poor human resource data handling and management has negative impact in essential health services delivery like essential medicines access (WHO, 2010). The major gaps in essential medicine access is weaknesses in the health care system as well as weak pharmaceutical regulation (Zaidi *et al.*, 2013). Raw material shortages, disease outbreak and shifts in clinical practice for selected products, inventory practices and inventory management like transportation efficiencies and distribution systems contribute to disruptions in the availability of drug products (Fox *et al.*, 2009). Lack of the electronic medicine management systems including electronic ordering, stock controlling and tracking systems contributed for the shortages of medicines (ZUMA, 2013)

Ethiopia is one of the developing countries in Horn of Africa affected by infectious diseases such as Tuberculosis (TB), Human Immunodeficiency Virus (HIV), Sexually Transmitted Infections (STI), diarrheal diseases, pneumonia, and malaria (WHO, 2007). In general irrespective of the causes, shortages of essential medicines lead to burdening health systems with additional costs (Kaakeh *et al.*, 2011) and posing risks to the health of patients who fail to receive the medicines they need (World Health Organization, 2016). Public Health facilities and other logisticians consistently reporting they are

suffering essential medicine shortages and listing many reasons for the shortages. However, these reasons or contributing factors were regionally not studied, which needs to be assessed.

1.2 .Statements of the problem

The shortage of essential medicines in public health facilities complicated health system management as majority of the populations in developing country including Ethiopia are served by these facilities. The stock out of essential medicines and medical supplies in public health facilities forced patients to use private facilities where costs are quite high (United Nations, 2012).

The average procurement MPR for the 22 medicines was 1.6 in the public HFs and sold 1.8 times IRPs (0.14 for omeprazole 20mg to 4.93 for haloperidol 5mg) in public and 4.94 times (0.19 for omeprazole to 57.99 for hydrochlorothiazide 25mg) in private medicines retail outlets in Ethiopia (WHO, 2017). And also the average price for commonly used drugs per recommended dose for an individual patient in Ethiopia public pharmacy, Ethiopian Red Cross (ERC) pharmacy and private pharmacies were \$0.65, \$0.62 and \$0.94 respectively (Abiye, Tesfaye and Hawaze, 2013).

Medication errors and adverse events associated with medicines shortages, and an increasing numbers of health care resources are being dedicated to drug shortage management. Delayed care and cancelled care have been reported as well as patient complaints because of medicine shortages (McLaughlin *et al.*, 2013). Nationally stock out of essential medicines is a problem. Average availability of essential medicines was reported 43 % at public and 42.8 % at private sectors (Sado and Sufa, 2016). The mean tracer items availability was 26 %, ranging from 15 % to 44 % across regions (WHO,

2017). Stock outs of maternal health commodities range from 77% for misoprostol 200 mcg tabs to 9% for oxytocin. For child health commodities, stock out rates vary from 74 % for chlorhexidine gel to 19% for zinc 20 mg dispersible tablets (Woinshet *et al.*, 2018).

Few studies have assessed on contributing factors for the stock out of the essential medicine in sub-Saharan Africa (Wagenaar *et al.*, 2014) and some studies were conducted on the shortage of the essential medicines in Ethiopia (WHO, 2017; Woinshet *et al.*, 2018). Even though there are so many rumors and complaints on the shortage of essential medicines in SNNPR's health facilities, there is no research on the factors affecting essential medicines availability in health centers and hospitals. And the previous study results vary with the different researchers (Carasso *et al.*, 2009; Abiye, Tesfaye and Hawaze, 2013; Hussien and Tafese, 2015). Some of the national studies conducted in Ethiopia were recommended further study on the factors affecting availability of medicines (Abiye, Tesfaye and Hawaze, 2013; Sado and Sufa, 2016). Therefore, this study examined that the stock out and factors contributing for essential medicines shortages in hospitals and health centers in selected zones of SNNPR.

1.3 . Significance of the study

Shortage of essential medicines directly affects the health care quality and contributes significantly to the lower utilization of public health services. The study will contribute towards more acceptance of contributing factors for the medicines shortages with the intention of enhancing the availability of medicine in various health facilities in SNNPR. The findings will influence actors engaging in operational management of the pharmaceutical system particularly logistics managers will be able to better plan and

monitor and evaluate activities related to logistics cycle. Ultimately quality of health care is expected to improve as is utilization of public facilities by health care clients increase.

2 . LITERATURE REVIEW

2.1 . Essential medicines availability

Essential medicines are said to be available when the stock on hand is able to ensure that the patients receive all the essential prescribed items (WHO, 2011). Accessing health services throughout the world is linked with medicine prescription and issuing to patients. Securing sustainable health commodity supply in health facilities built trusted health care facilities in the community as well as health care providers satisfaction in their duties (Farquharson *et al.*, 2011).

Availability of health commodities and affordable prices in health sectors are the vital indicators of access to health services. Accessing affordable essential medicines for developing countries is priority issue in United nations the 2030 agenda (Johnston, 2016). Essential medicines are expected to be available at all times within health facilities. Therefore medicine needs to be accessible to the majority of the population in required quantities, dosages and quality, and at affordable prices (World Health Organization, 2007). Ensuring accessing effective and affordable essential medicines and lowering pharmaceutical wastage in line with rational medicine use are the primary concern of Ethiopian Medicine Policy (Federal Democratic Republic of Ethiopia Ministry of Health, 2015).

When a health facility couldn't respond to the patients demand for prescribed medicine, it is said to be medicines shortage in which the medicines is stock out in the facility. In developing countries almost half of the public health facilities (51.8%) can access essential medicines to serve patients which is different from private health facilities where 68.5% of them dispensing are patients with essential medicines (United Nations,

2012). Nearly 75% of the essential children's medicines was stock out in the public health facilities as well as and 65% them was out of stock in private health facilities. And the prices of the essential medicines was inconsistent and higher in private health facilities (Anson *et al.*, 2012). Almost 80% of essential medicines in public health facilities were out of stock where most of the available essential medicines prices were higher than the IRP in Haiti (Chahal, St.Fort and Bero, 2013). The stock out of the pediatric medicines in public and private sector have slightly different in that 27.4% in the public health facilities and 23.3% in the private health facilities (Dorj *et al.*, 2018). Stock out of essential medicines in the public health facilities was 73% in which health facilities severing with the stock outs in running health service provision (Nditunze *et al.*, 2015). The average stock-out duration of essential medicines in Kaliro district of Uganda was 75 days (Onchweri Albert, 2015).

2.1.1 . Magnitude of essential medicines Shortages in Ethiopia

The study conducted in 2013, in average the availability of essential medicines in Gondar town was 91% (Fentie *et al.*, 2016). On the other hand, medicines availability in public facilities of Ethiopia was 55.8% to 62.8% in contrast to private facilities where 94.4% to 100.0% of medicines were available (SIAPS, 2016). And also the average availability of essential medicines in east Wollega zone was reported 43 % at public and 42.8 % at private sectors (Sado and Sufa, 2016). The stock out of the 24 selected tracer items was 72 % with the highest stock 85% in Gambella and lowest stock out was 47% in Dire Dawa (Ethiopian Public Health Institute (EPHI), 2018). The median percentage availability of basket of medicines in dispensaries of public health facilities was 72.4 % whereas in the store there was slightly different; in which the median percentage

availability was 70.69% in June 2016. The median stock out duration was 19.6 days with ranging stock out duration between minimum 6.59 days and maximum 118.88 days in public health facilities of Ethiopia (WHO, 2017). Stock out rates of maternal health commodities varied from 77% for misoprostol 200 mcg tablets to 9% for oxytocin in different regions of Ethiopia. Similarly stock out rates of child health commodities was range from 74% for chlorhexidine gel to 19% for zinc 20 mg dispersible tablets (Woinshet *et al.*, 2018).

2.1.2 . Magnitude of essential medicines shortages in SNNP, Ethiopia

In health facilities excluding health poses, on average the availability of essential medicines items was 23% in 89 public and private health facilities of SNNPR (Ethiopian Public Health Institute (EPHI), 2018). Availability of basket of medicines in public health facilities in SNNP was 66% (WHO, 2017).

2.2 . Factors affecting essential medicines availability

Many globally and nationally studied literatures mentioned above indicated that the shortages of essential medicines are critical problem throughout the world. However, it is becoming the worst in developing countries. Contributing factors for the shortages also varies from nations to nations. We have discussed some of the contributing factors studied in different literatures as follow.

2.2.1 . Logistics management information system (LMIS)

Health commodity information is the nucleus of all logistics cycle system activities and potentiates the logistics managers to make evidence-based decisions and facilitate future actions. LMIS data often executed as a base for most of the main logistics activities effectiveness (USAID | DELIVER PROJECT, 2012). The supply chain system including

the budget allocation, forecasting process, stock out monitoring, and procurement was affected in the health care and central level health facilities in Tanzania because of failure to use health information generated by the facilities (Kagaruki, Kimaro and Mboera, 2011). The lack of automated commodity information management system was the most common cause that leads to medicines shortages in the Saudi Arabian hospital (Alshehri and Alshammari, 2016). Lack of the computerized drug management systems was contributed for the EMs shortage in South Africa (ZUMA, 2013).

2.2.2 . Organization and staffing

A logistics system cannot be effective without qualified and committed staff managing health commodities (USAID | Task Order 1, 2011). One of the contributing factors for the effective management of a supply chain is the good management of human resources employed in the health supply chain management (USAID, 2017).

Factors related to human resources such as health care providers knowledge and lack of treatment guidelines and patient behavior were a significant contributing factor to medication shortages in Jordan (Awad, Al-Zu'bi and Abdallah, 2016). The factors affecting the health commodities security and sustainability in Papua New Guinea includes workforces engaging in the health supply chain management activities (Brown and Gilbert, 2014). Skill gaps and other limitations of staff in managing health products at health facilities contributed to the stock outs of medicines (Nditunze *et al.*, 2015). In Ethiopia limited skills, experiences and commitments in managing health commodities and related challenges were the most serious bottleneck in the effectiveness of health supply chain management practices (Fenta, 2017).

2.2.3 . Quantification and demand

Due to occurrence of unexpected and large demand, health outbreaks and emergencies like disasters and disease outbreaks or change in clinical practices and protocols can cause shortages of drugs (Fox *et al.*, 2009). Supply and demand inconsistency including interruption of raw materials and finished health products supply, occurrence of health outbreaks, starting and initiating new clinical practices and political conflicts and instability were the factors that contributed to the drug shortages in Jordan (Awad, Al-Zu'bi and Abdallah, 2016). Access to essential medicines is positively affected by the availability of reliable health systems and rational selection and demand projection (Organization, 2004). The poor procurement planning and quantification gap were the main causes of drug shortages in Pakistan (Atif *et al.*, 2019).

2.2.4 . Budget and management

Shortages of essential medicines may results from due to high cost some items were excluded from central procurement lists and procurement plan (Robertson *et al.*, 2009). Securing health care budget and its management system disturb the quantification and procurement of health commodities; hence its availability (USAID | Task Order 1, 2011). The factors limiting availability of essential medicines in the public health sector includes low budget allocation, inaccurate demand projection, poor procurement planning and disorganized procurement and delivery or distribution. Due to unaffordable prices, accessing essential medicines for the management of chronic cases was challenging in developing countries (United Nations, 2012). Shortage of essential medicines may result in poor budgetary and funding management and unaffordable priced medicines itself (Zaidi *et al.*, 2013; Hinsch, Kaddar and Schmitt, 2014). Study conducted in Sudan reported contributing factors for medicine shortages was insufficient budgeting for

transportation and distribution of essential medicines, hence low availability in service delivery points (Elfatih Ibrahim Elamin, Mohamed Izham Mohamed Ibrahim, 2010).

2.2.5 . Distributions

A study conducted in Jordan documented distribution related factors including limited number of suppliers, poor communication between logisticians and supply chain actors and health facilities, weak ordering practices and delayed delivery affected level of the inventory (Awad, Al-Zu'bi and Abdallah, 2016). The availability of essential medicines adversely affected by the inconsistency timeliness of delivery, lack of consideration of the an individual characteristics of health facilities regarding disease burden, epidemiology and like that exist at the different health facilities among others, weak leadership and poor integration of the national system (Onchweri Albert, 2015).

2.2.6 . Health system capacity

Strong leadership, skilled supply chain workforce and appropriate investments are the key components that play main role on the supply chain reform in improving the availability of essential medicines (Yadav and Smith, 2014). The health commodities supply chains management accompanied with numerous challenges consisting delayed delivery schedule, the delivery of non-requested medicines and supply of under quality medicines. And also the absence of liability measures for those who were negligent in their duty, insufficient medicines budgetary, absence of transparent financial management and limited involvement of facility managements and society members in decision making even on the locally collected medicine fund could affect the availability of essential medicines (Mkoka *et al.*, 2014). Disorganized national supply plan for child

and maternal health products results in respective medicines shortages (Woinshet *et al.*, 2018).

2.3 . Impacts of the shortages and stock out of the essential medicines

The shortage of essential medicines in the public health facilities obligated patients to acquire medicine from private health facilities, which priced doubled to tripled more than public health facilities (United Nations, 2012). Irrespective of the causes of the stock out , shortages of essential medicines itself results in burdening health systems with additional unnecessary indirect costs and exposing patients to more risks who couldn't receive the medicines they demanded (World Health Organization, 2016). Shortages of essential medicines in public health facilities required patients either to buy medicines from private health facilities where usually medicines priced more than public which is not affordable to the patients or to omit the treatment (Abiye, Tesfaye and Hawaze, 2013).

2.4 . Conceptual framework

This study conducted mixed methods approach to identify the contributing factors for the essential medicines shortages in SNNP, Ethiopia. The conceptual framework developed by intending a direct or indirect relationship to the drug shortages which shows that performance of independent variables affects the availability of essential medicines.

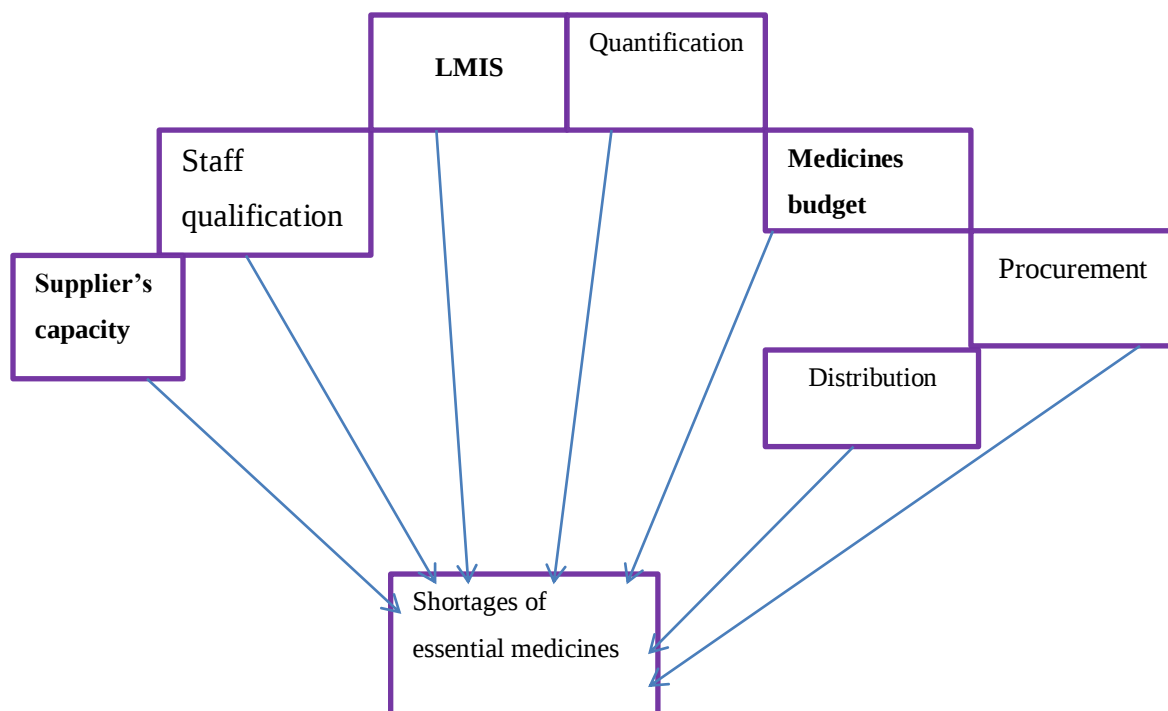


Figure 2:1-Conceptual framework for the independent and dependent variables, SNNPR, Ethiopia, July 2019

2.5 . Research questions

- What are the stocks out level of essential medicine in the study health facilities?
- What are the reasons for the shortage of essential medicines in the health facilities?
- What are the strategies used to overcome shortages of essential medicines in the facilities?

3 Objectives

3.1 . General Objective

- To assess the level of essential medicines shortages and contributing factors and mitigation strategies used in Public Health Facilities of SNNPR.

3.2 . Specific objectives

- To determine the current stock out levels in selected public health facilities in SNNPR of Ethiopia.
- To assess reasons for the stock out in selected public health facilities in SNNPR of Ethiopia.
- To explore the strategies used to manage shortages of essential medicines in the selected public health facilities of SNNPR of Ethiopia.

4 . Methods

4.1 . Study area

During the study time SNNPR comprised of a total of 17 zones, 7 special woredas and one city administration, with more than 200 woredas covering an area of 118,000 square kilometers (around 10% of the country). SNNPR bordered with Kenya to the south (including a small part of Lake Turkana), the Ilemi Triangle to the southwest, South Sudan to the west, the Ethiopian region of Gambella to the northwest, and the Ethiopian region of Oromia to the west, north and east. Its population was estimated to be 20,086,552 in 2019. The population is served by 4640 public health facilities (68 hospitals, 696 health centers, 3876 health posts) and more than 1183 private and non-governmental different types of health facilities (SNNP-RHB, 2018).

This study was focused on public health facilities which are supplied by government financial system. The ten top causes of morbidity in the regions are: 1. Pneumonia, 2. Typhoid fever, 3. Non-bloody diarrhea, 4. Respiratory disease, 5. Trauma, 6. Malaria (all types), 7. UTI, helminthiasis, 8. Dyspepsia, 9. Epidemic typhus, and 10. Bloody diarrhea (SNNPR-RHB, 2017).

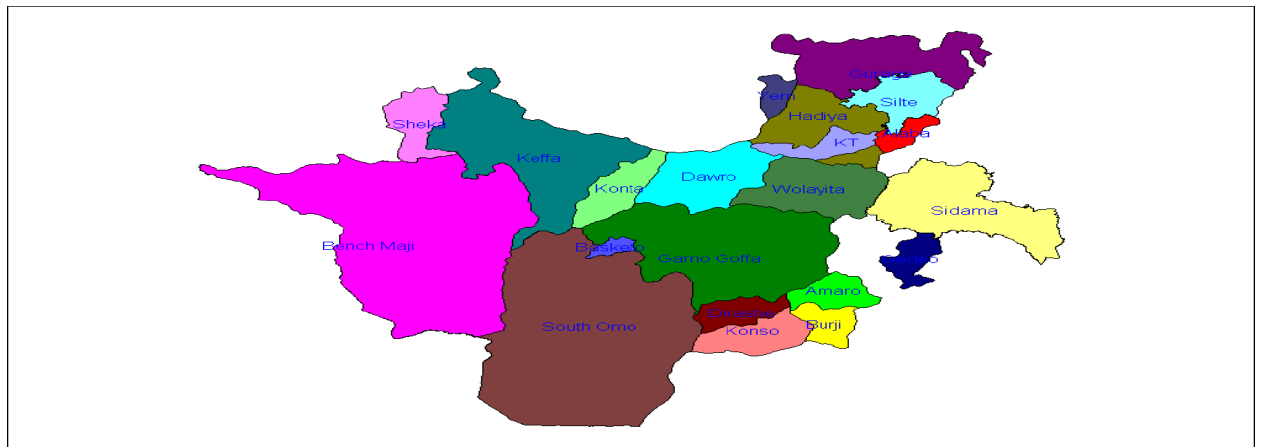


Figure 4:1: Administrative map of study areas, SNNPR, Ethiopia, July 2019.

4.2 . Study Design

A mixed method involving a quantitative and qualitative descriptive design was applied to assess stock outs and contributing factors affecting availability of essential medicines in 30 public health facilities. Quantitative study was used to assess shortages and a qualitative method was used to explore the contributing factors for shortages of essential medicines in public health facilities of SNNPR. The quantitative and qualitative data were collected simultaneously and separately analyzed. In this study, descriptive exploratory research design approach was used.

4.3 . Population

4.3.1 . Source population

All public health facilities including 68 public hospitals, 696 public health centers and 3878 health posts found in the region. Professionals from regional health bureau, zonal health departments (ZHDs), woreda health offices (WoHOs), and public health facilities were also the source population.

4.3.2 . Study population

The study area was clustered into five based on the geographical accessibilities, administrative zones and supplying EPSA hub. All public health centers and hospitals with not less than two years services in five selected clusters were included. Key informants were selected from the SNNP-RHB, ZHDs, WoHOs, and EPSA pharmaceutical sectors and departments.

4.3.2.1 Inclusion and Exclusion criteria for Institutions

- All public health centers and hospitals with two or more years of services provision. This is because most newly inaugurated public health facilities not

fully implemented all health services to manage all morbidity causes. It needs adaptability and stability period to operate all its standard services.

- EPSA, RHB, ZHDs, and WoHOs medicines and medical equipment supply and services directorates were covered in key informants' interview.
- Health posts were considered as a dispensing unit of health centers because products used by the health posts were directly included by the respective health centers, hence health posts were excluded.

4.3.2.2 Inclusion and Exclusion criteria for an individuals

- Health facility heads and all personnel working in the pharmaceutical services mainly store managers and dispensers in the facilities were included for the key informants' interview.
- Since the qualitative response require exposure to pharmacy sector activities, individuals that have not worked for last one year from the study period in the pharmacy sector was excluded from the key informants.

4.4 . Sample size and Sampling Technique

The multistage cluster sampling technique was employed to select sample health facilities. Based on distance from the capital of the region, Hawassa, zones and special woredas in SNNPR were classified into five geographic areas (Table 4-1). The classification was based on geographical accessibilities, infrastructure difference, as regional health sector management support varies with distance from the regional capital. Adjacent zones are included in one category. Then from each category of zones or clusters, one zone is selected using lottery method. The capital, Hawassa City Administration was purposively included in the sample.

Table 4-1: Geographic areas and selected sites for the study SNNPR, Ethiopia, July 2019

No	Geographic areas	Selected sites
1	Sidama, Gedeo, Hawassa city Administration	Hawassa city
2	Hadiya, Halaba, Kembata-Tembaro , Silte , Gurage	Silte
3	Wolaita, Gamo,Gofa, Basketo,	Wolaita
4	Segen area, South omo,	South Omo Zone
5	Yem , Kefa, Bench maji, Sheka, Konta, Dawro zones	Kefa

4.4.1 . Sampling health facilities

To select specific health facilities, WHO Operational Package for assessing, monitoring and evaluating country pharmaceutical situations (December 2007 Version) was used (WHO (World Health Organization), 2007). A total of 30 public health facilities were selected from the five clusters.

Within each site, six public health facilities were identified. One of the selected public health facilities was the main (biggest) public hospital in the area. The biggest hospital of the selected zone was a hospital with highest patient load and consisting of a greater number of specialties and providing wider health care services. These facilities could be General or Comprehensive Specialized/Referral/Teaching hospitals. The middle level health facilities were facilities located in the Zonal/Woreda centers which may be primary hospitals and high-volume health centers. The lowest level public health facilities are facilities located in the rural Keble with limited patient load.

The biggest facility of the site was selected purposively from a list of all public health facilities in each cluster, then the middle level health facilities were selected by lottery method in the all the five clusters. Finally, the lowest-level public health facilities were

identified and numbered and selected by systematic random sampling technique and the required sample size 30 health facilities were sampled as shown in Annex1.

4.4.2 . Selecting Key informants

Thirty key informants were selected from EPSA Forecasting and Procurement Departments Heads, SNNP-RHB and ZHD Pharmaceutical Services and Supply Department Coordinators and Health Facilities Pharmacy Unit. The sample size was determined based on the researcher's recommendations. Some researchers such as Mark Mason recommended that qualitative studies better to include between 20 and 30 interviews (Mason, 2010). The sample size for qualitative interview with the sample size 25-30 recommended for publications and to avoid redundancy. Similarly; the sample size for qualitative research need not to exceed 30 (Authors, 2016). Therefore, the 30 KIs were selected for this study.

4.4.3 . Selecting key medicines for this study

A list of 17 key medicines used and highly prescribed at all sample facilities i.e., health centers and hospitals to treat common health problems and taken purposefully from Ministry of Health (MOH) essential medicines lists to measure availability, and stock out level and to identify the factors affecting essential medicines shortages. These medicines were therapeutically most important based on national treatment guidelines and regional disease burden which were expected to be available at all sample health care facilities. The selection process was discussed with the SNNP-RHB experts from medical service department ad hoc clinical team. And also the WHO operational package for assessing, monitoring and evaluating country's pharmaceutical situation guide was used as a reference which recommended 15 and more key drugs must be selected to measure

availability and stock out duration of essential medicines (WHO (World Health Organization), 2007).

Table 4-2: Key sample medicines, SNNPR, Ethiopia, July 2019.

Sr.No	Names and strengths of the medicine
1	Amoxicillin 500mg cap
2	Ceftriaxone 1g injection
3	Ciprofloxacin 500mg caps/tab
4	Sulphamethoxazole and Trimethoprim 400mg/80mg tab
5.	Salbutamol Oral Inhalation
6	Magnesium Sulphate injection 50%
7.	Mebendazole Oral Suspension,100mg/5ml
8	Artemeter + Lumfantrine 20mg + 120mg tab
9	Metronidazole 250mg cap/tab
10	Atenolol 50mg tab
11	Hydrochlorothiazide 25mg tab
12	Phenobarbitone 100mg tab
13	Omeprazole 20mg
14	Metformin 500mg tab
15	Ferrous sulphate +folic acid
16	Sodium Chloride 0.9%(Normal Saline) 1000ml
17	Oxytocin 10uU/ml

4.5 . Data collection instrument and data collection procedures

Assessment questions for both quantitative and interview guide were adapted from results and discussion section parts of published papers on the similar studies (Muiruri and Mugambi, 2017) and (Fredrick and Muturi, 2016) and WHO Operational Package for assessing, monitoring and evaluating country pharmaceutical situations (December 2007 Version) (WHO , 2007) and (Elfatih Ibrahim Elamin, Mohamed Izham Mohamed

Ibrahim, 2010) was used for quantitative part specially days of stock out related questions.

4.5.1 . Quantitative data collection procedure

Quantitative data was collected by using structured questionnaires including document review. Bin cards, medicines reporting and requisition records, and electronic health commodities management information system (HCMIS) and dispensary registry books were used and reviewed as data sources for quantitative data. To assess the stock out items at the day of the visit, directly observed both dispensaries and medicine stores. Bin cards and HCMIS were reviewed for shortages and stock out records of last one year to calculate the stock out days. The items have no record at least for six months were excluded.

4.5.2 . Qualitative data collection procedure

Qualitative data was collected by using an interview guide questionnaires with an in depth interview to the key informants. The interview took on average 40 minutes.

Six data collectors (4 pharmacists and 2 druggists) were involved in data collection and key informants' interview. Two supervisors (1 MSc in Drug supply management & 1 pharmacist) were participated.

The data collection was conducted from May 2019 to July 2019.

4.6 . Data Quality Assurance

Training was given to data collectors and supervisors prior to data collection. The data collectors were supervised and the questionnaires were checked daily by the supervisors. The solution to any problems encountered was discussed with the supervisors and the data collectors. The survey instruments were pretested with 5 health facilities for

quantitative part and two pilot interviews were conducted for qualitative part. Pilot interview for the qualitative part was done simply to measure the time taken for the interview and determine the number of days required for the data collection and appointing Key informants for the interview. However, the data obtained by the pilot interview was not included in the analysis. The researcher was familiarized with the data collected in the listening, typing, and correcting the data. Based on this assessment, the necessary corrections and modifications made on the contents and clarity of the questionnaires with options of the choice for some questions were added to the questionnaires with the quantitative part.

4.7 . Data Processing and Analysis

4.7.1 . Quantitative data analysis

First the data was checked for completeness and consistency. Then detail data for each health facilities were entered in excel sheet with respect to facility code. In the next step for example; the average days of the stock out for the specific health facility was entered in the computer and analyzed using SPSS statistical package version 20 for social sciences software and results were presented in tables, graphs and charts. The average days of stock out for specific item in all health facilities was calculated by adding all the days of stock out in 28 health facilities and dividing it by 28. Similarly, the average days of stock out for all health facilities was calculated by adding the average days of stock out for all the 17 essential medicines in study health facilities and dividing it by 17. Because due to lack of recorded data for the items, two health facilities were excluded for days of stock out calculation.

4.7.2 . Qualitative data analysis

The interview audio data was recorded with in the mobile phone. Notes were taken while listening and capturing the main responses provided by each of the participants. The recorded data was translated into written documents in line with note taken during interview. All notes and the audio records were transcribed and translated from Amharic into English and used to finalize the note taken during interview. The investigator transcribed and translated each interview after checking the content. Following the transcription, coding of the data was done by using inductive approach. Since this study is exploratory study, the coding was done by inductive approach in which codes derived directly on the phrases or terms used by the participants. Because this coding can reflect participants response and most exploratory and theory building qualitative studies are employing it” (Gehman et al. 2018). We have done line-by-line coding with 58 codes. These codes were merged to 12 codes which were merged to six themes. Transcription and coding were done manually. The data was categorized into themes based on the study objectives and analyzed manually on different thematic areas.

4.8 . Ethical considerations

Ethical clearance was obtained from the Institutional Review Board (IRB) of the School of Pharmacy, College of Health Sciences, Addis Ababa University (Ref.No ERB/SOP/68/04/2019) and from SNNP-RHB (Ref.No.PM37-186/33029) (Annex 5). The data collectors clearly explained the aims of the study to the study participants and facility heads. Discussions were made with heads of the health departments, health center and hospitals on the aim of the study and the data to be assessed in the study facilities. It was also explained well that the data collected from the facilities are to be used for

research purpose only. Information was then collected after obtaining consent from the facilities and from each participant. The right to refuse or discontinue in the study was given to the study participants at any time they want and the chance to ask any thing about the study was given. For the purpose of anonymity participants' name was not used at the time of data collection and all other personnel and institutional information kept entirely anonymous and confidentiality was assured throughout the study period.

5 . Results

5.1 . Quantitative findings

5.1.1 Characteristics of studied facilities

Data from thirty health facilities were included for quantitative analysis; 22 health centers, 3 primary, 2 general and 3 comprehensive specialized hospitals (Table 5-1).

Table 5-1: Characteristics of surveyed public health facilities in SNNPR, Ethiopia, July, 2019. (N=30)

Variables	Frequency	Percentage
Health facility type		
CSHs	3	10
GHs	2	7
PHs	3	10
HCs	22	73

5.1.2 . Availability of human resource in pharmacy department

All the study health facilities at least have one druggists, and out of which 14(47%) of the health facilities have both pharmacists and druggist. From the expected pharmacy departments' technical human resource required by the standard, the available technical staff was with lowest 2(20%) and the highest value of 11(92%). Any of the study health facilities were not fulfilled the human resource requirements as per the standard. The availability of the pharmacy personnel i.e., pharmacists, and druggists were 65% against technical staff required in the study health facilities. Most proportion 81(78%) of the pharmacist working in tertiary level of health facilities and 61(44%) of druggists were employed in health centers (Table 5-2). Comprehensive specialized hospitals have high

numbers of technical staff fulfilled with pharmacy professions 119(87%) followed by general hospitals 25(63%) requirements as per the standard.

Table 5-2: Pharmacy department human resource by HF's level, SNNP, Ethiopia, July 2019

Facility level	Number of HF's	Pharmacist	Druggist	Other	Total Technical staffs available	Total technical staffs required	Total Technical staffs available in	%Pharmacy personnel
HCS	22	12	61	14	87	154	56	47
PH	3	7	19	4	30	44	68	59
GH	2	4	21	0	25	40	63	63
CSH	3	81	38	0	119	137	87	87
Total	30	104	139	18	261	375	70	65

5.1.3 . Pharmacy department human resource trainings and experiences

Fifty seven percent of pharmacy departments' staff have 5-10 years of working experiences. Fifty three percent of the study health facilities had health supply chain staff trained on IPLS and DTC (Table 5-3).

Table 5-3. Pharmacy department human resource trainings and experiences, SNNP, Ethiopia, July 2019

Variables	Frequency	Percentage
Work experience		
< 1 years	26	10
1-4years	87	33
5-10 years	150	57

Training obtained		
IPLS	7	23
DTC	1	3
IPLS & DTC	16	53
IPLS, Quantification & other	3	10
Have no training	3	10

5.1.4 . Logistics data recording in the study health facilities

In this study, it was found that half of the health facilities were using paper-based logistics management information system (LMIS) while 13 health facilities were using both automated and paper based LMIS. And two health facilities were using neither paper based, nor electronics recording (Figure 5:1). However, the data quality and accuracy were poor in health facilities using both electronics and paper-based health commodities recording systems. This is because erasing records and skipping or interrupting some records in bin card and HCMIS was commonly observed in majority of the health facilities.

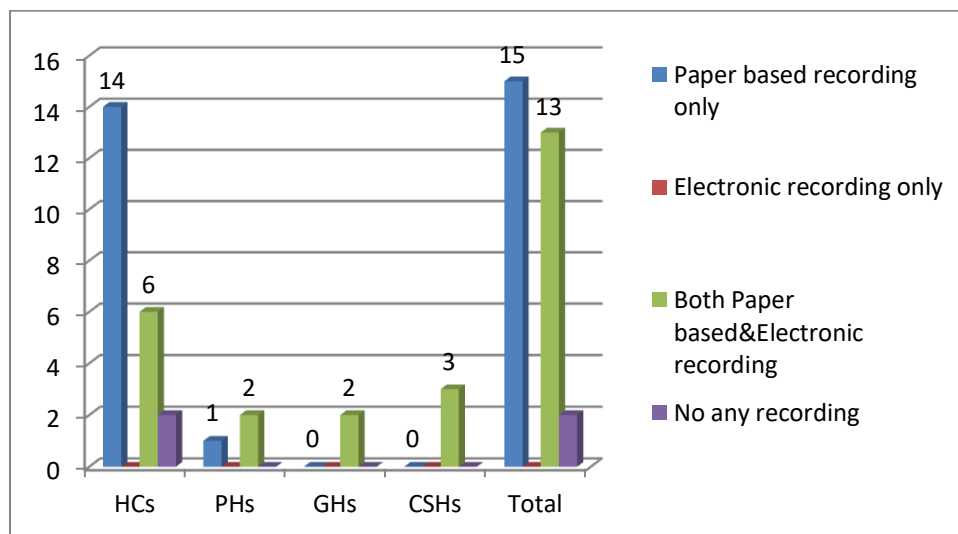


Figure 5:1: Logistics recording system in public health facilities of SNNP, Ethiopia July, 2019

As shown in Table 7.1.4, the average extent of bin card's updating practice was 15(50%). The result shows the extent of the practice of updating bin cards varied across health facilities and items. It ranged from 8(27%) to 20(67%).

Table 5-4: Percentage of facilities with an updated bin cards by product in public health facilities of SNNPR, Ethiopia, July 2019(N= 30)

S/No	Name of key medicines	Frequency	Percentage
1	Amoxicillin 500mg cap	19	63
2	Ceftriaxone 1g injection	19	63
3	Ciprofloxacin 500mg caps/tab	14	46
4	Sulphamethoxazole and Trimethoprim 400mg/80mg tab	18	61
5	Salbutamol Oral Inhalation	16	52
6	Magnesium Sulphate injection 50%	20	67
7	Mebendazole Oral Suspension,100mg/5ml	11	36
8	Artemeter + Lumfantrine 20mg + 120mg tab	10	33
9	Metronidazole 250mg cap/tab	20	67
10	Atenolol 50mg tab	8	27
11	Hydrochlorothiazide 25mg tab	13	43
12	Phenobarbitone 100mg tab	14	46
13	Omeprazole 20mg	19	63
14	Metformin 500mg tab	16	52
15	Ferrous sulphate +folic acid	16	52
16	Sodium Chloride 0.9%(Normal Saline) 1000ml	11	38
17	Oxytocin 10uU/ml	13	43

5.1.5 . Stock out of essential medicines

When we say stock out, the item was not available in both store and dispensaries. The proportion of health facilities with out of stock for one or more of the essential medicines assessed on the day of visit was 9(30%)) (Table 7.1. 5). Majority 17(57%) of the study health facilities did not have Atenolol 50mg on the day of visit. Amoxicillin 500mg was

available in most (87%) of the facilities. Based on the health facilities procurement plan and average monthly consumption for RDF pharmaceuticals , (4(24% of the items were with below minimum stock level., 6(38%) were in appropriate or safe (normal) stock level ,3(16%) were in overstock level and the rest were stock out for the items (See Annex-3).

Table 5-5: Essential medicines that are stock out, SNNP, Ethiopia, July 2019.

Items	No of HFs with stock out at the time of assessment	% of HFs with stock out at the time of assessment (N=30)
Amoxicillin 500mg cap	4	13
Ceftriaxone 1g injection	6	20
Ciprofloxacin 500mg caps/tab	9	30
Sulphamethoxazole and Trimethoprim 400mg/80mg tab	8	27
Salbutamol Oral Inhalation	10	33
Magnesium Sulphate injection 50%	8	27
Mebendazole Oral Suspension , 100mg/5ml	13	43
Artemeter + Lumfantrine 20mg + 120mg tab	8	27
Metronidazole 250mg cap/tab	6	20
Atenolol 50mg tab	17	57
Hydrochlorothiazide 25mg tab	11	37
Phenobarbitone 100mg tab	12	40
Omeprazole 20mg	6	20
Metformin 500mg tab	16	53
Ferrous sulphate +folic acid	7	23
Sodium Chloride 0.9% 1000ml	6	20
Oxytocin 10uU/ml	6	20
Average	9	30

5.1.5.1 . Average stock out duration of essential medicines

The items stock out at the any of the days of the year (2018) was different from the stock outs recorded on the day of visit. On average 13 (43%) HFs were stock out for any of the selected essential medicines at least for a day/days) in 2018. The lowest stock out duration was for amoxicillin 500mg caps with 43 days. Similarly, the highest stock out

duration was for ceftriaxone 1gm injection with 110 days. Average stock out duration of essential medicines in the health facilities in 2018 was 74 days.

The highest days of stock out were recorded in general hospitals (77 days) followed by comprehensive specialized hospitals (76 days) (Table 5-6).

Table 5-6: Average stock out duration of essential medicines in public health facilities in SNNPR, Ethiopia, July 2019.

Items	No of HFs with stock out for 2018 (N=30)	% of HFs with stock out for the year (N=30)	HCs	PHs	GHs	CSHs	Total Days of out of stock	Average stock out duration in days in 2018
Amoxicillin 500mg cap	12	40	851	340	0	0	1191	43
Ceftriaxone 1g injection	19	63	2443	254	170	225	3092	110
Ciprofloxacin 500mg caps/tab	16	53	2399	0	177	126	2702	97
Sulphamethoxazole and Trimethoprim 400mg/80mg tab	10	33	1529	0	116	266	1911	68
Salbutamol Oral Inhalation	16	53	1326	382	347	257	2312	83
Magnesium Sulphate injection 50%	8	27	1092	0	497	99	1689	60
Mebendazole Oral Suspension,100mg/5ml	11	37	2379	127	0	327	2833	101
Artemeter + Lumfantrine 20mg + 120mg tab	16	53	1097	162	14	267	1540	55
Metronidazole 250mg cap/tab	13	43	1040	61	61	398	1560	56
Atenolol 50mg tab	5	17	1595	399	55	0	2050	73
Hydrochlorothiazide 25mg tab	11	37	1505	159	78	239	1981	71
Phenobarbitone 100mg tab	16	53	1959	286	77	453	2774	99
Omeprazole 20mg	19	63	1495	471	114	90	2169	77
Metformin 500mg tab	10	33	1500	0	378	153	2031	73
Ferrous sulphate +folic acid	19	63	1580	259	293	258	2390	85
Sodium Chloride 0.9% 1000ml	12	40	728	282	241	223	1474	53
Oxytocin 10uU/ml	8	27	567	334	0	485	1386	50
Total	221	735	25084	3517	2618	3866	35085	1253
Average	13	43	74	69	77	76	74	74

5.2 . Qualitative findings

A total of thirty key informants were interviewed; of whom 24 were males and 6 females. The key informants were representatives of various institutions; including 10 from health facilities, 10 from the Zonal Health Departments, 4 from RHB and 6 from EPSA staffs working at the Pharmaceutical Logistics Unit were purposively selected and interviewed. More than half of the key informants were pharmacists by profession 17(57%); with three of them were with MSc in pharmacy. And most of the head of the facilities and pharmacy departments 19(63%) were included in key informant interviews (Table 5-7).

Table 5-7: Characteristics of key informants, public health facilities in SNNPR, Ethiopia, July, 2019.

Characteristic	N	%
Gender		
Female	6	20
Male	24	80
Educational Background(Profession)		
Druggist	5	17
Pharmacist	14	47
MSC in Pharmacy	3	10
MBA	4	13
Others	4	13
Length of Experience		
1-4 years	3	10
5-10 years	17	57
>10 years	10	33
Role or Positions in the Organization		
Head of the Facility	10	33
Store man	4	13
Head of the Pharmacy	9	30
Dispenser	2	7
Others	5	17

Participants' phrases and or terms were coded line-by-line coding system with 58 codes. These codes were merged to 12 codes which were merged to six themes. These themes were directly or indirectly related to factors for shortage of medicines. These include: (1) LMIS related factors, (2) quantification and demand projection related, (3) distribution related factors, (4) health system capacity related factors, (5) dispensing and prescribing practice related factors and (6) strategies used to manage shortages of essential medicines in the facilities. Each theme was narrated in detail as follows.

5.2.1 . LMIS related factors

The key informants emphasized that poor commodities' data recording and documentation by the health facilities was one of the significant factors affecting the health supply chain system. This is because the logistics recording system is mainly paper-based which is not interlinked from patient level to the different levels of the health system. Key informants reported that product invisibility is the common problem at all level of the facility, contributing to medicines shortage. This was indicated by informants as follows:

“The stock outs and over stock of essential medicines in our health facility was the most common results of poor LMIS” (KI7).

LMIS related factors which result in shortage of medicines identified by the KIs included quantification, unexpected demands factors, and distribution factors.

5.2.2 . Quantification and demand projection related factors

Eighteen of the participants said that health facilities do not practice appropriate quantification process for revolving drug fund. In some occasion revolving drug fund (RDF) procurements were based on available budget but not demand based. Some of the

participants mentioned that man-made disasters and political instability resulted in supply and demand imbalances, finally causing medicines shortages.

One of the KI said that *“since 2018 there was internal conflicts and displacement of peoples in the SNNPR, hence hundreds of thousands of people were living in the refugee camps which resulted in unexpected demands and pressure on the nearby health facilities and health systems”* (KI3).

KI also added that *“due to lack of reliable logistics data health facilities were unable to develop regular and reliable stock status and consumption report including average monthly consumption which results in wrong forecasting and procurement decision”* (KI4).

5.2.3 . Distribution related factors

According to the key informants, the RRF and products transfer steps from HFs to EPSA and vice versa is long and involve non-value added, RRF transfer steps. First health facilities send their consumption information (report) to EPSA for program products on bimonthly basis. Their RRF passes through WoHOs, then ZHDs and via regional health bureau to reach EPSA.

EPSA has grouped health facilities in to two for program pharmaceuticals resupply (delivery); direct or non-direct delivery sites based on the ART service provision. Health facilities that are providing ART services grouped in the direct delivery sites whereas health facilities that are not providing ART services are grouped in the non-direct delivery sites. Therefore, direct delivery site are received program pharmaceuticals

directly from EPSA hubs whereas non-direct delivery sites are received products from EPSA hubs through WoHOs.

Mostly at woreda level, the products unnecessarily stored for long time without delivering to the respective health centers (PMTCT sites) which results in stock outs. Distribution of medicines with short expiry date and applying push system from RHB and EPSA were also common factors for the inappropriate stock level of essential medicines which results in having over or under stock.

One of the KI said that;

“Some health facilities in our Woreda do not prepared their RRF and submit to WoHO. However; in order to prevent product shortage in non-reporting health facilities we estimate their consumption without any information from the non-reporting health facilities, which may results in shortages” KI 6.

Similarly, one of the KI said that *“EPSA has special agreement with some of the health facilities of neighboring region, hence unfairly reserving stocks and supply for those facilities affecting our stock status”* KI 15.

5.2.4 . Health system capacity related factors

Fourteen of the Key informants indicated that medicine shortage is because of a weak health supply chain system. The existing health system is characterized by long lead time, supply of non-demanded and near expiry medicines.

Ethiopian public health commodity supply policy recommended that 80% of the products could be imported; while 20% left for domestic manufacturers. Due to shortage of raw materials domestic manufacturers fail to fulfill their commitment, KI1.

One of the KI said:

“Even though there is a procurement policy promoting a minimum of 20% country’s demand from domestic manufacturing, due to raw material shortage domestic manufacturers couldn’t fulfill it, they couldn’t supply even 10% of the demand” KI 23.

Mismanagement and system corruption and theft were indicated as the main contributing factors for the medicines shortage. In this connection, majority of the key informants reiterated that absence of accountability is a hindrance for promoting good medicine supply management practice.

For example, one of the KIs said the following:

“Medicines are made deliberately out of stock in the health facility because of business relationship with the private retailers” KI17.

Key informants also revealed that *“there was lack of ownership and accountability for stock out of essential medicines in public health facilities. And also there was poor internal medicines control system in public sector which may affect public health supply security. The public health facilities have not monitoring and controlling system to establish accountability and transparency” KI3.*

One of the KI depicted the following

” We have not conducted product and pharmaceuticals service auditing in our health facility for last two years, even professionals working in the pharmacy departments were released without auditing the practice” KI18.

The key informants also stressed that the communication within and with outside of the facilities about the inventory coordination mechanism to control inventory between the RHB, ZHDs, WoHOs and public health facilities was loose.

A significant proportion of key informants mentioned that there was improper staffing of health supply chain management departments. Under qualified and disempowered staff managing public health supply chain and improper management of health supply chain personnel are identified as challenges associated with human resources for supply chain. Most of the supply chain staffs were less motivated and with low commitment. Shortage of HR is also a problem mentioned by the KIs. The following quotes demonstrated the problem related to human resources:

“Most of the Personnel assigned to manage the-health supply chain are non-pharmacy personnel or with no training. Political affiliation is taken as major criteria to assign managers to the HSCM” KI 26.

“Our health centers’ pharmacy department manpower was dominated by clinical nurses; hence we couldn’t implement IPLS and DTC activities properly” KI 14.

Key informants also indicated that turnover of trained manpower would aggravate health supply chain issues. Trained pharmacy department manpower frequently leaves from the facilities, resulted in interruption of essential logistic activities. The health facilities do have neither human resources retention policy system nor established mechanism to skill transfer from trained personnel to others. In relation to this, one of the KIs mentioned the following:

*”Two of our trained pharmacy professionals were transferred to other health facilities without any information, then we are challenged by pharmacy professionals shortage and we couldn’t do logistics activities in the good manner, hence there were under stock or over stock of essential medicines in our health facilities ”*KI 7.

KIs indicated the presence of unjustifiable or low budget allocation and inefficient management of medicines' budgets. Health facilities secure medicines budget from different sources. The medicines budget may be allocated from woreda health office (WoHO) or ZHD or from facility itself (RDF). However, the budget allocated from the ZHD or WoHO are not usually reconciled with the real quantification and demand.

One of the KI mentioned that;

“Our medicines budget allocation was not reliable that means the medicines budget for the facility is not allocated based up on the facility demanded or consumed , every year it's allocated simply from sharing with the all other health facilities and sectors available in the Woreda” KI20.

According to some of the KIs, even the available low budget is inefficiently utilized because the fact that in most instances the budget may not be released on time.

In connection with this, one of the respondents said that *“Our medicines budget from WoHo has often been secured after the half of the budget or fiscal year is lapsed, making timely procurement difficult ”* KI12.

5.2.5 . Dispensing and prescribing related factors

Majority of the KIs expressed that ART commodities are supplied bimonthly. However, the new appointment spacing model calls for dispensing *ART medications for six months* creating pressure on the commodity security.

A KI said

*“While our facility shifted the HIV clients to appointment spacing schedule, the consumption was increased dramatically for the particular items.”*KI16.

KIs also stressed that the irrational prescribing and dispensing practice in the public health facilities would result in stock out of some of the medications. For instance, A KI expressed the following:

“In our health facility, physicians are frequently prescribing certain items like Ciprofloxacin 500mg & Ceftriaxone injection for many illnesses irrationally which is the cause for the shortages of those items” KI19

5.2.6 . Strategies used to manage shortages of essential medicines in the facilities

1. Looking for stock exchange with other nearby public health facilities

According to KIs, some products that are out of stock in one health facility might be even overstocked in other facilities. In this situation, we try either to exchange with other items or obtain it on loan basis. The following sayings from two KIs demonstrated the practice and the challenge associated with it.

“While our facility have stock out, we look for exchange of overstocked items from other facilities found first in our Woreda, then look for other public health facilities found in the area” KI22.

*“Acquiring stock out items with the exchange of other items is good strategy, but difficult to manage for us, because the cost of the different medicines varied from time to time and it requires accounting skill.”*KI18.

2. Preparing emergency order

In IPLS, one of essential medicines acquiring mechanism is emergency order. Frequently health facilities were procuring stock out items by emergency order.

One of the KI depicted that;

“We don’t have good procurement plan, hence we face frequent stock out, but we try to acquire those items by means of emergency order” KI 4.

Other KIs revealed that;

“Emergency order is our immediate solution for our stock out. However, it costs a lot for transportation, due to frequent emergency order” KI11.

2. Quick win initiatives of EPSA in selected hospitals

Public health facilities frequently challenged with unconditional medicines demand, hence shortages. The situation is worst in the facilities with larger patient loads. Therefore, in order to manage unexpected or accidental shortages of medicines in those facilities, EPSA secure safety stock which is called ‘quick win initiative.

Ethiopian pharmaceuticals supply agency follows an initiative named quickly win initiative, which have special privileges for hospitals with high patient load in reserving and delivering pharmaceuticals.

Some key informants also commend EPSA’s strategy of having special program for big hospitals with highest patient load. *This strategy allows a special follow-up and keeping safety stock for these hospitals to prevent stock out*

6 . Discussion

This study has tried to assess shortages of essential medicines and explored factors that contribute for shortages in public health facilities of SNNPR, Ethiopia. The quantitative and qualitative data are triangulated for the discussion.

On the day of the visit, 9(30%) of the health facilities were out of stock of one or more of the essential medicines assessed in this survey. The result in this study was higher than the study conducted between March and April 2017 in six health centers of Adama town on the tracer drugs which documented a 23.7% out of stock on the day of the survey (Kefale and Shebo, 2019). Similarly the study result was also slightly higher than national study findings in public health facilities that described 27.6% out of stock of items in the studied facilities (WHO, 2017).

The present study also indicated that the average stock out duration of essential medicines in the public health facilities of SNNPR in the year 2018 was 74 days. The duration of stock out was higher in General hospitals (77 days) followed by Comprehensive specialized hospitals (76 days). When comparison is done among different levels of health facilities, the difference was not significant. This is because of the fact that despite health centers failed to replenish the items soon they are out of stock, they have low average monthly consumption whereas general hospitals and comprehensive specialized hospitals have higher average monthly consumption than actual demand. The stock out duration documented in the present study is greater than the results of the survey conducted in Adama Health Centers where the average length of stock out days for tracer medicines during the prior 12 months was 40.6 days (42 days for Amoxicillin and 18 days for Artemether/Lumefantrine) (Kefale and Shebo, 2019). A

national study conducted in 2016 also indicated that the length of stock out duration was 37 days for public health facility dispensaries (WHO, 2017), which was lower than finding of the current study. However; the result was lower than similar study conducted in Uganda which documented average stock-out duration of 78.5 days from four years consumption data (Onchweri Albert, 2015).

In the present study, the highest stock out duration was 110 days, which was recorded for ceftriaxone 1g. On the other hand, Amoxicillin 500mg had relatively the lowest stock out duration (43 days). This might be because of the existence of irrational prescription of third generation cephalosporin. For example, the study conducted in Gondar University Referral Hospital on the utilization rate of ceftriaxone found out a high point prevalence of 59% ,out of which 79.5% of cases were used empirically (Ayele *et al.*, 2018). Similar study conducted in a tertiary care hospital in Kilimanjaro (Tanzania), revealed that 51.1% patients were on ceftriaxone during their time of hospitalization and 6.9% of patients had been on ceftriaxone treatment without evidence of infection (Sonda *et al.*, 2019). From the assessed bin cards can be observed that essential medicines that are prescribed for chronic illness like atenolol, hydrochlorothiazide and metformin had low consumption rate in the most health centers and hence most health centers were not replenished soon when they are out of stock.

The essential medicines security in across the developing countries is not achieved. This may be linked to one or more factors. One of the significant contributing factors was lack of organized logistics data management and information system in the health facilities. Similarly, our study has shown that half of the health facilities were using paper based LMIS system with poor data handling and recording. The key informants in the present

study also indicated that poor commodities' data recording and documentation by the health facilities was one of the major factors affecting the supply chain system in the particular facilities. Study has shown that paper-based records of logistics data at all levels would make it difficult to aggregate and analyze data in timely fashion; limited access to budget available and no real time visibility into stock levels (USAID | DELIVER PROJECT, 2012). Related study findings in Saudi Arabia depicted that the common causes that lead to medicines shortage was lack of electronics commodity information management system (Alshehri S, 2016). Similarly, a study conducted in Lusaka district of Zambia indicated that having inaccurate consumption data of essential medicines at health facilities has major impact on the efficiency of supply chain (Musonda *et al.*, 2018). Other study also indicated lack of automated health commodity management system as the most significant factor for the stock out of essential medicines (Fredrick and Muturi, 2016).

Man-made disasters and political instabilities were identified in the present study as causes for medicines shortages in SNNPR. Concur to our finding, study has shown that political instability contributed for supply and demand imbalance which result in medication shortages (Awad, Al-Zu'bi and Abdallah, 2016).

The health facilities were unable to develop regular and reliable stock status and consumption report including AMC which results in wrong forecasting and procurement decision. Other study conducted in Pakistan between May and July 2018, indicated that planning and forecasting gap related issues were the main reasons of medicine shortages in Pakistan (Atif *et al.*, 2019).

RRF and products transfer steps from HFs to EPSA and vice versa was found to be long. Besides, some woredas unnecessarily stored products for a long time without delivering to the respective health centers, which resulted in stock outs at facilities' levels. Supplying medicines with short life and delivering medicines without request (push system) were examples of poor distribution of essential medicines observed in the region. The median number of days out of stock for drugs was higher in the Push system compared to the Pull system (94 versus 24 days) (Tumwine *et al.*, 2010). Similarly, a study conducted in Jordan indicated that distribution factors are significantly related to medicines shortages (Awad, Al-Zu'bi and Abdallah, 2016).

The key informants of our study also indicated that the public health facilities had no strong monitoring and evaluation system to establish accountability and transparency which might have exposed critical essential medicines to theft and resulted in stock outs. Other study finding revealed that monitoring and evaluation system was the significant factor influencing essential medicines availability (Fredrick and Muturi, 2016). In hospital setting poor inventory management and procurement procedure accompanied with poor demand prediction, poor procurement procedure, and pilferage of medicines were the common reasons for the medicines shortages (Atif *et al.*, 2019).

The key informants in the present study emphasized that weak collaboration and communication among supply chain actors, as one of the factors for the stock out of the essential medicines. The stock status of health facilities were not communicated with the health sectors and departments of RHB, ZHD and WoHO levels. But health facilities were supplied by the health sector departments based on available budget. Similarly,

other study indicated lack of strong governance and coordination of the national system adversely affecting the availability of essential medicines in public health facilities (Onchweri Albert, 2015).

The human resources in pharmacy department were low in number and also non-pharmacy personnel (clinical nurses) were assigned to carry out pharmacy services and manage the health supply chain activities. Besides the human resources working in the pharmacy departments of health facilities were not having adequate training. Moreover, most of the supply chain staffs were less motivated and with low commitment. Furthermore, there was turnover of trained manpower. Among the major supply chain related factors that have contributed to the problem of the supply chain was human resources. Study conducted in Rwanda revealed that limited capacity (Nditunze *et al.*, 2015) were a contributing factor to medication shortages. Staff qualifications were common factor in public health facilities that contribute to the stock out of essential medicines (Fredrick and Muturi, 2016). Similarly study conducted in Ethiopia indicated that scarcity and lack of expertise, inadequate level of the training, commitment and lack of motivation on the part of the personnel currently involved in the management of the supply chain were noted as the challenges of the supply chain management (Fenta, 2017).

Key informants said that the budget allocation for the essential medicines were low and even the allocated budget by the WoHO have not been delivered from the Woreda finance office on time for timely procurement. On the other hand the allocated few budget and internal facility revenue are being used inefficiently. Budget allocation and management directly affect all parts of the logistics cycle, including the quantities of

products that can be procured (USAID | Task Order 1, 2011). Moreover shortages of essential medicines may result in lack of sustainable financing and affordable price medicines itself (Zaidi *et al.*, 2013; Hinsch, Kaddar and Schmitt, 2014).

Overprescribing of essential medicines in public health facilities was the common problem in SNNPR. Presence of poly pharmacy or over prescribing in health facilities lead to extravagant use of essential medicines. The average number of drugs per encounter as a whole was 2.1 in the study done in hospitals of west Ethiopia (Haile Fereja, 2014) and 2.34 (2.06–2.49) in selected public hospitals of eastern Ethiopia (Sisay *et al.*, 2017) and the mean number of medicines per prescription in Southern Ethiopia at non-APTS facilities was 2.8 drugs per encounter (Wogayehu *et al.*, 2019) which are greater than WHO standard. The percentage of encounters with antibiotic prescribed in Hawassa University Teaching and Referral Hospital was 58.1% which is far greater than WHO's recommendation (Desalegn, 2013). It is logically agreed that overprescribing results in over utilization of the essential medicines leading to shortages. The study finding in Pakistan indicated that irrational prescribing were the major reasons for medicines shortages (Atif *et al.*, 2019).

Study health facilities were using different strategies to overcome shortages. Health facilities tried to acquire essential medicines that were out of stock in exchange of over stocked items from other health facilities, placing emergency order to EPSA and quick win initiatives of EPSA in selected hospitals. Acquiring stock out items with the exchange of overstocked items is good strategy, but difficult to manage financial equivalence, because of the cost of the medicines is dynamic and varies with suppliers and time. Placing emergency order may not help to mitigate shortages of medicines, if

these items were nationally out of stock. The other limitation of emergency ordering is high cost for frequent transportation. Keeping safety stock for the large hospitals with high patient loads was also the third strategy used to overcome shortages of essential medicines in those facilities. Case load based delivering approach of EPSA could minimize shortages of essential medicines in the respective facilities but couldn't bring comprehensive change on the interruption of essential medicines delivery in the region. In general, these mitigation strategies used for the essential medicines shortages did not significantly contribute to alleviate problems of the stock out, because these approaches could not address major contributing factors affecting essential medicines shortages in the study facilities.

6.1 . Limitations of the study

Even though this study identified the contributing factors for the shortages of essential medicines in public health facilities, it was not without limitations. The unavailability of data for some of the medicines might have affected estimation of stock out duration as facilities were excluded for specific missing data. The current study didn't conduct analytical research, which have not comparison group to inference the effect of contributing factors on the medicines shortages.

6.2 . Conclusion

Essential medicines shortages were a common problem in SNNPR. Most of the public health facilities have essential medicines shortage because there was limited capacity and commitment of staff managing logistics and supplies at health facilities. And also there was inadequate or poor logistics data recording system, limited budget allocation and its mismanagement like use of medicines budget for the procurement of non-health products and administrative expenses and the poor medicines distribution practices to the facilities like longer products transfer steps from EPSA to HFs, supplying medicines with short life and delivering medicines without request were some of the main gaps identified significantly contributed to medicines shortages. The weak stock monitoring and communication system, lack of coordination of the supply chain actors and *lack of ownership and accountability for stock out of essential medicines* adversely affected essential medicines security in public health facilities.

6.3 . Recommendations

The regional health bureau should establish system to hire and retain skilled health supply chain professionals in HSCM positions. The RHB should work to improve product data quality at all levels. MOH and RHB should support in transforming from paper-based health commodities recording system to automated systems at all levels. All health facilities should implement APTS with good leadership and professional commitments. Health facilities should quantify their need based on the documented consumption record. All supply chain actors including MOH, RHB, ZHDs and health facilities should ensure justifiable budget allocation and efficient budget management by developing clear auditing system for pharmaceuticals. The in house transportation

capacity of the ZHDs and WoHOs should be improved to facilitate medicines distribution. It also should be avoid push system and unplanned and near expiry supply of medicines. The regional health bureau should develop mechanisms to monitor and evaluate health commodities supply chain. Regional health bureau should facilitate good collaboration, coordination, & communication among supply chain actors. It should be developed a culture of accountability for those who are irresponsible in their duties regarding logistics activities. Further study should be conducted on the magnitude of irrational use of medicines and its impacts on the shortages of the essential medicines.

7 References

- Abiye, Z., Tesfaye, A. and Hawaze, S. (2013) 'Barriers to access: Availability and affordability of essential drugs in a retail outlet of a public health center in south western ethiopia', *Journal of Applied Pharmaceutical Science*, 3(10), pp. 101–105. doi: 10.7324/JAPS.2013.31017.
- Alshehri, S. and Alshammari, A. (2016) 'Drug Supply Shortages in Pharmacies : Causes and Solutions ; A Case Study in King Khaled Eye Special Hospital', 10(12), pp. 2453–2459.
- Anson, A. *et al.* (2012) 'Availability, prices and affordability of the World Health Organization's essential medicines for children in Guatemala', *Globalization and Health*, 8, pp. 1–10. doi: 10.1186/1744-8603-8-22.
- Atif, M. *et al.* (2019) 'Medicines shortages in Pakistan: A qualitative study to explore current situation, reasons and possible solutions to overcome the barriers', *BMJ Open*, 9(9). doi: 10.1136/bmjopen-2018-027028.
- Awad, H., Al-Zu'bi, Z. M. F. and Abdallah, A. B. (2016) 'A Quantitative Analysis of the Causes of Drug Shortages in Jordan: A Supply Chain Perspective', *International Business Research*, 9(6), p. 53. doi: 10.5539/ibr.v9n6p53.
- Ayele, A. A. *et al.* (2018) 'Prospective evaluation of Ceftriaxone use in medical and emergency wards of Gondar university referral hospital, Ethiopia', *Pharmacology Research and Perspectives*, 6(1), pp. 1–7. doi: 10.1002/prp2.383.
- Brown, A. N. and Gilbert, B. (2014) 'The Papua New Guinea medical supply system - documenting opportunities and challenges to meet the Millennium Development Goals', *Journal of Pharmaceutical Policy and Practice*, 7(1), pp. 1–10. doi: 10.1186/2052-3211-7-5.
- Carasso, B. S. *et al.* (2009) 'Availability of essential medicines in Ethiopia: An efficiency-equity trade-off?', *Tropical Medicine and International Health*, 14(11), pp. 1394–1400. doi: 10.1111/j.1365-3156.2009.02383.x.
- Chahal, H. S., St.Fort, N. and Bero, L. B. (2013) 'Availability, prices and affordability of essential medicines in Haiti', *Journal of Global Health*, 3(2). doi: 10.7189/jogh.03.020405.
- Desalegn, A. A. (2013) 'Assessment of drug use pattern using WHO prescribing indicators at Hawassa University teaching and referral hospital, south Ethiopia: A cross-sectional study', *BMC Health Services Research*, 13(1). doi: 10.1186/1472-6963-13-170.
- Dorj, Gereltuya *et al.* (2018) 'Availability, affordability and costs of pediatric medicines in Mongolia', *BMC Pediatrics*, 18(1), pp. 1–8. doi: 10.1186/s12887-018-1123-x.
- Elfatih Ibrahim Elamin, Mohamed Izham Mohamed Ibrahim, M. A. E. Y. (2010) 'Availability of Essential Medicines in Sudan', *Sudanese Journal of Public Health*, 5(1), pp. 32–37.
- Ethiopian Public Health Institute (EPHI) (2018) 'Services Availability and Readiness Assessment (SARA) Ethiopian Public Health Institute Ethiopia Service Availability and Readiness Assessment (SARA) 2018 Final Report', p. 119. Available at: <http://www.eph.gov.et/index.php/2014-04-10-07-22-18/download>.
- Farquharson, E. *et al.* (2011) 'Managing Procurement', *How to Engage with the Private Sector in Public-Private Partnerships in Emerging Markets*, pp. 111–131. doi: 10.1596/9780821378632_ch09.

- Federal Democratic Republic of Ethiopia Ministry of Health (2015) 'Ethiopian Health Sector Transformation Plan.2015/16 - 2019/20', *Federal Democratic Republic of Ethiopia Ministry of Health*, 20(May), p. 50.
- Fenta, T. G. (2017) 'Human resources for public health supply chain management in Ethiopia: Competency mapping and training needs', *Ethiopian Journal of Health Development*, 31(4), pp. 266–275.
- Fentie *et al.* (2016) 'Availability of Essential Medicines and Inventory Management Practice in Availability of Essential Medicines and Inventory Management Practice in Primary Public Health Facilities of Gondar Town , North West Ethiopia', *Journal of PharmaSciTech*, 4(March), pp. 2–4.
- Fox, E. R. *et al.* (2009) 'ASHP guidelines on managing drug product shortages in hospitals and health systems', *American Journal of Health-System Pharmacy*, 66(15), pp. 1399–1406. doi: 10.2146/ajhp090026.
- Gehman, J. *et al.* (2018) 'Finding Theory–Method Fit: A Comparison of Three Qualitative Approaches to Theory Building', *Journal of Management Inquiry*, 27(3), pp. 284–300. doi: 10.1177/1056492617706029.
- Fredrick, M. W. and Muturi, W. (2016) 'Factors Influencing Frequent Stock-outs of Essential Medicines in Public Health Facilities in Kisii County , Kenya', *Journal of Business and Management.*, 18(10), pp. 63–75. doi: 10.9790/487X-1810066375.
- Haile Fereja, T. (2014) 'A Retrospective Analysis of Prescribing Practices through WHO Prescribing Indicators at Four Selected Hospitals of West Ethiopia', *Journal of Bioanalysis & Biomedicine*, 06(02), pp. 4–8. doi: 10.4172/1948-593x.1000105.
- Hinsch, M., Kaddar, M. and Schmitt, S. (2014) 'Enhancing medicine price transparency through price information mechanisms', *Globalization and Health*, 10(1). doi: 10.1186/1744-8603-10-34.
- Hussien, M. and Tafese, F. (2015) 'Access to Essential Medicines in Primary Health Care Units of South Wollo Zone, Ethiopia', *OALib*, 02(01), pp. 1–10. doi: 10.4236/oalib.1100983.
- Johnston, R. B. (2016) 'Arsenic and the 2030 Agenda for sustainable development', *Arsenic Research and Global Sustainability - Proceedings of the 6th International Congress on Arsenic in the Environment, AS 2016*, pp. 12–14. doi: 10.1201/b20466-7.
- Kaakeh, R. *et al.* (2011) 'Impact of drug shortages on U.S. health systems', *American Journal of Health-System Pharmacy*, 68(19), pp. 1811–1819. doi: 10.2146/ajhp110210.
- Kagaruki, G., Kimaro, H. and Mboera, L. (2011) 'Factors Affecting Utilization of Evidence Based Health Information System for Effective Supply Chain of Essential Medicine in Tanzania: A Case Study from Mbeya Region', (January 2015).
- Kefale, A. T. and Shebo, H. H. (2019) 'Availability of essential medicines and pharmaceutical inventory management practice at health centers of Adama town, Ethiopia', *BMC Health Services Research*, 19(1), pp. 0–7. doi: 10.1186/s12913-019-4087-0.
- Mason, M. (2010) 'FORUM : QUALITATIVE SOCIAL RESEARCH SOZIALFORSCHUNG Sample Size and Saturation in PhD Studies Using Qualitative Interviews'.
- McLaughlin, M. *et al.* (2013) 'Effects on patient care caused by drug shortages: A survey', *Journal of Managed Care Pharmacy*, 19(9), pp. 783–788. doi: 10.18553/jmcp.2013.19.9.783.

- Miljković, N. *et al.* (2019) 'Results of EAHP's 2018 Survey on Medicines Shortages', *European Journal of Hospital Pharmacy*, 26(2), pp. 60–65. doi: 10.1136/ejhpharm-2018-001835.
- Mkoka, D. A. *et al.* (2014) 'Availability of drugs and medical supplies for emergency obstetric care: Experience of health facility managers in a rural District of Tanzania', *BMC Pregnancy and Childbirth*, 14(1), pp. 1–10. doi: 10.1186/1471-2393-14-108.
- Muiruri, C. W. and Mugambi, M. M. (2017) 'Factors Influencing Availability of Essential Medicines in Public Health Facilities in Kenya: a Case of Embu County', *International Academic Journal of Information Sciences and Project Management* |, 2(2), pp. 43–57. Available at: http://www.iajournals.org/articles/iajisp_m_v2_i2_43_57.pdf.
- Musonda, M. *et al.* (2018) 'Proceedings of the 21st International Symposium on Advancement of Construction Management and Real Estate', *Proceedings of the 21st International Symposium on Advancement of Construction Management and Real Estate*, 2020(August). doi: 10.1007/978-981-10-6190-5.
- Nditunze, L. *et al.* (2015) 'Assessment of Essential Medicines Stock-Outs at Health Centers in Burera District in Northern Rwanda', *Rwanda Journal*, 2(1), p. 85. doi: 10.4314/rj.v2i1.12f.
- Onchweri Albert, O. B. (2015) 'Availability of Essential Medicines and Supplies during the Dual Pull-Push System of Drugs Acquisition in Kaliro District, Uganda', *Journal of Pharmaceutical Care & Health Systems*, s2. doi: 10.4172/2376-0419.s2-006.
- Organization, W. H. (2004) 'Equitable access to essential medicines : a framework for collective action'. Geneva PP - Geneva: World Health Organization (WHO policy perspectives on medicines ; no.8). Available at: <https://apps.who.int/iris/handle/10665/68571>.
- Robertson, J. *et al.* (2009) 'What essential medicines for children are on the shelf?', *Bulletin of the World Health Organization*, 87(3), pp. 231–237. doi: 10.2471/BLT.08.053645.
- Sado, E. and Sufa, A. (2016) 'Availability and affordability of essential medicines for children in the Western part of Ethiopia: Implication for access', *BMC Pediatrics*, 16(1), pp. 1–8. doi: 10.1186/s12887-016-0572-3.
- Sisay, M. *et al.* (2017) 'Drug Prescribing and Dispensing Practices in Tertiary Care Hospital of Eastern Ethiopia: Evaluation with World Health Organization Core Prescribing and Patient Care Indicators', *Clinical and Experimental Pharmacology*, 07(03). doi: 10.4172/2161-1459.1000238.
- Sonda, T. B. *et al.* (2019) 'Ceftriaxone use in a tertiary care hospital in Kilimanjaro, Tanzania: A need for a hospital antibiotic stewardship programme', *PLoS ONE*, 14(8), pp. 1–11. doi: 10.1371/journal.pone.0220261.
- Tumwine, Y. *et al.* (2010) 'Availability and expiry of essential medicines and supplies during the "Pull" and "Push" drug acquisition systems in a Rural Ugandan Hospital', *Tropical Journal of Pharmaceutical Research*, 9(6), pp. 557–564. doi: 10.4314/tjpr.v9i6.63555.
- United Nations (2012) *The global partnership for development: making rhetoric a reality ; MDG GAP Task Force report 2012 ; millennium development goal 8*.
- USAID (2017) 'Human Resource Capacity Development in Public Health Supply Chain Management: Assessment Guide and Tool', *Journal of Chemical Information and Modeling*, 53(9), pp. 1689–1699. Available at: <file:///C:/Users/User/Downloads/fvm939e.pdf>.

USAID | DELIVER PROJECT (2012) ‘Computerizing Logistics Management Information Systems: A Program Manager’s Guide. Arlington, Va.: USAID | DELIVER PROJECT, Task Order 4.’, (October), p. 72. Available at: http://www.villagereach.org/wp-content/uploads/2013/07/CompLMIS_PMG-1.pdf. Accessed date December 21,2018.

USAID | Task Order 1, 2011 (2011) ‘The Logistics Handbook: A Practical Guide for the Supply Chain Management of Health Commodities’, *USAID | DELIVER PROJECT, Task Order 1*, p. 174. Available at: http://deliver.jsi.com/dlvr_content/resources/allpubs/guidelines/LogiHand.pdf.

Wagenaar, B. H. *et al.* (2014) ‘Stock-outs of essential health products in Mozambique - longitudinal analyses from 2011 to 2013.’, *Tropical medicine & international health : TM & IH*, 19(7), pp. 791–801. doi: 10.1111/tmi.12314.

WHO (2010) ‘Monitoring the Building Blocks of Health Systems : a Handbook of Indicators and’, p. 110.

WHO (2011) ‘The World Medicines Situation 2011. Medicines prices, availability and affordability’, *The World Medicines Situation*, p. 32. Available at: http://www.who.int/medicines/areas/policy/world_medicines_situation/WMS_ch6_wPricing_v6.pdf.

WHO (2017) ‘Pharmaceutical Sector Assessment in Ethiopia’, (December), p. 55.

WHO (World Health Organization) (2007) ‘WHO Operational package for assessing , monitoring and evaluating country pharmaceutical situations Guide for coordinators and data collectors’, *World Health Organization*, p. 160.

Wogayehu, B. *et al.* (2019) ‘A cross sectional comparison of drug use indicators using WHO methodology in primary level hospitals participating in an Auditable Pharmaceutical Transactions and Services program versus non-APTS primary hospitals in Southern Ethiopia’, *PLoS ONE*, 14(10), pp. 1–26. doi: 10.1371/journal.pone.0223523.

Woinshet, N. *et al.* (2018) ‘Maternal, newborn, and child health logistics system assessment, ethiopia’, *Arlington,VA: Strengthening High Impact Interventions for an AIDS-free Generation (AIDSFree) Project and Pharmaceuticals Fund and Supply Agency (PFSA)*, (May).

World Health Organization (2007) ‘Measuring medicine prices, availability, affordability and price components’, *WHO Technical Report Series*, 20(8), pp. 763–765. Available at: <http://www.tandfonline.com/doi/abs/10.1080/08941920701456422>.

World Health Organization (2016) ‘Annual Report : WHO Essential Medicines & Health Products 2016’, *Annual Report 2016*, pp. 1–23.

Yadav, P. and Smith, L. (2014) *Pharmaceutical Company Strategies and Distribution Systems in Emerging Markets, Encyclopedia of Health Economics*. Elsevier Ltd. doi: 10.1016/B978-0-12-375678-7.01218-9.

Zaidi, S. *et al.* (2013) ‘Access to Essential Medicines in Pakistan: Policy and Health Systems Research Concerns’, *PLoS ONE*, 8(5), pp. 1–10. doi: 10.1371/journal.pone.0063515.

Zimbulu, V. (2016) ‘Organizational practices influencing availability of essential medicines at hospitals in Nairobi county’, *African Journal of Pharmacy and Pharmacology*, 17(12), pp. 738–742.

ZUMA, S. M. (2013) 'the Factors Affecting Availability of Medicines in the Free State', (June), pp. 1–108. doi: 10.13140/RG.2.2.34141.92642.

8 . Data collection Instrument

8.1 . Quantitative data Collection Instrument

Health Facility code:_____Date of the survey: _____ /___/_____

I. General

1. Health facility type: Health center[☐] primary hospital [☐] General hospital [☐]
Comprehensive specialized hospital [☐]
2. Date of establishment : _____ /___/_____
3. Category by service difference : ART [☐] PMTCT [☐]
4. Do you have sufficient man power for the pharmaceuticals management? Yes [☐]
No [☐]Rate the required HR with available HR. _____%
5. What is their current professional mix (more than one answer can be applied)?
 - 5.1.[☐] Pharmacists in number_____
 - 5.2.[☐] pharmacy diploma in number_____
 - 5.3.Clinical nurse in number_____
 - 5.4.[☐] Others in number_____
6. On which range most of the pharmacy department personnel relevant work experience lied on?(more than one answer can be applied)
 - 6.1. [☐] less than 1 year
 - 6.2. [☐] 1-4 years
 - 6.3. [☐] 5-10 years
 - 6.4. [☐] above 10 years
7. On which of the health commodity management have any of the pharmacy department personnel trained before 6 months ago?
 - 7.1. [☐] IPLS
 - 7.2. [☐] HSCM
 - 7.3. [☐] Quantification
 - 7.4. [☐] DTC
 - 7.5. [☐] *Inventory management*
 - 7.6. [☐] Others

II. **Stock** recording and using data for decision and **Stock status**

8. Which mechanism of the pharmaceutical data recording and documenting system did you applied? Automated [] Paper based [] Both []
9. Check the accuracy and completeness of sample items from last three consecutives reporting periods.

Reporting periods	complete <i>yes = 1</i> <i>No = 0</i>	Accurate <i>yes = 1</i> <i>No = 0</i>	Timeliness Yes=1 No=0
1			
2			
3			

10. Check Bin cards for the sample items from the facility main store.

Name of key medicines	updated <i>yes = 1</i> <i>No = 0</i>	Accurate <i>yes = 1</i> <i>No = 0</i>	Remark
Amoxicillin 500mg cap			
Ceftriaxone 1g injection			
Ciprofloxacin 500mg caps/tab			
Sulphamethoxazole and Trimethoprim 400mg/80mg tab			
Salbutamol Oral Inhalation			
Magnesium Sulphate injection 20%			
Mebendazole Oral Suspension,100mg/5ml			
Artemeter + Lumfantrine 20mg + 120mg tab			
Metronidazole 250mg cap/tab			

Atenolol 50mg tab			
Hydrochlorothiazide 25mg tab			
Phenobarbitone 100mg tab			
Omeprazole 20mg			
Metformin 500mg tab			
Ferrous sulphate +folic acid			
Sodium Chloride 0.9%(Normal Saline) 1000ml			
Oxytocin 10uU/ml			

11. Stock status: What is the availability of essential medicines at time of assessment?

Name of key medicines	In stock <i>yes</i> = 1 <i>No</i> = 0	Expired medicines in the shelves <i>yes</i> = 1 <i>No</i> = 0	medicines that are stocked below minimum stock level(<2months) Yes=1 No=0	medicines that are stocked at more than maximum stock levels(>4months) Yes=1 No=0	medicines that are stocked at the appropriate stock levels (i.e., between max-min stock levels) Yes=1 No=0
Amoxicillin 500mg cap					
Ceftriaxone 1g injection					
Ciprofloxacin 500mg caps/tab					
Sulphamethoxazole and Trimethoprim 400mg/80mg tab					
Salbutamol Oral Inhalation					
Magnesium Sulphate injection 20%					
Mebendazole Oral Suspension,100mg/5ml					
Artemeter + Lumfantrine 20mg + 120mg tab					
Metronidazole 250mg cap/tab					
Atenolol 50mg tab					

Hydrochlorothiazide 25mg tab					
Phenobarbitone 100mg tab					
Omeprazole 20mg					
Metformin 500mg tab					
Ferrous sulphate +folic acid					
Sodium Chloride 0.9%(Normal Saline) 1000ml					
Oxytocin 10uU/ml					

12. Number of stock-out days of 17 selected essential medicines over the year January 1, 2018 to December 30, 2018

Key medicines	Records cover at least 6 months within the past 12 months between Tir 1/2010 to Tahisas 30/2011 E.C. <i>yes</i> = 1 <i>No</i> = 0	Only collect data for medicines with records covering at least 6 months within the past 12 months		
		Number of days out of stock	Number of days covered by the review (at least 6 months)	Remark
Amoxicillin 500mg cap				
Ceftriaxone 1g injection				
Ciprofloxacin 500mg caps/tab				
Sulphamethoxazole and Trimethoprim				

400mg/80mg tab				
Salbutamol Oral Inhalation				
Magnesium Sulphate injection 20%				
Mebendazole Oral Suspension,100mg/5ml				
Artemeter + Lumfantrine 20mg + 120mg tab				
Metronidazole 250mg cap/tab				
Atenolol 50mg tab				
Hydrochlorothiazide 25mg tab				
Phenobarbitone 100mg tab				
Omeprazole 20mg				
Metformin 500mg tab				
Ferrous sulphate +folic acid				
Sodium Chloride 0.9%(Normal Saline) 1000ml				
Oxytocin 10uU/ml				

8.2 . Key informant interview guide

Key informants code: _____ Date of interview: __/__/_____

I. Demographic Information

1. Gender : ☐ Male ☐ Female
2. Educational background: ☐ Diploma ☐ Undergraduate ☐ post graduate
3. Category of Key informants by Professional: ☐ Druggist ☐ Pharmacist ☐ MSC/MBA ☐ Others
4. What is your current position in this department?
 - 4.1. ☐ the head of the facility/organization
 - 4.2. ☐ store man
 - 4.3. ☐ dispenser
 - 4.4. ☐ other
5. How long have you worked in this facility?
 - 5.1. ☐ less than 1 year
 - 5.2. ☐ 1-4 years
 - 5.3. ☐ 5-10 years
 - 5.4. ☐ above 10 years
6. Do you think the stock out of the essential medicines is the problem of your department/facility? ☐ yes ☐ No
7. If your response “yes” for the q5, describe the causes for the stock out of the medicines. _____

8. How do you associate the causes with the shortages of essential medicines in your facility? _____

9. How do you explain the effect of Logistics management information system on the availability of EMs? _____

10. Let tell me about your medicines budget allocation. Do think this budget could satisfy your EMs needs and procurement? [☐] yes [☐] No_____

11. Relate your Main Logistics activities; quantification, procurement and monitoring and evaluation performance with your EMs shortages._____

12. Does the medicine distribution system contribute for the shortage of essential medicines? [☐] Yes [☐] No

13. If your response for q11 is yes, how? _____

14. How do you manage shortages of essential medicines in your facility? _____

15. What solutions do you recommend to ensure uninterrupted supply of essential medicines? _____

9 . Annexes

9.1 Annex 1:- Selected sites with sample health facilities

SNNP,Ethiopia,July 2019

Zone/Sp. Woreda	Hospital	Health Center	Total	Clusters	Sample	Lists of selected HF's
Hawassa	5	11	16	1	6	HUCSH,Adare HC, Tula HC, Millinum HC, Alamura HC,Tilte HC
Wolaita	7	68	75	2	6	Sodo Referral, Areka HC,BodityHC,Tebela HC, Bele PH,Bedesa HC
Siltie	4	32	36	3	6	WCSH, Kerate HC, Adazer HC, Kibet PH, Dallocha HC,
South Omo	2	40	42	4	6	JinkaGH, Gazer PH, Bital HC, Gayetl HC , KayaferHC,Dimeka HC
Keffa	2	44	46	5	6	G/Tsadic Shawo GH, Watcha PH, Wuwush HC,ShishondaHC,Uffa HC, Bonga HC,
Total	20	195	215		30	

9.2 Annex 2:- Pharmacy and other manpower available in the study health facilities disaggregated by the level of health facilities, SNNP, July 2019.

Sr No	Facility Code	Pharmacist	Druggists	Clinical Nurse	Facilities with both Pharmacist and Druggist	Facilities have only druggists	Total Available HR	Required positions in the facility	Total Technical staff available in %	Total Pharmacy professionals available as per %	% professional per available HR
1	HAdHC	2	3	0	1	0	5	7	71	71	100
2	HTHC	0	2	2	0	1	4	7	57	29	50
3	HalHC	2	4	0	1	0	6	7	86	86	100
4	HMHC	3	5	0	1	0	8	9	89	89	100
5	HTiHC	0	5	0	0	1	5	7	71	71	100
6	HHUH	38	4	0	1	0	42	51	82	82	100
7	SOGPH	0	2	2	0	1	4	10	40	20	50
8	SOBHC	0	1	2	0	1	3	5	60	20	33
9	SOGHC	0	1	1	0	1	2	5	40	20	50
10	SOJGH	2	12	0	1	0	14	20	70	70	100
11	SOKaHC	0	2	1	0	1	3	5	60	40	67
12	SO HHC	0	1	2	0	1	3	4	75	25	33
13	WSB-03	1	5	0	1	0	6	7	86	86	100
14	WSA-04	0	6	0	0	1	6	7	86	86	100
15	WST-01	1	4	0	1	0	5	7	71	71	100
16	WBPH	4	7	0	1	0	11	12	92	92	100
17	WBeHC	0	4	2	0	1	6	7	86	57	67
18	Wso-02	34	11	0	1	0	45	51	88	88	100
19	KUHC	0	3	0	0	1	3	6	50	50	100
20	KBoHC	0	4	0	0	1	4	7	57	57	100
21	KShiHC	0	2	0	0	1	2	5	40	40	100

22	KWaPH	0	3	2	0	1	5	12	42	25	60
23	KWuHC	0	1	1	0	1	2	7	29	14	50
24	KGTsSGH	2	9	0	1	0	11	20	55	55	100
25	SWCSH	9	23	0	1	0	32	40	80	80	100
26	SKiHC	2	7	0	1	0	9	12	75	75	100
27	SDHC	1	3	0	1	0	4	7	57	57	100
28	SKuHC	1	1	0	1	0	2	6	33	33	100
29	SHuHC	0	2	2	0	1	4	7	57	29	50
30	SAdHC	0	2	1	0	1	3	6	50	33	67
31	Total	102	139	18	14	16	259	363	71	66	93
32	Percentage	39	54	7	47	53	100	71	0	0	93

9.3 Annex-3. The stock status of the study health facilities with Minimum, appropriate (safe) and over stocking for the selected items at the day of the visit, SNNP,Ethiopia, July 2019

Essential Medicines					
Name of key medicines	In stock Yes=1, No=0		Current stock status		
	Yes=1	No=0	Below min	Safe	Above max
Amoxicillin 500mg cap	26	4	3	11	7
Ceftriaxone 1g injection	24	6	8	9	2
Ciprofloxacin 500mg caps/tab	21	9	6	7	4
Sulphamethoxazole and Trimethoprim 400mg/80mg tab	22	8	6	5	7
Salbutamol Oral Inhalation	20	10	7	7	2
Magnesium Sulphate injection 50%	22	8	4	7	5
Mebendazole Oral Suspension,100mg/5ml	17	13	3	6	4
Artemeter + Lumfantrine 20mg + 120mg tab	22	8	6	6	5
Metronidazole 250mg cap/tab	24	6	4	12	2
Atenolol 50mg tab	13	17	3	4	2
Hydrochlorothiazide 25mg tab	19	11	5	10	1
Phenobarbitone 100mg tab	18	12	2	10	2
Omeprazole 20mg	24	6	9	8	3
Metformin 500mg tab	14	16	3	9	1
Ferrous sulphate +folic acid	23	7	5	8	4
Sodium Chloride 0.9%(Normal Saline) 1000ml	24	6	7	9	2
Oxytocin 10uU/ml	24	6	4	9	5
Total	357	149	85	137	58
Average in percentages	21	9	24	38	16

9.4 Annex 4: Factors for medicines shortages SNNPR, Ethiopia, July 2019.

		(Number of Key respondents)
Sr.No	Factors for shortages of Ems	
1	LMIS related factor	22
2	Health System Capacity Related factors	18
3	Human resources related factors	14
4	Budget allocation and management related factor	18
5	Dispensing and prescribing related factors	8

የአዲስ አበባ ዩኒቨርሲቲ
Addis Ababa University

School of Pharmacy
Ethical Review Board

ተገ
Date April 08, 2019

ቁጥር
Ref. No. ERB/SOP/68/04/2019

To: Dargicho Ahmed
School of Pharmacy

Re: Ethical Clearance

It is to be recalled that you submitted a study proposal entitled "**Assessment of Medicine Shortages and Associated Factors Affecting Non-availability of Essential Medicines in Public Health Facilities in Selected Zones of Southern Nation and Nationalities Region**" for ethical approval by the School's Ethical Review Board (ERB). The Board thoroughly reviewed the proposal based on its operational guidelines and found it to fulfill all ethical requirements stipulated in the guidelines. This is, therefore, to inform you that the proposal is ethically approved for implementation.

With best regards,

Arebu Issa
Chairperson, ERB

የአዲስ አበባ ዩኒቨርሲቲ
SCHOOL OF PHARMACY
Ethical Review Board

00251156 02 12 1176

Telex: 21205 Fax: 00251(11)1558566 Cable: AAUNIV

Ethical clearance from AAU ERB

አዲስ አበባ ዩኒቨርሲቲ
Addis Ababa University

በፋርማሲ ት/ቤት
የፋርማሲ ዩኒቨርሲቲ ስላል ፋርማሲ
ትምህርት ክፍል



School of Pharmacy
Department of Pharmaceutics
and Social Pharmacy

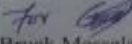
Date: Apr 8, 2019
Ref No: Ph/ceutics/229/11/2019

To: Southern Nations, Nationalities and Peoples' Regional Health Bureau

Subject: Request for Support

Mr. Dargicho Ahmed is 2nd year Health Supply Chain Management MSc student at the School of Pharmacy. Currently, he is working on a research entitled "*Assessment of essential medicines shortage and contributing factors in public health facilities of SNNPRS*" for the partial fulfillment of the Master's degree. This is therefore to kindly request your good office to provide him the required support for the same.

With regards,



Bruck Messele (PhD)

Head, Department of pharmaceutics and social pharmacy



+251118697102 1176 ቱሌክስ

telex: 21205

ፋክስ

Fax: 00251(11)1558566

ኤሌክትሮኒክስ

Cable: AAUNIV

Support letter from AAU, school of pharmacy, department of
pharmaceutics & social pharmacy ERB

