COLLEGE OF HEALTH SCIENCE SCHOOL OF PHARMACY

DEPARTMENT OF PHARMACEUTICS AND SOCIAL PHARMACY

HEALTH SUPPLY CHAIN MANAGEMENT MSc PROGRAM

ASSESSMENT OF AVAILABILITY, AFFORDABILITY AND PRICES OF ESSENTIAL MEDICINES FOR UNDER-FIVE CHILDREN IN NORTHWEST ETHIOPIA

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A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY SCHOOL OF PHARMACY FOR PARTIAL FULFILMENT OF THE REQUIREMENT OF MSATERS DEGREE IN HEALTH SUPPLY CHAIN MANAGEMENT

ADVISOR: BRUCK MESSELE HABTE (PhD)

Declaration

I, signed under, declare that this thesis entitled “assessment of availability, affordability and prices of essential medicines for under-five children in Northwest Ethiopia” is my original work and has not been presented for fulfillment of degree by any other person, and all the source of the material used for this thesis have been properly acknowledged.

Declared by:

Berihun Sisay Yohannes

Signature_____Date_____

ADDIS ABABA UNIVERSITY SCHOOL OF PHARMACY

"Assessment of Availability, Affordability and Prices of Essential Medicines for Under-Five Children in Northwest Ethiopia"

Approved by Examining Committee

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Abstract

Background: Maintaining the health of under-five children is a major indicator of a countries well-functioning health care system and socioeconomic development. To ensure this, essential medicines need to be available and affordable at all times. Thus, the objective of this study was to determine the availability, prices and affordability of essential medicines for under-five children in selected health facilities of North West Ethiopia.

Methods: The availability and prices data of fifty essential medicines (EMs) for under-five children in 30 public and 30 private health facilities was collected by employing the WHO/HAI methodology using a cross sectional study design. Availability was calculated by dividing the number of health sectors which stocked the medicines at the time of data collection by the total number of facilities surveyed and expressed as percentage. Affordability was measured as the number of daily wages required for the lowest-paid government worker to purchase a full treatment course for an acute condition or a 30-day treatment for a chronic condition.

Results: The mean availabilities of lowest priced generic (LPG) medicines were 52.1% in the public sector and 40.2% in the private sectors, whereas for highest priced medicines (HPMs) it was found to be 0% and 11.5% respectively. The median price ratios (MPRs) of LPG medicines were 0.98 and 2.3 times the international reference price (IRP) for public and private sectors respectively. In the private sector the patient prices of HPMs were 4 times the IRP. The percentages of unaffordable medicines for the assessed common conditions were 75% and 91% in the public and private sectors respectively.

Conclusion: The overall availability of EMs for under-5 children was suboptimal. Prices of EMs in the private sector exceed the IRP and most EMs for under-5 children were found to be unaffordable in both public and private sectors. Thus, further analysis of reasons for low availability and regulations on price markups in the private sector are needed to promote health and prevent catastrophic expenses.

Key words: Availability, prices, affordability, children under five, northwest Ethiopia

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List of acronyms and abbreviations

EMDHS	Ethiopian Mini Demographic and Health Survey
EFDA	Ethiopian Food and Drug Authority
EMs	Essential Medicines
EML	Essential Medicine List
EPSS	Ethiopian Pharmaceuticals Supply Service
HAI	Health Action International
HPMs	Highest Priced Medicines
IRP	International Reference Price
LPG	Lower-Priced Generics
LPGW	Lowest Paid Government Worker
MPR	Median Price Ratio
MSH	Management Science for Health
SDG	Sustainable Development Goal
WHO	World Health Organization

1. INTRODUCTION

1.1. Background

Globally, over the last 50 years, a decline in mortality rates has been pointed out in all age groups, with the greatest decrement being observed among children younger than 5 years. Generally, the worldwide mortality rate has declined from 90.6 deaths per 1000 live births in 1990 to 37 deaths per 1000 live births in 2020 in under 5 children. Despite the success in the reduction of mortality an estimated 5 million children are reported to have passed away before their fifth birthday in 2020 (WHO, 2020). However, at the national level, considerable disparity remains in terms of both level and rate of changes in age-specific mortality. This implies that satisfactory decrement in mortality of under 5 children has not occurred in several countries of the world (Wang *et al*., 2017).

Apart from prematurity and birth-related complications, the major causes of death for under five children are infectious diseases, like bronchopneumonia, pyogenic meningitis, septicemia, diarrhea, malaria, and malnutrition which, can be prevented or treated by ensuring uninterrupted and consistent access to quality essential medicines (UNICEF, 2020) and (Tessema *et al*., 2023).

To ensure essential medicines (EMs) are accessible to people when and wherever they need them, prices should be at levels affordable by governments, health care providers, and the community. Furthermore, fair and sustainable financing for the EMs should be ensured through adequate funding levels and equitable prepayment mechanisms, such as government revenues or social health insurance so as, to ensure that poor people do not face proportionally higher costs than the better off. Finally, reliable health and supply systems need to be in place, incorporating an efficient and locally-appropriate mix of public and private service providers. Failure in any one of these

processes will jeopardize availability and affordability of EMs for those in need of them (WHO, 2004).

According to World Health Organization (WHO), access to EMs of assured quality still poses problems for countries in the Western Pacific Region due to rising prices of new medicines; persisting shortages and stock-outs; and increasing numbers of substandard and falsified medical products. To overcome this, WHO has designed three strategies. These are developing policy and strengthening pharmaceutical supply systems to improve access to medicines, strengthening national regulatory systems, and improving rational selection and use of medicines (WHO, 2020). A review done by Adebisi et al (2022) points out that Africa faces numerous challenges in accessing EMs. Thus, in strengthening the health care system to ensure universal health coverage emphasis should be given towards solving these access issues (Adebisi *et al.*, 2022).

Despite this assumption, more than a quarter of the world population lacks consistent access to EMs. The situation is even worse in the developing countries of Africa and Asia, where, nearly half of the total population lacks such access, resulting in pain and suffering, prolonged illness, disability and preventable death (Ozawa *et al.*, 2019).

To improve the access and rational use of medicines for children, WHO recommends the development of an essential medicine list for children. But studies show that many countries did not have a separate list of EMs for children. Even in countries where childhood medicines are government and or NGO funded and provided for free, access to these medicines may be denied in the public sector because of supply interruption. Moreover, health care services may threaten by problems in sustainable financing at public facilities and affordable price in the private sectors (Hoppu and Sri Ranganathan, 2015) and (Debie, Khatri and Assefa, 2022).

1.2. Statement of the problem

The 2019 Ethiopian Mini Demographic and Health Survey (EMDHS) report revealed that the under-5 mortality rate for Ethiopia was 59 deaths per 1000 live births. The under-5 mortality rate of Ethiopia has recorded a 52% decrease over the years from 123 deaths per 1000 live births that was reported in 2005 (EPHI, 2019). The report from the world bank indicates that, although there is a significant decline in under-5 mortality over the past fifty years, the rate in Ethiopia is still greater than the world's average, of 39 deaths per 1000 live births (World Bank, 2020).

Under-5 morbidity and mortality rates are major indicators of a countries socioeconomic and health system developments as well as maternal education levels (Kanmiki *et al*., 2014). Socio-economic development on the other hand is a determinant factor for improved access to EMs for under-5 children, which are used to prevent or treat diseases. The 2019 EMDHS report has further indicated that the under-5 mortality rate showed decreases with increases in the household wealth. For example, the under-5 mortality rate was 46 deaths per 1,000 live births in the wealthiest households as compared to 77 deaths per 1,000 live births in the poorest households (EPHI, 2019).

In addition to this the sustainable development goals (SDGs) aims to end preventable deaths of newborns and children under-5 years of age with mortality targets at least as low as 12 per 1000 live births for neonates and at least as low as 25 per 1000 live births for under-5 children by 2030 (UNDP, 2015).

To attain the SDG in 2030, ensuring availability and affordability of EMs for children is a crucial step. But data from country surveys indicate that deprived availability and affordability of essential medicines. Contributing factors for the lack of EMs for children include unsustainable supply

systems, out-of-pocket payments which make the medicines unaffordable, and poor quality products (Hill, Yang and Bero, 2012).

A study conducted in northern Ethiopia (Tigray) on the availability and prices of EMs for under-5 children shows that an average availability of 41.9% and 31.5% in public and private sectors respectively. Prices of medicines was 1.18 times the international reference prices (IRP) in the public sector and 1.54 times the IRP in the private sector (Abrha *et al.*, 2018). A similar study done in western Ethiopia (Wolega) shows average availability of 43.0 % for the lowest priced generic medicines for under-5 children, in the public sector and average availability of 42.8 % in the private sector (Sado and Sufa, 2016). According to another report from a study in southern part of Ethiopia the average availability of EMs for under-5 children was 57.7% for the public sector and 53.7% for the private sector (Tadesse and Abuye, 2021).

Even though the government of Ethiopia has given greater attention to child health, product access and affordability by introducing and expanding the waiver system and community-based health insurance, lack of access to EMs for under-5 children is still a growing concern because of low availability, unaffordability and high prices as the above studies indicate (Sado and Sufa, 2016; Abrha *et al.*, 2018), (Tadesse and Abuye, 2021).

The studies done in Ethiopia on the availability and affordability of EMs for under-5 children are few and limited to northern, southern and western parts of the country. Added to this, the number of medicines and the number of health sectors surveyed are not equal to that recommended by the WHO and Health Access International (HAI). Thus, the availability and affordability of these medicines in the explored areas may not represent their availability and affordability in all parts of the country as the source and distance has a factor. Moreover, the prices of EMs vary from time to time especially in countries with unstable economy/high inflation rates, also the Under-5 mortality

in Amhara region is 85 per 1000 live births which is far above from the countries average (Brief, 2022). WHO recommends survey on availability and affordability of essential medicines to be done at least bi-annually (WHO/HAI, 2008).

1.3. Significance of the study

The purpose of this study was to assess the availability, affordability and prices of essential medicines for under-5 children in the post COVID-19 era. This study will help to improve availability and affordability of childhood EMs by filling the gaps in knowledge on availability, affordability and prices in the study area, informing organizations participating in the supply system about the current status of availability and affordability and those that are responsible for regulating the medicines' price and rational use. Added to this it can be used as a supplement to the body of knowledge so far available and a reference for further studies.

2. REVIEW OF RELATED LITERATURE

Promoting health, improving growth and development, reducing morbidity and mortality of children requires a reliable health system and pharmaceutical supply, sustainable financing, affordability and rational use (WHO, 2014), (WHO, 2018). This chapter describes the challenges associated with the health care system, pharmaceutical supply system, health financing system and availability and affordability of essential medicines.

2.1. Ethiopian health care system

Ethiopia's health service is structured into a three-tier system: primary, secondary and tertiary levels of care. The primary level of care includes primary hospitals, health centers and health posts. The lowest level of the primary health care are the health posts staffed with two women each to take care of their communities and under each health center there are about 5 health posts on average. The secondary level of care consists of general hospitals that serve 1 to 1.5 million people. The tertiary level of health care consists specialized hospitals and serves 3.5 to 5.0 million people (MOH, 2015).

Ethiopia is committed to achieving universal health coverage through investing in health work force, infrastructure and expanding health services. However, the health care system of Ethiopia is facing a number of issues, such as behavioral factors including malnutrition, dietary risks, unsafe sex, alcohol and tobacco use; facility-related factors such as poor client satisfaction, low trust in the health service provided, poor geographical accessibility, stock outs of medical supplies and equipment, lack of cleanliness at facilities, and long waiting times; health delivery factors including poor coordination and referral linkages, inefficient facility management and weak accountability, weak ambulance management system, low staffing in and financial factors

including inadequate budgeting, out of pocket payments, wastage of resource and low household income (MOH, 2021). These all factors are challenging the reliability of the health care system in achieving universal health coverage and sustainable development goals.

2.2. Ethiopian pharmaceutical supply system

Ethiopian Pharmaceuticals Supply Service (EPSS), formerly known as Ethiopian Pharmaceuticals Supply Agency (EPSA) is the only governmental organization responsible for suppling quality assured pharmaceuticals to public health facilities at an affordable price sustainably. There are two categories of pharmaceuticals that the organization procures, stores and distributes. These are revolving drug fund (RDF) and Health program (HP) pharmaceuticals. The health program pharmaceuticals are fully public, meaning that the government in collaboration with NGOs finances, procures, distributes and public facilities dispense them for free to patients. These programs include HIV AIDS, TB, Family planning, Malaria, neglected tropical diseases, vaccines, and some medicines and nutritional components for maternal and child health. EPSS delivers this commodities to health facilities using the integrated pharmaceuticals logistics system (IPLS) (EPSA, 2019).

The supply chain system of both RDF and health program commodities is facing numerous challenges. Factors that affect the reliability of the supply system include, but not limited to inadequate budget for the procurement of pharmaceuticals, inadequate and unreliable local manufacturers leading to sourcing majority of the products from foreign companies, Lack of system to prequalify suppliers, long procurement lead time, unsatisfactory supplier relationship, rising costs of pharmaceuticals, inadequate inventory management, increased number of counterfeited pharmaceuticals on the market and irrational use of medicines (EPSA, 2020).

Simillar challenges are also observed in the private sector supply chain management system. According to a study carried out by Bayew and Tariku in zaf pharmaceuticals private limited company in Addis Ababa, foreign supplier product market authorization processes, foreign exchange permit directives, waiting for Ethiopian shipping vessels and fluctuation of currency exchange rates were the major risk factors for the reliability of pharmaceutical supply system in the private sectors (Liknaw and Shimels, 2020).

2.3. Health care financing system in Ethiopia

Health care provision rely on efficiently combining financial resources, human resources, health supplies, and delivering services timely with equitable distribution throughout a country. Ethiopia's health sector has multiple financing sources, including the government treasury (federal, regional and woreda/district levels), bilateral and multilateral donors, household out-of-pocket expenditure, international and local NGOs, and insurance companies (WHO, 2017).

To maximize the accessibility of essential medicines to the Ethiopian population the government is implementing health financing reform encompassing components such as, revenue retention for health service quality improvements; systematizing the fee waiver system for the poor; standardizing exemption services; outsourcing of non-clinical services in public hospitals; user fee setting and revision; expanding of community based health insurance (CBHI), initiation of health insurance (SHI); establishment of a private wing in public hospitals; and health facility autonomy through the establishment of governing bodies (Ali, 2014).

Ethiopia's health financing has significant contributions to healthcare infrastructures, medical supplies, diagnostics, drugs, financial risk protection, and healthcare services. However, poor access to equitable and quality healthcare services was associated with low healthcare funding and

high out of pocket payments, health service disparity, adverse selection, low enrollment in CBHI, poor awareness, fraud and corruption (Debie, Khatri and Assefa, 2022).

2.4. Essential medicines

The term essential medicines which is applied to medicines that meet the priority health care needs of the population is not a new concept and has been around for more than 45 years. The application of the concept of essential medicines is intended to be flexible and adaptable to many different situations; exactly which medicines are regarded as essential remains a national responsibility (Laing *et al*., 2003). In 1985 a conference held in Kenya (Nairobi) has recognized the importance of these medicines and beyond selection emphasis goes to their procurement, distribution, rational use and quality assurance. By then government officials and other stakeholders developed comprehensive policies on the rational use of these medicines (WHO, 1985). To maximize the role of EMs in meeting the sustainable development goals (SDGs) five policy areas have been identified in 2015. These are paying for a basket of EMs, making them affordable, assuring the quality and safety of medicines, promoting quality use of medicines and developing missing EMs (Wirtz *et al.*, 1985).

These are the pillars of the well-being of individuals as well as the population. Their selection is based on public health relevance, evidence on efficacy, safety, and comparative cost-effectiveness. EMs are intended to be available within the context of functioning health systems at all times in adequate amounts, in the appropriate dosage forms, with assured quality and adequate information, and at a price, the individual and the community can afford (WHO, 2019).

Children are not treated as little adults. Thus, EMs for this age group needs to be in proper dosage and formulations suitable to their smaller body sizes and constantly changing body physiology.

Thus, the WHO has developed a list of EMs for priority childhood diseases that are the most efficacious, safe, and cost-effective and has been updating them regularly since 1977 (Laing *et al.*, 2003), (WHO, 2023).

2.5. Availability of essential medicines

A study done by Bazargani (2014), pointed out that the availability of EMs in middle- and low-income countries are better compared to non-essential medicines. But still, the overall availability of EMs in public and private health facilities is inconsistent and inequitable (Bazargani *et al.*, 2014).

A study done by Nascimento (2017), in Brazilian public health facilities on the availability of essential medicines, shows that in primary health care facilities it was 52.9% which is lower than the WHO recommended availability of at least 80%. But variations in availability of tracer medicines are observed in different regions of the study areas and based on the disease condition, that is low availability of pharmaceuticals for chronic diseases (do Nascimento *et al*., 2017*)*.

A study carried out on availability, affordability, and prices of EMs in Jordan by Alefan et al (2018) describes that the availability of lower-priced generic medicines (LPGs) in both private and public health facilities was good. Whereas the availability of originator brands (OBs) was low in both public and private health facilities (Alefan, Amairi and Tawalbeh, 2018).

A national survey on the availability of key EMs for children in Sri Lanka done by Balasubramanian et al (2011) on both public and private health facilities using the WHO/HAI standards for assessing availability and affordability of EMs found out that, the mean percentage availability of the basket of survey medicines was 52% in public hospitals and 80% in private hospitals. Based on the survey results they concluded that the availability of key EMs in public

facilities is lower than that of private health facilities (Balasubramaniam, Beneragama and Sri Ranganathan, 2011).

Robertson et al (2009) had undertaken a study on the availability of EMs for children in 14 countries found in the central Africa region. They found out that the availability range tended to be similar in teaching hospitals (15–70%) and district hospitals (10–80%), while primary health care clinics generally had low availability (range, 18–48%). Retail or private pharmacies tended to have more survey medicines available (range, 38–62%). The study concluded that the overall availability of EMs for children in those countries is low (Robertson *et al*., 2009).

Anson et al (2012) conducted a study on the availability, prices, and affordability of the WHO's EMs for children in Guatemala and concluded that the availability of EMs for children varies based on the type of medicines and level of health facilities. Availability was found to be higher in public tertiary hospitals (46%) compared to other levels and availability in the private sector was found to be 36% on average. Overall the average availability of all surveyed medicines was found to be very low (Anson *et al*., 2012).

Wang et al (2014) had studied the access of EMs for under-5 children, by surveying the availability, affordability and price components in the Shaanxi Province of China. They took 28 pediatric EMs and collected data on their availability from 60 public and 60 private health facilities using the WHO/HAI methodology. Based on their survey they found out that the mean availabilities of OBs and lowest priced generic (LPG) medicines were 10.8% and 27.3% in the public hospitals and 11.9% and 20.6% in the private pharmacies respectively. They concluded that the overall availability of EMs for children is low and recommended that the availability of these medicines should be improved in both public and private health facilities (Wang *et al.*, 2014).

Nsabagasani et al (2015) have studied the availability and utilization of the WHO recommended priority life-saving medicines for under-5 children in public health facilities in Uganda using a cross-sectional survey in 32 health facilities. They found out that the availability and utilization of EMs for pneumonia and malaria to be low and the availability and utilization of EMs for diarrhea and sepsis to be high (Nsabagasani *et al*., 2015).

Orubu et al (2016) studied a topic entitled medicines for children in hospitals in Nigeria and implications for policy development. They focused on the impact of compounding in improving age-appropriate dosage forms and found out that although compounding can increase children's access to EMs it is given the last choice, even though access to childhood medications is low. The authors recommend policy expansion through increased supply through facilitated importation/accelerated product registration, or in-country manufacturing, rational medicine use including therapeutic substitution and establishment of a national formulary for compounding to improve access to essential child medicines (Orubu *et al*., 2019).

A study carried out in China Jiangsu province, on the access of EMs for children concerning availability, affordability, and prices by Sun et al (2018) found out that the availability of the LPGs and OBs to be 34.2% and 7.5% in the public sector and 29.4% and 8.9% in the private sectors. Based on their findings they concluded that although, the availability of LPGs is higher than OBs in both sectors, the overall mean availability was very low (Sun *et al.*, 2018).

Bassoum et al (2020) carried out a study on the availability, management, and use of EMs for under-5 children in two health districts in Senegal. They use a cross-sectional study design to assess the proportion of health facilities that have EMs at the time of the survey. They come out with the result of the complete non-availability of the selected EMs in private health facilities and availability in 50.4% of the public health facilities (Bassoum *et al.*, 2020).

Sado and Sufa have carried out a study on the availability and affordability of EMs for children in the western part of Ethiopia and arrived at a result that the average availability of EMs at both public and private sectors was found to be 43% (range 10.7-75%) and 42.8% (range 6.5-77.1%) respectively. This result indicates that the availability of EMs for children in the western part of Ethiopia is low as compared to the WHO recommendation which is at least 80% of availability, and this has hampered access to medicines for those who are in need (Sado and Sufa, 2016). The authors further have recommended a study to be carried out on a large scale to assess the affordability of childhood medicines all over the country.

A study was conducted by Abrha et al (2018) on the availability and affordability of EMs for under-5 children in health facilities of Tigray region, northern Ethiopia and discussed both OBs and LPGs availability and found out that the overall availability of EMs in the study areas was low (34.1%). The average availabilities of all surveyed medicines in public and private sectors were 41.9 and 31.5%, respectively which is far lower than the WHO good availability criteria of 80% and above (Abrha *et al.*, 2018).

2.6. Affordability of essential medicines

As the concept of affordability is inherently normative it is not an easy task to determine whether EMs are affordable to the low- and middle-income countries or not. Affordability can be affected largely by the methods (impoverishment and the catastrophic payment) and thresholds (Hailemichael *et al.,* 2019). To be able to compare affordability measures between and among different countries of the world, policymakers and researchers need to standardize the range of affordability thresholds (Niëns and Brouwer, 2013).

Affordability in several kinds of literature is calculated using the daily wage of the lowest-paid government worker (LPGW) by determining the number of days' wages required to purchase

selected courses of treatment for common acute (one treatment course) and one month's supply of medicines for chronic conditions. If the medicine costs less than one day of wage for a course of treatment it is considered affordable, otherwise, it is taken as unaffordable (World Health Organization, 2007).

A study undertaken by Alefan et al (2018) on the availability, prices, and affordability of selected EMs in Jordan by carrying out a national survey indicated that generally, medicines' prices were affordable in the public sector for the LPGW, needing less than a 1-day income to purchase the LPG medicines. While in the private sector, the medicine prices were not affordable by comparing to the IRP developed by Management Science for Health (MSH) (Alefan, Amairi and Tawalbeh, 2018).

Shafiq et al (2011) reported a study that explored the health-seeking behaviors and health service utilization for under-5 children living in a squatter settlement of Karachi, Pakistan by using observational visits, focused group discussions, and interviews as data collection methods. The authors reported that the limited purchasing power to buy medicines from a retail pharmacy has resulted in considerable 'financial burden' on the low-income groups of the population, treatment non-compliance, seeking health care from informal health providers and healer shopping (Shafiq, Shaikh and Kumar, 2011).

Wang et al (2014) studied the access of EMs for children by surveying and examining the prices, availability, and affordability components in Shaanxi Province, China, using a standardized tool developed by WHO/HAI. The findings depicted that generally standard treatments cost less than a day wage in both private and public health facilities. Affordability was measured as the number of days' wages required for the LPGW to purchase standard treatments for common conditions (Wang *et al.*, 2014).

Anson et al (2012) conducted a cross-sectional survey on the availability, prices and affordability of the WHO EMs list for children in Guatemala using a standardized WHO/HAI methodology. According to their study, they found out that in the private sector, the highest and lowest priced EMs for children were 22.7 and 10.7 times more expensive than their international reference price comparison. Treatments were generally unaffordable, costing as much as 15 days of wages for a course of ceftriaxone (Anson *et al.*, 2012).

Sado and Sufa 2016, examined the availability and affordability of EMs for children in the western part of Ethiopia and pointed out that 70% of treatments of common childhood diseases prevalent in the study area with standard treatment were unaffordable, as they cost a day's wage or more days' wages in both sectors. The unaffordability of LPGs varies from 1.5 to 8.7 days' wages in the public sector and from 1.8 to 30.7 days' wages in the private sector respectively (Sado and Sufa, 2016).

Abraha et al (2018) explored the availability and affordability of EMs for under-5 children in health facilities of Tigray region, northern Ethiopia, and found out that about 30% EMs in the public sector and 50% of them in the private sector required more than a single daily wage to purchase the standard treatment of the prevalent diseases of children. The wages required to purchase the standard treatment of LPG medicines for public and private sectors were in the ranges of 0.2 (ORS and paracetamol tablet) to 8.0 (penicillin G 1MIU) and 0.2 (paracetamol tablet) to 14.1(penicillin G 1MIU), respectively. Accordingly some of the treatments were considered as highly unaffordable based on the number of day's wage required to pay for the standard treatment course (Abrha *et al.*, 2018).

In summary, almost all reviewed studies regarding access to EMs for children indicate that the availability, prices and affordability of these medicines are suboptimal in both the public and private health sectors.

2.7. Existing literature gaps

According to the above-reviewed literature, the availability and affordability of EMs for children under the age of 5, was mainly measured in limited parts of the country using a few numbers of essential medicines and health facilities. This indicates the existence of gap in knowledge in this area with regard to the availability, affordability and price issues, especially during the current post COVID-19 pandemic era. Therefore, this study was intended to fill at list part of the current gaps in knowledge on the availability, affordability and price of EMs for under-5 children in this post pandemic period.

3. RESEARCH QUESTIONS

1. What is the availability of essential medicines in public and private health facilities of the study area?
2. How affordable are essential medicines in the study area?
3. How local prices are compared with international reference prices?

4. THE OBJECTIVE OF THE STUDY

4.1. General objective:

To assess the availability, affordability and prices of EMs for under-five children in North West Ethiopia

4.2. Specific objectives

To determine the availability of EMs for under-five children in public and private health facilities

To examine the affordability of EMs for under-five children

To compare the local prices of EMs for children with international reference prices

5. RESEARCH METHODS, MATERIALS AND PROCEDURES

5.1. Study area

The study was carried out in the northwestern part of Ethiopia, around 700km far from the capital city Addis Ababa. There are about 7.4 million people living in dega, weina dega and qola regions of the study area projected to the year 2023 by using a growth rate of 1.7% from the 2008 national census report. Among this around 1.6 million are children under the age of five (Population census commision, 2008). The common under-5 disease conditions in the area are pneumonia, meningitis, diarrhea, malaria, sepsis, malnutrition and typhoid fever. Six study districts were used as study areas. These are North, South, West and Central Gondar Zones plus Bahir-Dar and Gondar City Administrations. The districts are based on the current zone-based administrative division. The total number of public and private health facilities in each district is indicated in the following tables.

Figure 1. Map of study areas

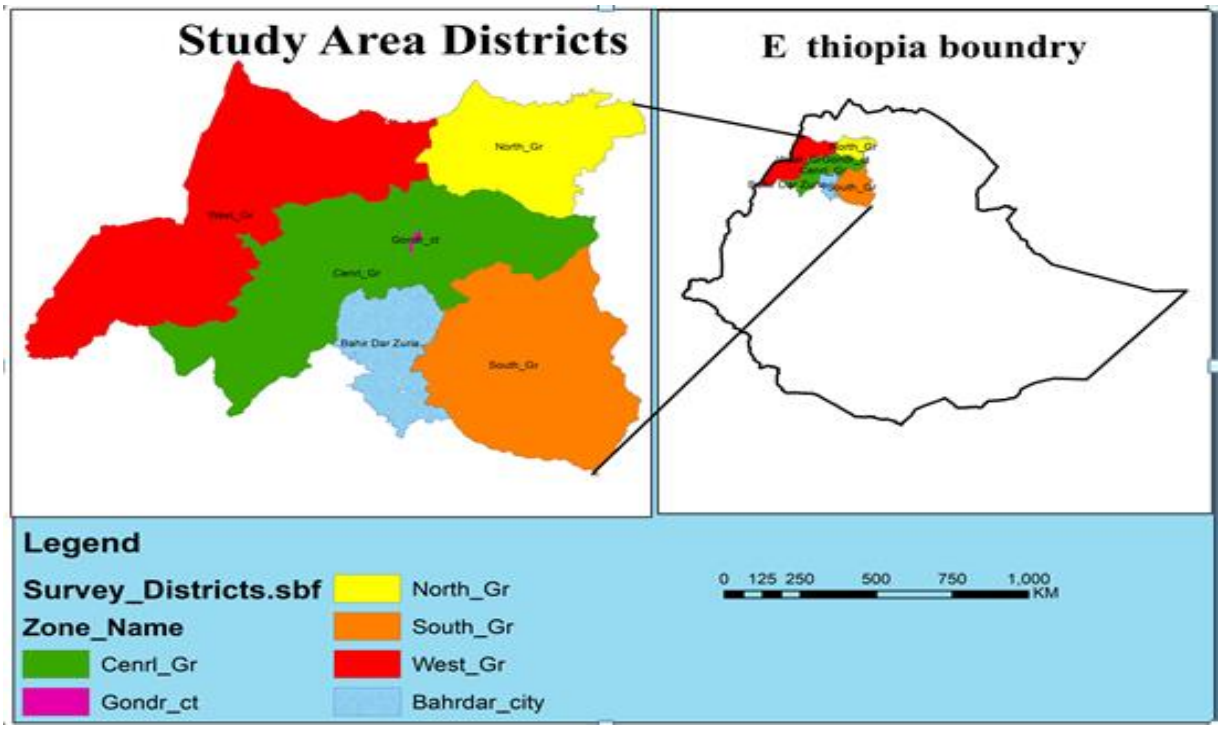


Table 1. Number of public health facilities by type

Zonal Health Department	Referral hospital	General hospital	Primary hospital	Health center
North Gondar	0	1	3	34
Central Gondar	0	0	10	76
West Gondar	0	1	2	15
South Gondar	1	1	5	25
Bahir-Dar City	2	1	0	12
Gondar City	1	1	0	8
Total	4	5	20	170

Table 2. Number of medicine outlets by type

Zonal Health Department	Pharmacies	Drug stores	Drug vendors
North Gondar	1	9	0
Central Gondar	2	36	2
West Gondar	1	24	1
South Gondar	8	27	2
Bahir Dar City	23	35	0
Gondar City	19	27	0
Total	54	158	5

5.2. Study design

A descriptive cross-sectional survey study design was utilized for collecting the required data in the study areas from April 15- May 18, 2023. The survey employed a quantitative method of data collection. The required data were obtained from pharmacies and drug stores in the private sector and from hospitals and health centers in the public sector.

5.3. Source population

The source population of the study are all public and private health facilities found in north western part of the country.

5.4. Study population

Hospitals and health centers from the public sector and pharmacies and drug stores from the private sector found with in the six study districts were used as study populations.

5.5. Eligibility Criteria

5.5.1. Inclusion criteria

Public health facilities that have served for at least one year, have begun basic childhood services, and can handle selected EMs for children and those that are easily accessible were included in the study. Private medicine outlets that are registered by the local regulatory bodies and which are within 10km distance from the public health facilities were included. Pharmacy heads at public hospitals and health centers and procurement departments at private pharmacies and drug stores were asked for the availability and selling prices of medicines to end users.

5.5.2. Exclusion criteria

Health posts which, are the lowest level in the health system structure were not included in the study as the number of populations served and several medicines handled are limited. In addition to this they did not have pharmacy professionals. Drug vendors were excluded from the study as they did not keep and dispense all EMs surveyed.

5.6. Sample size

A total of 60 health facilities were included, 30 from public and 30 from private using WHO and HAI methodology (WHO/HAI, 2008), for selecting representative health sectors. This number is according to the recommendation developed by WHO/HAI to select 5 public and 5 private sectors from each of the six study areas.

5.7. Sampling methods

5.7.1. Selection of facilities

The medicine outlets were selected using the WHO/ HAI methodology (WHO/HAI, 2008) which has been validated to select a representative sample. According to the manual first, the main public hospital was selected. Then public and private health facilities that are within three hours of travel from the main hospital were listed out. After this, 4 public health facilities within each of the study areas were selected. Additional four public health facilities were selected as back up outlets. Then five licensed private-sector medicine outlets in each survey area were selected. Additionally, five private-sector medicine outlets in each survey area were selected as back-up facilities. The selection of both private and public health facilities was based on the total number of facilities in that specific study area. That is for those which had more than five health facilities in both sectors, random sampling was employed, whereas, for those which were five all were included. On the other hand, in those where there were no private facilities close to the public facilities, those that were available within a ten km distance were included.

5.7.2. Selection of medicines

Fifty EMs were identified based on the WHO model list of EMs for children 8th list 2021, and medicines commonly used for prevention and treatment of prevalent diseases associated with under-5 children specified in the list of priority life-saving medicines for women and children (Hill, Yang and Bero, 2012) and (WHO, 2021a). Local medicine list, which is based on top 10 prevalent disease conditions, were considered during selection. The core list represents a list of minimum medicine needs for a basic health-care system, listing the most efficacious, safe, and cost-effective medicines for priority conditions. Priority conditions are selected based on current and estimated future public health relevance, and potential for safe and cost-effective treatment (WHO, 2021a).

5.8. Method of data collection

The methodology developed by the WHO and HAI on measuring medicine availability, prices, and affordability was applied, for data collection. An interview-based questionnaire was carried out with pharmacy heads at public hospitals and health centers and with procurement officers at private drug outlets. Document review and observation was carried out with the help of dispensers to verify the physical presence and prices of medicines reviewed. The questionnaire tool was made up of two sections. Section I contains background information about the facility: location, name, type of outlet, and survey data. Section II contains information about the medicines surveyed: HPMs and LPGs, strength, dosage form, pack size and unit cost (Annex-1).

Data on both availability and prices of EMs were collected at different levels of public health facilities and private drug outlets. The prices of highest priced and LPG medicines for patients were recorded in the data collection format. Then the MPR that will help in cross-country

comparison of prices was calculated and compared with the IRP set by MSH adjusted to the year 2023, (MSH, 2016).

5.9. Data quality assurance

Experienced data collectors were recruited and trained in data collection. A pilot study was carried out in two drug outlets from both public and private sectors, which are outside of the sampled facilities to identify and refine the research question, examine its clarity, validation, suitability, figure out what methods are best for pursuing it, check the appropriateness of the tool, and estimate how much time and resources will be necessary to complete the larger version of the study, among other things. Based on the pretest analysis the research questions have been modified because of some ambiguities in obtaining a genuine data.

Interview based questionnaire was carried out with the health workers in a private room within the health facility. The availability of EMs was checked with the help of the dispenser by physically verifying the medicines on the shelves. Data was checked for completeness and accuracy before leaving the facility and as such, no data were missed out. In addition, to check the validity of the data collected the principal investigator carried out data collection in 20% of sampled facilities and crosschecked it with what was collected by data collectors. Double entry of data was carried out to confirm its correctness. The principal investigator closely supervised the data collectors and solved some problems that occur during data collection.

5.10. Operational definitions

Availability: measures the number of health facilities having a usable stock of the selected EMs at the time of the survey compared to the total number of health facilities surveyed.

Affordability: is defined as the number of days wage required by the LPGW to purchase the LPG/HP medicines for his/her health condition. If the wage required for purchasing a full course of treatment for acute conditions and for 30 days of treatment for chronic conditions is of one day and less it was considered as affordable.

Highest priced medicines: are defined as the medicines with the highest price compared with other same available medicines.

5.11. Data entry

Price and availability data was entered into the pre-programmed MS Excel workbook according to WHO/HAI methodology (WHO/HAI, 2008). Data was entered and checked twice to guarantee the quality of data and to prevent any errors.

5.12. Data processing and analysis

The data was collected in the standardized data collection format developed by WHO and HAI for surveying the availability, prices, and affordability of EMs and was copied to MS excel 2010 (WHO/HAI, 2008). Then, after checking for completeness and consistency, it was analyzed and results were summarized and presented in tables and graphs. Data for section one were entered, analyzed and summarized using the Statistical Package for Social Science (SPSS), and results displayed in tables. EMs availability was measured as percentage availability of individual medicines. Availability only refers to the day of data collection in each sector. Mean availability across sectors, level of facilities and group of medicines was also manipulated for the basket of medicines surveyed.

EMs prices were calculated as median price of individual medicines in USD. The exchange rate to Ethiopian birr was taken at the first day of data collection (April 15, 2023) and was

$1US=54.0679 Ethiopian Birr (https://banksethiopia.com/ethiopian-birr-exchange-rate/). This was the commercial buy rate. Median price ratio (MPR) was computed as ratio of local median prices for international reference prices using the formula;

$$\text{MPR}= \frac{Median\ local\ unit\ price\ of\ a\ given\ Medicine\ (USD)}{Median\ international\ refernce\ price\ of\ that\ medicine\ (USD)}$$

The ratio is thus an expression of how much greater or less the local medicine price is than the international reference price e.g., an MPR of 2.5 would mean that the local medicine price is two and half times that of the international reference price. Median price ratios were only calculated for medicines with price data from at least 4 medicine outlets. As averages can be skewed by outlying values, median values have been used in the price analysis as a better representation of the midpoint value. International reference prices were adjusted to the current 2023 by using average annual increment of medicines price (Of, Policy and Findings, 2022), (MSH, 2016), Annex-3.

Treatment affordability was calculated using the daily wage of the LPGW and the mean buying price of each medicine for the user. The monthly wage of the LPGW in Ethiopia was 1150 ETB and thus, the daily wage is about 38.33 ETB, which is equivalent to $0.7089USD (http://www.salaryexplorer.com/salary-survey.php/). To calculate the cost of standard treatments an average weight of 14.5kg was utilized (Rosenberg and Miles, 2022). The formula used to calculate the affordability of EMs for under-5 children in both public and private sectors was as follows:

$$\text{Affordability} = \frac{Total\ price\ of\ a\ regimen\ for\ a\ given\ medicine\ (USD)}{Daily\ wage\ of\ lowest\ paid\ government\ worker\ (USD)}$$

The total costs of medicine for the complete duration of therapy of acute conditions or a one-month course of chronic conditions were determined and compared to the daily wage. Then, medicines

that cost less than a day’s wage to buy one standard treatment of an acute condition or treatment for a chronic condition for a month are taken as affordable and unaffordable if they cost more.

5.13. Ethical considerations

Approval of the project and ethical clearance were respectively obtained from the department of Pharmaceutics and Social Pharmacy and the Ethical Review Committee of the school of pharmacy, Addis Ababa University (ERB/SOP/371/13/2021) (Annex-2). The purpose and the benefit of the study and the voluntary nature of participation was discussed with each study participant/facility and informed verbal consent was obtained. The survey was conducted in a way that will not compromise their privacy and confidentiality of information was kept by not using any identifiers of the study participants/facilities.

6. RESULTS

The self-administered questionnaire was disseminated to 60 health facilities and out of those, 52 health facilities have responded for it. Thus, the response rate from the primary sample health facilities was 86.7%. The non-responders were substituted by the preselected backup facilities and the overall response rate was 100%.

For the general questions 96.7% and 0% of respondents from the public and private sectors respectively reported that prescription by generic name is a must. In addition to this all respondents in the public sector and non in the private sector said that there are some medicines provided for free for under-5 children. Likewise, all respondents from both sectors respond that there is no a separate national essential medicine list for children in their sectors. The inclusive availability of EMs in the surveyed facilities was found to be 48%.

6.1. Availability of selected EMs for under-5 children

Availability of highest priced and lowest priced individual EMs was varied by type of medicine, sectors, and level of health facilities as summarized in Tables 3 and 4. Out of 60 health facilities surveyed the overall average availability of the highest priced medicines (HPM) was found to be 11.5%, range (0-46.7%) in the private sector and 0% in the public sector and that of LPG medicines was found to be 52.1%, range (0-100%) in the public and 40.2% range (0-96.7%) in the private sector. The average availability of surveyed LPG EMs by level was found to be 59.7% and 44.6% in public hospitals and health centers respectively. Whereas the average availability of LPG EMs by level in the private sector was found to be 41.2% and 37.0% for pharmacies and drug stores respectively.

The availability of HPMs for children in the public sector was null, on the other hand in the private sector only 48% of the availed medicines have highest priced version, of which the availability of 37.5% of the medicines was low (between 30-49%), and for 62.5% it was very low (<30%).

Ceftriaxone 1g vial for injection, cloxacillin 250mg/ml suspension, gentamicin 10mg/ml injection and sodium chloride (NS) 0.9% were fully available in the public sectors (Table 3). On the contrary, medicines like vitamin A 50,000 iu capsule and amoxicillin 125mg dispersible tablet were not available at all in both sectors. In total 5(10%) medicines were fully available in the public sectors. On the other hand, 7(14%) and 17 (34%) of the surveyed medicines were not available at all in the public and private sectors respectively.

The overall availability of LPG medicines for under-5 children in the public sector is found to be nearly 50% as enumerated in Table 3. However, the availability of individual LPGs varies from completely non available (Amoxicillin 125mg dispersible tablet, Chloroquine phosphate 50mg base/5ml syrup… to fully available (Cloxacillin 250mg/ml suspension, Ceftriaxone 1g vial injection…).

Table 3. Average availability of EMs for children in the public sector

	Name of medicine, strength, dosage form	Percentage of outlets where medicines found		
		Public sector (n=30)		
		Hospital (n=12)	Health center (n=18)	
		LPG	LPG	Overall
1	Adrenaline (Epinephrine) - 0.1% in 1ml ampoule injection	91.66	66.67	76.7
2	Amoxicillin + Clavulanic Acid 125 mg + 31.25 mg/5 ml suspension	50	5.56	23.3
3	Amoxicillin + Clavulanic Acid 250 mg + 62.5 mg/5 ml suspension	66.67	38.89	63.3
4	Amoxicillin 125mg dispersible tablet	0	0	0.0
5	Amoxicillin 125mg/ml suspension	58.33	38.89	46.7
6	Amoxicillin 250mg dispersible tablet	83.33	100	93.3
7	Amoxicillin 250mg/ml suspension	91.67	61.11	75.3

8	Ampicillin 500 mg powder for injection	100	55.56	73.3
9	Artemether + Lumefantrine 120mg+20mg tablet	100	66.67	80.0
10	Artemether + Lumefantrine 120mg+20mg tablet	58.33	61.11	60.0
11	Artesunate 60 mg vial	58.33	5.56	36.7
12	Ceftriaxone 1g vial	100	100	100.0
13	Ceftriaxone 250mg vial	33.33	38.89	36.7
14	Cephalexin 125mg/5ml syrup	41.67	33.33	36.7
15	Chloramphenicol 1 gm vial	0	0	0.0
16	Chloroquine phosphate 50mg base/5ml syrup	0	0	0.0
17	Chlorpheniramine maleate 2mg/5ml syrup	83.33	77.78	80.0
18	Ciprofloxacin 0.03 Ear drop	83.33	55.56	73.3
19	Ciprofloxacin 250 mg tab	25	0	15.0
20	Cloxacillin 250mg/ml suspension	100	100	100.0
21	Dextrose 40% infusion	75	94.44	86.7
22	Diazepam 5 mg/ml ampoule injection	66.67	44.44	66.7
23	Diclofenac sodium 25mg/ml in 3ml ampoule injection	100	77.78	83.3
24	Erythromycin 200mg/5ml oral suspension	100	72.22	83.3
25	ET tube size 2.5,3 and 3.5 and 4	91.67	16.67	46.7
26	Ferrous sulphate 20mg/ml suspension	50	0	26.7
27	Gentamicin 10 mg/ml ampoule injection	100	100	100.0
28	Ibuprofen 100mg/5ml suspension	41.67	0	26.7
29	Loratadine 5mg/5ml syrup	0	0	0.0
30	Mebendazole 100mg/5ml syrup	0	0	0.0
31	Metronidazole 125mg/5ml oral suspension	83.33	72.22	76.7
32	Miconazole 2% cream	100	94.4	96.7
33	Morphine 10mg in 1ml injection	25	0	10.0
34	Morphine sulfate 20mg/5ml syrup	16.67	0	8.7
35	Oral rehydration salt (ORS)	83.33	55.56	66.7
36	Oxygen medical gas	100	0	40.0
37	Paracetamol 120mg/5ml syrup	50	66.67	56.7
38	Paracetamol 125mg suppository	91.67	77.78	83.3
39	Permethrin 5% cream	25	77.78	66.7
40	Phenobarbitone 30mg tab	66.67	50	56.7
41	Phytomenadione (Vitamin K),10mg/ml in 1ml ampoule Injection	25	0	14.6
42	Promethazine HCL 5mg/5ml elixir	41.67	22.2	30.0
43	Salbutamol 100 mcg/dose inhaler	100	100	83.3
44	Salbutamol 2mg/5ml syrup	25	0	20.7
45	Sodium chloride (normal saline) 0.009 iv with giving set	100	100	100.0
46	Sodium Valporate 250mg/5ml suspension	6.7	0	6.7
47	Tetracycline 1% eye ointment	100	100	100.0
48	Vitamin A 50,000 units capsule	0	0	0.0

49	Zinc phosphate 20 mg dispersible tab	0	0	0.0
50	Zink ORS copack 2 sachets ORS 20.5mg/ml to 10 zink 20mg dispersable tablets	96.7	100	96.7
		59.73	44.55	52.09

The availability of LPGs and HPMs in the private sector is presented in Table 4. Based on this the overall availability of LPGs is approximately 40% and that of HPMs is around 12%. On the other hand, the individual availability of EMs varies from 0 to 96.7% and 0 to 46.7% for LPGs and HPMs respectively.

Table 4. Average availability of EMs for children in the private sector

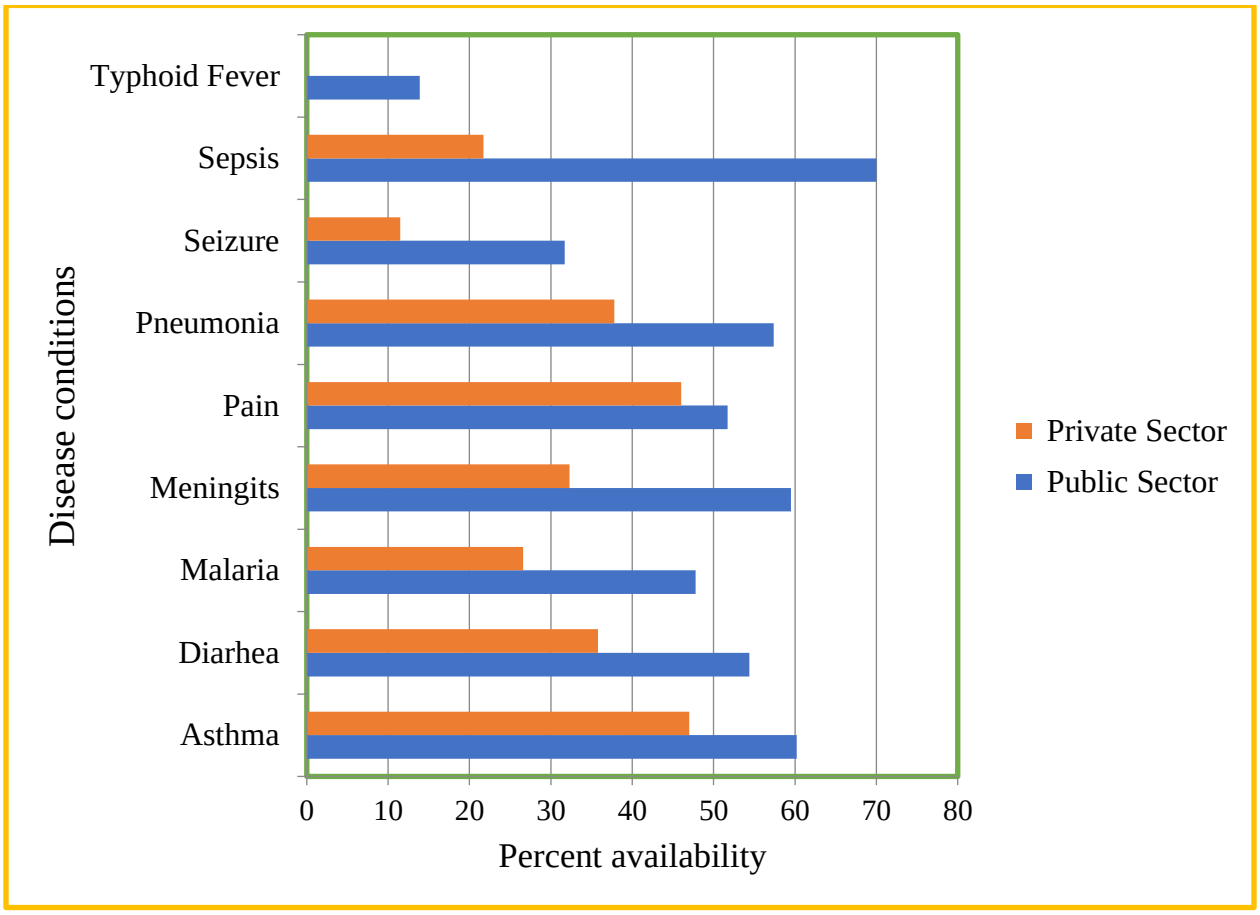
	Name of medicine, strength, dosage form	Percentage of outlets where medicines found					
		Private sector (n=30)					
		Pharmacy (n=12)		Drug store (n=18)		Overall	Overall
		LPG	HPM	LPG	HPM	LPG	HPM
1	Adrenaline (Epinephrine) - 0.1% in 1ml ampoule injection	69.23	0	38.89	0	50.00	0.00
2	Amoxicillin + Clavulanic Acid 125 mg + 31.25 mg/5 ml suspension	76.92	22.22	72.22	33.33	73.33	30.00
3	Amoxicillin + Clavulanic Acid 250 mg + 62.5 mg/5 ml Suspension	46.15	33.33	66.67	27.78	60.00	30.00
4	Amoxicillin 125mg dispersible tablet	0	0	0	0	0.00	0.00
5	Amoxicillin 125mg/ml suspension	53.85	27.78	83.33	22.22	70.00	23.33
6	Amoxicillin 250mg dispersible tablet	0	0	0	0	0.00	0.00
7	Amoxicillin 250mg/ml suspension	61.54	27.78	61.11	27.78	60.00	26.67
8	Ampicillin 500 mg powder for injection	92.31	0	27.78	0	53.33	0.00
9	Artemether + Lumefantrine 120mg+20mg tablet	0	0	0	0	0.00	0.00
10	Artemether + Lumefantrine 120mg+20mg tablet	0	0	0	0	0.00	0.00
11	Artesunate 60 mg vial	61.54	0	33.33	0	40.00	0.00
12	Ceftriaxone 1g vial	92.31	44.44	100	50	96.67	46.67
13	Ceftriaxone 250mg vial	0	0	0	0	0.00	0.00

14	Cephalexin 125mg/5ml syrup	61.54	16.67	50	22.22	53.33	20.00
15	Chloramphenicol 1 gm vial	0	0	0	0	0.00	0.00
16	Chloroquine Phosphate 50mg base/5ml syrup	76.92	0	61.11	0	66.67	0.00
17	Chlorpheniramine maleate 2mg/5ml syrup	38.46	16.67	61.11	22.22	50.00	20.00
18	Ciprofloxacin 0.03 Ear drop	46.15	33.33	61.11	27.78	56.67	30.00
19	Ciprofloxacin 250 mg tab	0	0	0	0	0.00	0.00
20	Cloxacillin 250mg/ml suspension	53.85	27.78	50	22.22	50.00	20.00
21	Dextrose 40% infusion	61.54	0	66.67	0	63.33	0.00
22	Diazepam 5 mg/ml Ampoule injection	30.77	5.56	0	0	16.67	3.33
23	Diclofenac sodium 25mg/ml in 3ml ampoule injection	61.54	33.33	50	38.89	60.67	36.67
24	Erythromycin 200mg/5ml oral suspension	69.23	38.89	55.56	38.89	63.33	38.89
25	ET tube size 2.5,3 and 3.5 and 4	0	0	0	0	0.00	0.00
26	Ferrous sulphate 20mg/ml suspension	76.92	44.44	66.67	27.78	70.00	30.30
27	Gentamicin 10 mg/ml ampoule injection	61.54	16.67	16.67	5.56	43.67	10.00
28	Ibuprofen 100mg/5ml suspension	76.92	27.78	61.11	38.89	76.67	33.33
29	Loratadine 5mg/5ml syrup	30.77	44.44	50	23.08	43.33	30.00
30	Mebendazole 100mg/5ml syrup	76.92	16.67	55.56	27.78	66.67	20.00
31	Metronidazole 125mg/5ml oral suspension	84.62	11.11	61.11	16.67	84.62	13.33
32	Miconazole 2% cream	46.15	0	66.67	0	60.00	0.00
33	Morphine 10mg in 1ml injection	0	0	0	0	0.00	0.00
34	Morphine sulfate 20mg/5ml syrup	0	0	0	0	0.00	0.00
35	Oral rehydration salt (ORS)	53.85	0	55.56	0	54.20	0.00
36	Oxygen medical gas	0	0	0	0	0.00	0.00
37	Paracetamol 120mg/5ml syrup	92.31	27.78	61.11	27.78	92.31	26.70
38	Paracetamol 125mg suppository	38.46	22.22	55.56	22.22	46.67	20.00
39	Permethrin 5% cream	46.15	33.33	50	0	50.00	13.33
40	Phenobarbitone 30mg tab	23.08	0	0	0	23.08	0.00
41	Phytomenadione (Vitamin K),10mg/ml in 1ml ampoule injection	0	0	0	0	0.00	0.00
42	Promethazine HCL 5mg/5ml elixir	0	0	0	0	0.00	0.00
43	Salbutamol 100 mcg/dose inhaler	92.31	33.33	88.89	27.78	92.31	23.30
44	Salbutamol 2mg/5ml syrup	0	16.67	0	0	0.00	6.67

45	Sodium chloride (normal saline) 0.009 iv with giving set	92.31	0	88.89	0	92.31	0.00
46	Sodium valporate 250mg/5ml suspension	0	0	0	0	0.00	0.00
47	Tetracycline 1% eye ointment	61.54	36.67	77.78	16.67	76.67	23.33
48	Vitamin A 50,000 units capsule	0	0	0	0	0.00	0.00
49	Zinc phosphate 20 mg dispersible tab	53.85	0	50	0	53.33	0.00
50	Zink ORS copack 2 sachets ORS 20.5mg/ml to 10 zink 20mg dispersable tablets	0	0	0	0	0.00	0.00
		41.23	13.18	36.89	11.35	40.20	11.52

The overall average availability of essential medicines was found to be less than 50% and generally, availability of a basket EMs for the selected disease conditions is found to be higher in the public sectors than the private sectors as displayed in Figure 2. In the public sector the availability of EMs for 3(33.3%) of the selected disease conditions is less than 50%. Whereas in the private sector the availability of EMs for 9(100%) of disease conditions is less than 50%.

Figure 2. Availability of a basket of medicines for selected disease conditions in public and private sectors.



6.2. Price analysis of medicines in public and private sectors

6.2.1. Public sector patient prices

Out of all surveyed medicines, those that are found to be available in at least four health facilities (29 medicines) were used to calculate the MPRs. Medicines that are dispensed for free in the public sector were also excluded from the MPRs calculation.

LPG EMs for under-5 children are generally sold at 0.98 times the IRP as shown in Table 5. Half of the LPGs were generally sold at 0.59 (25^{th} percentile) to 1.48 (75^{th} percentile) times the IRP.

There is therefore moderate variation in MPRs across individual generic medicines in the public sector.

Out of 29 medicines used for MPR calculation, the MPR for 7 (24.14%) of LPGs medicines in the public sector was found to be greater than 1.5 times the IRP. Such medicines include, amoxicillin 125mg/ml suspension, ceftriaxone 250mg vial injection, diazepam 5 mg/ml ampoule injection, salbutamol 100 mcg/dose inhaler, sodium chloride (normal saline) 0.009 iv with giving set and phenobarbitone 30 mg tablet. The MPR for 22 (75.86%) of medicines analysed was less than 1.5 times the IRP.

Table 5. Median medicine price ratio for medicines found in the public sector

Product type	MPR	25^{th} percentile	75^{th} percentile
Lowest price generic medicines (n = 29)	0.98	0.59	1.48

6.2.2. Private sector patient prices

The LPG medicines for under-5 children were generally sold at 2.33 times their IRP in the private sectors as depicted in Table 6. Half of the LPGs were generally sold at 1.3 (25^{th} percentile) to 4.9 (75^{th} percentile) times their IRPs.There is therefore moderate variation in MPRs across individual LPG medicines in the private sector. HPMs are generally sold at approximately 4 times their IRPs. Half of the highest priced medicines were priced at 2.8 (25^{th} percentile) to 11.3 (75^{th} percentile) times the IRPs which indicates significant variation in MPRs across individual HPMs in the private sector.

Table 6. Median price ratio for all medicines found in the private sector

Product type	MPR	25%ile	75%ile
Highest priced medicines (n = 23)	3.98	2.81	11.32
Lowest price generic medicines (n = 30)	2.33	1.3	4.91

Final patient prices in the private sector are 237.76% higher than in the public sector for LPG medicines as presented in Tables 7 and 8. Medicines that are available in both public and private sectors only were compared for this purpose. Therefore, given that medicines availability in the public sector is nearly 50%, patients are forced to pay for expensive medicines from the private sector.

Table 7. Ratio of private to public MPR

Product type	MPR public sector patient prices	MPR private sector patient prices	Ratio of private to public MPR
Lowest price generic (n = 26 medicines)	0.98	2.33	237.76

Table 8. Local median price, international reference price (buyers' price), and median price ratios (MPR) of LPGs and HPM

	Item Description	Local median price (USD) Public	Local Median price (USD) private	Local Median prices HPM (Private)	WHO/MSH Reference Median price (USD)	MPR Public	MPR Private	MPR HPM (Private)	Private to public ratio
1	Amoxicillin 125mg/ml suspension	0.0088	0.0145	0.0226	0.0050	1.76	2.90	4.52	1.65
2	Amoxicillin 250mg/ml suspension	0.0094	0.0188	0.0200	0.0073	1.29	2.58	2.74	2.00
3	Amoxicillin + Clavulanic Acid 125 mg + 31.25 mg/5 ml Suspension	0.0136	0.0625	0.1102	0.0213	0.64	2.93	5.17	4.60
4	Amoxicillin + Clavulanic Acid 250 mg + 62.5 mg/5 ml suspension	0.0169	0.0992	0.1477	0.0546	0.31	1.82	2.71	5.87
5	Ampicillin 500 mg powder for injection	0.0111	0.0424		0.0177	0.63	2.40		3.82
6	Ceftriaxone 250mg vial inj	0.5774	–		0.3706	1.56	–	0.00	–
7	Ceftriaxone 1g vial inj	0.0409	0.1778	0.2472	0.0417	0.98	4.26	5.93	4.35
8	Chloramphenicol 1 gm Vial	_	–			–	–		–
9	Chlorpheniramine maleate 2mg/5ml syrup	0.0036	0.0060		0.0046	0.78	1.30		1.67
10	Diazepam 5 mg/ml Ampoule injection	0.3768	0.5849	0.5941	0.0609	6.19	9.60	9.76	1.55
11	Erythromycin 200mg/5ml oral suspension	0.0099	0.0175	0.3421	0.0082	1.21	2.13	41.72	1.77
12	Ibuprofen 100 mg/5 ml suspension	_	0.0024	0.0038	0.0051	_	0.47	0.75	_
13	Mebendazole 100mg/5ml syrup	_	0.0782	0.1913	0.0259	_	3.02	7.39	_
14	Metronidazole 125mg/5ml oral suspension	0.0047	0.0252	0.0618	0.0108	0.44	2.33	5.72	5.36
15	Morphine Sulfate 20mg/5ml syrup	_	–		_	_	–		–
16	Paracetamol 120mg/5 ml syrup	0.0087	0.0244	0.0440	0.0067	1.30	3.64	6.57	2.80
17	Paracetamol 125mg suppository	0.059	0.2693	0.5498	0.1519	0.39	1.77	3.62	4.56
18	Promethazine HCL 5mg/5ml elixir	_	–		_	_	–		–

19	Salbutamol 2mg/5ml syrup	0.0053	0.0164	0.0159	0.0061	0.87	2.69	2.61	3.09
20	Salbutamol 100 mcg/dose Inhaler	0.0171	0.0319	0.0713	0.0063	2.71	5.06	11.32	1.87
21	Sodium chloride (normal saline) 0.009 Iv with giving set	0.0023	0.00355		0.0012	1.92	2.96	0.00	1.54
22	Oxygen medical gas								
23	Adrenaline (Epinephrine) - 0.1% in 1ml Ampoule - Injection	0.1267	0.1518		0.1887	0.67	0.80		1.20
24	Cephalexin 125mg/5ml syrup	0.0087	0.0506	0.1278	0.0103	0.84	4.91	12.41	5.82
25	Chloroquine Phosphate 50mg base/5ml syrup	_	0.0225		0.0115	_	1.96	0.00	_
26	Cloxacillin 250mg/ml suspension	0.0098	0.019	0.0412	0.0169	0.58	1.12	2.44	1.94
27	Ciprofloxacin 0.03 Ear drop	0.1172	0.6246	1.2248	0.0793	1.48	7.88	15.45	5.33
28	Dextrose 40% infusion	0.0162	0.0208		0.016	1.01	1.30		1.28
29	Diclofenac sodium 25mg/ml in 3ml ampoule injection	0.0174	0.5349	1.6922	0.0311	0.56	17.20	54.41	30.74
30	ET tube size 2.5,3 and 3.5 and 4	0.4153	_		_	_	_		_
31	Ferrous sulphate 20mg/ml suspension	0.0036	0.0034	0.0087	0.0031	1.16	1.10	2.81	0.94
32	Loratadine 5mg/5ml syrup	_	0.0187	0.0631	0.0215	_	0.87	2.93	_
33	Miconazole 2% cream	0.0165	0.0227		0.0118	1.40	1.92		1.38
34	Morphine 10mg in 1ml injection	0.0929	_		0.5855	0.16			_
35	Permethrin 5% cream	0.0327	0.0418	0.1310	0.0329	0.99	1.27	3.98	1.28
36	Phenobarbitone 30 mg tab	0.1411	0.3019		0.0082	17.21	36.82	0.00	2.14
37	Phytomenadione (Vitamin K) ,10mg/ml in 1ml ampoule injection	0.2951			0.5007	0.59			0.00
38	Sodium valporate 250mg/5ml suspension	_	_		_	_			_
39	Tetracycline 1% eye ointment	0.0429	0.0645	0.1745	0.0503	0.85	1.28	3.47	1.50
	Median MPR					0.98	2.33	3.98	

6.3. Affordability of standard treatment regimens

The affordability of treatment for eight common conditions was estimated as the number of days' wages of the LPGW needed to purchase medicines prescribed at a standard dose. For acute conditions, treatment duration was defined as a full course of therapy, while for chronic diseases, the affordability of a 30-days' supply of medicines was determined.

The affordability of standard treatments for eight different health conditions (12 medicines) is described in Table 9. The findings revealed that out of 12 medicines used to treat for the 8 common childhood disease conditions in the study area, only 3 and 1 medicine was found to be affordable in public and private sectors respectively. Overall, about 75% of EMs in the public sector and 91% of EMs in the private sector are found to be non-affordable to be used for the selected disease conditions. Thus, the affordability of LPGs in the public and private sector was low for most conditions (25%) and (9%) respectively with standard treatment costing a day's wage and less.

Table 9. Affordability of 12 treatment regimens for the lowest paid government worker using prices of LPG

Condition	Medicine name,Strength, Dosage form	Treatment parameters: Treatment schedule (dose, frequency, Days)	Unit	Median unit price: Public sector	Median unit price: Private sector	Total treatment price: Public sector	Total treatment price: Private sector	Number of days wage to pay for treatment: Public sector	Number of days wage to pay for treatment: Private sector
Pneumonia	Amoxicillin 250mg/5ml suspension	30mg/kgx14.5x3x7days= 9135mg=182.7ml	ml	0.0094	0.0180	1.7173	3.2886	2.4	4.6
	Ceftriaxone 1g Vial	1gmx2x5= 10 vials	vial	0.4193	1.7785	4.193	17.785	5.9	25.1
Otitis Media	Amoxicillin + Clavulanic Acid 125 mg + 31.25 mg/5ml Suspension	5mlx3x10= 150ml	ml	0.0136	0.0625	2.0349	9.3679	2.9	13.2
Seizure disorder	Diazepam 5mg/ml ampoule injection	1mlx1x1=1ml	ml	0.3768	0.6034	0.3768	0.6034	0.5	0.9
Respiratory infection	Ceftriaxone 250mg Vial	500mgx2x7= 7 gm	gm	0.3823		2.6761		3.8	
Pain and Fever	Paracetamol 24mg/ml suspension	5mlx3x3=45ml	ml	0.0087	0.0244	0.3893	1.0985	0.5	1.5
	Paracetamol 125mg suppository	125mgx4x1=500mg=4 suppository	mg	0.0590	0.2693	0.236	1.0774	0.3	1.5
Asthma	Salbutamol 0.1mg/dose	0.2mgx6x30= 360	dose	0.0171	0.0319	6.1682	11.472	8.7	16.2
Meningitis	Ceftriaxone 1g Vial	1.5gm x2x14=42	gm	0.3823	1.7785	16.056	74.697	22.6	105.4
	Ampicillin 500mg vial	50mg/kgx14.5x4x21=60900	mg	0.0111	0.0424	13.523	51.609	19.1	72.8
	Gentamycin 10mg/ml ampoule injection	7.5mg/kgx14.5x1X21=2283 .75	ml	0.1006	0.3070	22.123	70.109	31.159	98.74
Sepsis	Ceftriaxone 1g Vial	1.5gx1x7 =10.5	gm	0.4193	1.7785	4.4025	18.674	6.2	26.3

Overall, when the affordability of LPGs was compared in both public and private sectors, EMs for under-5 children were more than two times costly in the private sector than in the public sector for about 72.7% of the medicines. The highest ratio was observed with gentamycin 10mg/ml injection which, is used for the treatment of childhood meningitis and sepsis together with ampicillin followed by ceftriaxone which is used for most infectious diseases.

7. DISCUSSION

The outcomes of this study have provided insights into the availability, affordability and prices of EMs for under-5 children in public and private sectors of six districts in North West Ethiopia. This chapter provides a reflection of the research process. The chapter ends with several recommendations for action and the need for future research.

Having the assumption that essential medicines should be available at any time and in all health facilities, the results of this study generally confirms that the availability of selected EMs to be sub optimal. Sector wise availability is slightly higher in the public health facilities (52.1%) than in the private health facilities (40.2%) for LPGs. The MPRs in the public and private sectors were found to be 0.98 and 2.3 times the IRP for LPGs respectively. About 75% and 91% of EMs used for selected disease conditions were found to be non-affordable in the public and private sectors respectively.

Regarding the higher availability of LPGs in the public sector compared to that of the private sector the result is consistent with the findings obtained by (Sado and Sufa, 2016) (43% and 42.8%) in Western Ethiopia, (Tadesse and Abuye, 2021) (57.7% and 53.7%) in southern Ethiopia, (Bassoum *et al.*, 2020) in Senegal and (Sun *et al.*, 2018) (34.2% and 29.4) in China. However, it is against the results obtained by (Alefan, Amairi and Tawalbeh, 2018) in Jordan and (Anson *et al.*, 2012) (25% and 35%) in Guatemala. In this study only 13 (26%) and 4 (8%) of LPMs were found in greater than 80% of surveyed facilities in the public and private sectors respectively. The slightly higher availability of EMs for under-5 children in the public sector than the private sector may be explained in part by the provision of some EMs for under-5 free of charge by the government, support from nongovernmental organizations and the government's focus to childhood health.

Highest priced EMs for under-5 children were not found in the public sector where as in the private sector their availability was about 11.5%. This may be due to the announcement and encouragement of generic EMs selection, quantification, procurement and prescription in the public sectors and the availability of lowest priced generic alternatives. Medicines with particularly low availability in the public sector include morphine 10 mg vial injection (10 %), amoxicillin + clavulanic acid (125mg+31.25mg/5ml) suspension (23.3%), ciprofloxacin 250mg tablet (10%) and ibuprofen 100mg/5ml suspension (16.7%). In the private sector the availability of diazepam 5mg/ml ampoule injection (13.3%), salbutamol 2mg/5ml syrup (26.7%) and gentamycin 10mg/ml injection (36.7%) were found to be very low. This may suggest that prescribers are forced to prescribe alternative medicines that might be more costly. Moreover, treatment interruptions may occur specially for those in need of chronic treatment which, compromises the quality of life of patients.

A review done on availability and affordability of EMs in Africa recognized a supportive evidence to the above finding and pointed out that the primary obstacles for availability to be poor inventory management, manual demand forecasting and inadequate funds (Yenet, Nibret and Tegegne, 2023). Thus, strong efforts need to be exercised to enhance the availability of EMs for under-5 children.

It can be noted from the study results that four out of fifty (8%) of EMs surveyed for under-5 children were totally absent in both public and private sectors. Particularly this is critical for amoxicillin 125mg dispersible tablet, which is the preferred priority lifesaving essential medicine for the treatment of pneumonia in infants and neonates. In terms of total absence of essential medicines in both public and private sectors, this finding is in agreement with a study conducted

in Uganda by Nsabagasani et al (2015). This may imply unsatisfactory health service due to lack of consistent availability of EMs and the necessity of actions to bring quality health services.

When observation of availability of EMs for under-5 children was made by level of health facilities, in the public sector the availability in hospitals was generally found to be greater than the availability in health centers. Similarly in the private sector, availability in pharmacies was generally higher than the availability in drug stores. This may be in part due to restriction of some medicines to specific levels in the health care system. On the other hand, the low consumption rate of some medicines may be a reason for their low availability in the private sectors as private sectors are profit based. This reveals the need for actions to strengthen the public health facilities.

As the study results implies the overall availability of EMs for under-5 children is not satisfactory. This may be in part due to absence of children's EML, lack of accurate forecasts, long procurement lead time, low capacity of local manufacturers and irrational use of medicines (Marew *et al.*, 2022), (Mekonnen, Ayalew and Tegegn, 2021). This attests, a separate EML for children, advancing the demand forecasting and procurement process as well as enhancing the capacity of local manufacturers need to be in place. Further to these future studies should focus on the root causes of suboptimal availability of EMs for under-5 children.

Final patient prices for LPG medicines in the public sector are reasonable. LPG medicines in the public sector were priced at 0.98 times their IRP. While, private sector patient prices were, on average, 237.8% higher than public LPG equivalents. LPG medicines in the private sector were priced at 2.3 times their IRP, while HPMs were priced at around 4 times the IRP. The highest priced premium in the private sector is 170.8%, showing that patients are paying substantially

more to purchase highest priced products as compared to lowest priced generics. These warrants' introduction and enforcement of polices on price markups of EMs in the private sector.

Medicines were not found to be priced consistently with respect to the IRP. In the public sector, half of LPG medicines were priced between 0.6 and 1.5 times the IRP. In the private sector, half of LPG medicines were priced between 1.3 and 4.9 times the IRP, while half of HPMs were priced between 2.8 and 11.3 times the IRP. The result is similar with the study findings obtained in China by (Jiang *et al.*, 2013). These disparities suggest substantial variation in procurement efficiency and/or price markups between medicines.

Although it is hard to trace true affordability, results of this study implies that about 75% and 91% of LPGs used to treat the common diseases conditions were unaffordable in the public and private sectors respectively. This result is congruent with the findings obtained by Abrha et al (2018) in north Ethiopia and by Anson et al (2012) in Guatemala. From these findings it can be confirmed that majority of the population is unable to buy EMs for its sick child in the absence of community-based health insurance. This finding was inconsistent with study done on the availability, prices and affordability of EMs for children in China (Sun *et al.*, 2018). This might in part be explained by the fact that China is an upper middle-income country (World Bank, 2022).

It should be noted that, treatment costs refer to medicines only and do not include the additional costs of travel, consultation and diagnostic tests. Further, many people in Ethiopia earn less that the lowest government wage and as such even treatments which appear affordable are too costly for the poorest segments of the population (UNDP, 2023). Finally, even where individual treatments appear affordable, parents of children's who need multiple medications may quickly face unmanageable medicine costs.

8. LIMITATIONS OF THE STUDY

Being point availability cross sectional study, it cannot reflect average availability over time and cause effect relationship, rather correlation. Furthermore, there are some important medicines that are not included in the list of EMs selected for the study and also it does not dig out the reasons for low availability because of time and logistical constraints. Despite these limitations the findings provide important clues on the status of availability and affordability of EMs for under-5 children and the need for future research.

9. CONCLUSION AND RECOMMENDATIONS

9.1. Conclusion

This study was conducted to assess availability, affordability and prices of EMs for under-5 children using a cross sectional study design in public and private health facilities of North West Ethiopia. Considering the limitations of the study and the need for future comprehensive studies using longitudinal design and qualitative approach, the results direct that the overall average availability of the surveyed EMs for children to be insufficient in both public and private sectors at the time of the study. Most medicines were sold at prices higher than their IRPs in the private sectors and majority of the selected EMs that are crucial in treating prevalent disease conditions in under-5 children were found to be unaffordable in both public and private sectors. This may imply unsatisfactory health care and supply system leading to prolonged illness and suffering, poor quality of life, disabilities, preventable death and unnecessary health and financial expenses.

9.2. Recommendations

The results of this study suggest that a mix of actions need to be implemented to make medicines more affordable and available. Although further investigation is required to obtain a more in-depth understanding of the causes and consequences of medicine pricing, affordability and availability, the results of this study provide baseline information for future research and action. It is therefore, recommended that the following paces be taken to improve medicine prices, availability and affordability.

Managerial strategies such as development of national EMs list for under-5 children and based on NEML timely and accurate forecast and supply-planning activities for under-5 children EMs and strengthening local manufacturing plants to produce medicines for children should be in place.

Regulatory strategies such as monitoring the rational utilization and price mark ups of the essential medicines for und-5 children, financial strategies such as strengthening the current community-based health insurance (CBHI) scheme and starting social health insurance, and educational strategies to promote rational use of these EMs should be emphasized.

References

Abrha, S. *et al.* (2018) 'Availability and affordability of priority life-saving medicines for under-five children in health facilities of Tigray region, northern Ethiopia', *BMC Pregnancy and Childbirth*, 18(1), pp. 1–9. Available at: https://doi.org/10.1186/s12884-018-2109-2.

Adebisi, Y.A. *et al.* (2022) 'Revisiting the issue of access to medicines in Africa : Challenges and recommendations', (May), pp. 1–13. Available at: https://doi.org/10.1002/puh2.9.

Alefan, Q., Amairi, R. and Tawalbeh, S. (2018) 'Availability, prices and affordability of selected essential medicines in Jordan: A national survey 16 Studies in Human Society 1605 Policy and Administration 14 Economics 1402 Applied Economics', *BMC Health Services Research*, 18(1), pp. 1–12. Available at: https://doi.org/10.1186/s12913-018-3593-9.

Ali, E.E. (2014) 'Health care financing in Ethiopia: Implications on access to essential medicines', *Value in Health Regional Issues*, 4(1), pp. 37–40. Available at: https://doi.org/10.1016/j.vhri.2014.06.005.

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. Available at: https://doi.org/10.1186/1744-8603-8-22.

Balasubramaniam, R., Beneragama, B. V. and Sri Ranganathan, S. (2011) 'A national survey of availability of key essential medicines for children in Sri Lanka.', *The Ceylon medical journal*, 56(3), pp. 101–107. Available at: https://doi.org/10.4038/cmj.v56i3.3597.

Bassoum, O. *et al.* (2020) 'Availability , Management and Use of Priority Life-Saving Medicines for Under-Five Children in Two Health Districts in Senegal : A Cross-Sectional Study', pp. 204–218. Available at: https://doi.org/10.4236/health.2020.122017.

Bazargani, Y.T. *et al.* (2014) 'Essential Medicines Are More Available than Other Medicines around the Globe', 9(2), pp. 1–7. Available at: https://doi.org/10.1371/journal.pone.0087576.

Brief, R. (2022) 'Amhara', *Mortality rate for under five children* [Preprint], (April).

Debie, A., Khatri, R.B. and Assefa, Y. (2022) 'Contributions and challenges of healthcare financing towards universal health coverage in Ethiopia: a narrative evidence synthesis', *BMC*

Health Services Research, 22(1), pp. 1–16. Available at: https://doi.org/10.1186/s12913-022-08151-7.

EPHI (2019) 'Ethiopia', *Mini Ethiopian demogrphic and health survey* [Preprint].

EPSA (2019) 'Standard Operating Procedures (SOP) Manual for the Integrated Pharmaceuticals Logistics System in Health Facilities of Ethiopia,2nd Edition', *Standard Operating Procedure Manual for the Integrated Pharmaceutical Sysytem in Health Facilities of Ethiopia*, pp. 1–124.

EPSA (2020) 'The Federal Democratic Republic Of Ethiopia Ethiopian Pharmaceutical Pharmaceuticals Supply Transformation Final Report', (Pstp Ii).

Hailemichael, Y. *et al.* (2019) 'Catastrophic health expenditure and impoverishment in households of persons with depression: A cross-sectional, comparative study in rural Ethiopia', *BMC Public Health*, 19(1), pp. 1–13. Available at: https://doi.org/10.1186/s12889-019-7239-6.

Hill, S., Yang, A. and Bero, L. (2012) 'Priority medicines for maternal and child health: A global survey of national essential medicines lists', *PLoS ONE*, 7(5), pp. 3–8. Available at: https://doi.org/10.1371/journal.pone.0038055.

Hoppu, K. and Sri Ranganathan, S. (2015) 'Essential medicines for children', *Archives of Disease in Childhood*, 100(December), pp. S38–S42. Available at: https://doi.org/10.1136/archdischild-2013-305705.

Jiang, M. *et al.* (2013) 'Measuring Access to Medicines: A Survey of Prices, Availability and Affordability in Shaanxi Province of China', *PLoS ONE*, 8(8), pp. 1–8. Available at: https://doi.org/10.1371/journal.pone.0070836.

Kanmiki, E.W. *et al.* (2014) 'Socio-economic and demographic determinants of under-five mortality in rural northern Ghana', *BMC International Health and Human Rights*, 14(1), pp. 1–10. Available at: https://doi.org/10.1186/1472-698X-14-24.

Laing, R. *et al.* (2003) '25 years of the WHO essential medicines lists : progress and challenges', 361, pp. 1723–1729.

Liknaw, B. and Shimels, T. (2020) 'Challenges Facing Global Pharmaceuticals Supply Chain Management: The Case of Zaf Pharmaceuticals Private Limited Company, Addis Ababa,

Ethiopia', 9, pp. 8–19.

Marew, T. *et al.* (2022) 'Trends and Challenges in Access to Essential Medicines in Ethiopia and the Contributions of Local Pharmaceutical Production', *Ethiopian journal of health sciences*, 32(5), pp. 1027–1042. Available at: https://doi.org/10.4314/ejhs.v32i5.18.

Mekonnen, B.D., Ayalew, M.Z. and Tegegn, A.A. (2021) 'Rational drug use evaluation based on world health organization core drug use indicators in ethiopia: A systematic review', *Drug, Healthcare and Patient Safety*, 13, pp. 159–170. Available at: https://doi.org/10.2147/DHPS.S311926.

MOH (2015) 'Ethiopian Health Sector Transformation Plan.2015/16 - 2019/20', *Federal Democratic Republic of Ethiopia Ministry of Health*, 20(May), p. 50.

MOH (2021) 'Health Sector Transformation Plan II 2020/2021-2024/2025', *Ethiopian Ministry of Health*, 25(February), pp. 1–128.

MSH (2016) 'International Medical Products Price Guide', *Management Sciences for Health*, p. 443. Available at: https://www.msh.org/sites/default/files/msh-2015-international-medical-products-price-guide.pdf.

do Nascimento, R.C.R.M. *et al.* (2017) 'Availability of essential medicines in primary health care of the Brazilian Unified Health System', *Revista de Saude Publica*, 51, pp. 1s-11s. Available at: https://doi.org/10.11606/S1518-8787.2017051007062.

Niëns, L.M. and Brouwer, W.B.F. (2013) 'Measuring the affordability of medicines: Importance and challenges', *Health Policy*, 112(1–2), pp. 45–52. Available at: https://doi.org/10.1016/j.healthpol.2013.05.018.

Nsabagasani, X. *et al.* (2015) 'Availability and utilization of the WHO recommended priority lifesaving medicines for under five-year old children in public health facilities in Uganda: a cross-sectional survey', *Journal of Pharmaceutical Policy and Practice*, 8(1), pp. 1–7. Available at: https://doi.org/10.1186/s40545-015-0038-2.

Of, O., Policy, D. and Findings, K.E.Y. (2022) 'ISSUE BRIEF Trends in Prescription Drug Spending , 2016-2021', (September), pp. 2016–2021.

Orubu, E.S.F. *et al.* (2019) ‘Access to essential cardiovascular medicines for children: A pilot study of availability, price and affordability in Nigeria’, *Health Policy and Planning*, 34, pp. III20–III26. Available at: https://doi.org/10.1093/heapol/czz057.

Ozawa, S. *et al.* (2019) ‘Access to medicines through health systems in low-and middle-income countries’, *Health Policy and Planning*, 34, pp. III1–III3. Available at: https://doi.org/10.1093/heapol/czz119.

Population census commision, E. (2008) *EDHS, 2007*. Addis Ababa.

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. Available at: https://doi.org/10.2471/BLT.08.053645.

Rosenberg, D. and Miles, K. (2022) ‘Average weight and growth chart for babies , toddlers , and kids’.

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. Available at: https://doi.org/10.1186/s12887-016-0572-3.

Shafiq, Y., Shaikh, B.T. and Kumar, R. (2011) ‘Availability and affordability of essential medicines: exploring the health seeking behaviours and health service utilisation for children under-5 years living in squatter settlement of Karachi, Pakistan.’, *Journal of Ayub Medical College, Abbottabad : JAMC*, 23(1), pp. 132–138.

Sun, X. *et al.* (2018) ‘Availability, prices and affordability of essential medicines for children: A cross-sectional survey in Jiangsu Province, China’, *BMJ Open*, 8(10), pp. 1–12. Available at: https://doi.org/10.1136/bmjopen-2018-023646.

Tadesse, T. and Abuye, H. (2021) ‘Availability and affordability of children essential medicines in health facilities of southern nations , nationalities , and people region , Ethiopia : key determinants for access’, pp. 1–12.

Tessema, G.A. *et al.* (2023) ‘PLOS GLOBAL PUBLIC HEALTH National and subnational burden of under-5 , infant , and neonatal mortality in Ethiopia , 1990 – 2019 : Findings from the Global Burden of Disease Study 2019’, 4, pp. 1–18. Available at:

https://doi.org/10.1371/journal.pgph.0001471.

UNDP (2023) ‘Multidimensional Poverty Index 2023 Unstacking global poverty : Ethiopia’, pp. 1–2.

UNDP (no date) *Sustainable Development Goals | UNDP*. Available at: https://www.undp.org/content/undp/en/home/sustainable-development-goals.html (Accessed: 28 October 2020).

UNICEF (no date) *Childhood diseases | UNICEF*. Available at: https://www.unicef.org/health/childhood-diseases (Accessed: 6 December 2020).

Wang, H. *et al.* (2017) ‘Global, regional, and national under-5 mortality, adult mortality, age-specific mortality, and life expectancy, 1970-2016: A systematic analysis for the Global Burden of Disease Study 2016’, *The Lancet*, 390(10100), pp. 1084–1150. Available at: https://doi.org/10.1016/S0140-6736(17)31833-0.

Wang, X. *et al.* (2014) ‘Access to paediatric essential medicines: A survey of prices, availability, affordability and price components in Shaanxi Province, China’, *PLoS ONE*, 9(3). Available at: https://doi.org/10.1371/journal.pone.0090365.

WHO/HAI (2008) ‘Measuring medicine prices, availability, affordability and price components, second edition’.

WHO (2004) ‘the World Medicines’. Available at: http://apps.who.int/medicinedocs/es/d/Js6160e/.

WHO (2014) ‘Chart Booklet: Integrated Management of Childhood Illness’, *Integrated Management of Childhood Illness* [Preprint], (March).

WHO (2017) ‘Primary Health care systems case study from Ethiopia’, (August).

WHO (2018) ‘Standards for improving the quality of care for children and young adolescents in health facilities’, *World Health Organisation* [Preprint], (file:///C:/Users/grace/Documents/DATA/1/EMERGENCY READNESS/TDHS 2022[1].pdf). Available at: https://apps.who.int/iris/bitstream/handle/10665/272346/9789241565554-eng.pdf?ua=1.

WHO (2021a) '© World Health Organization 2021', *Model list of essential medicines for children 8th edition*, p. 48.

WHO (2021b) 'Improving access to essential medicines'. Available at: https://www.who.int/westernpacific/activities/improving-access-to-essential-medicines (Accessed: 29 October 2020).

WHO (2023) © *World Health Organization 2023, World Health Organization model list of essential mediciners for children*.

WHO (no date a) *WHO | Essential medicines*. Available at: https://www.who.int/topics/essential_medicines/en/ (Accessed: 26 October 2020).

WHO (no date b) *WHO | Under-five mortality*. Available at: https://www.who.int/gho/child_health/mortality/mortality_under_five_text/en/ (Accessed: 5 September 2020).

Wirtz, V.J. *et al.* (1985) 'Essential medicines for universal health coverage'. Available at: https://doi.org/10.1016/S0140-6736(16)31599-9.

World Bank (2022) *The world bank in China - Facts and figures*.

World Bank (no date) *Mortality rate, under-5 (per 1,000 live births) - Ethiopia | Data*. Available at: https://data.worldbank.org/indicator/SH.DYN.MORT?locations=ET (Accessed: 5 September 2020).

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.

Yenet, A., Nibret, G. and Tegegne, B.A. (2023) 'Challenges to the Availability and Affordability of Essential Medicines in African Countries: A Scoping Review', *ClinicoEconomics and Outcomes Research*, 15(June), pp. 443–458. Available at: https://doi.org/10.2147/CEOR.S413546.

Annex-1: Consent form and questionnaire

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Health Supply Chain Management Program

A questionnaire to assess the availability and prices of essential medicines for under-5 children.

My name is Berihun Sisay. This is a questionnaire to collect data on availability and prices of essential medicines for under 5 children in public and private health facilities. The survey follows methods promoted by the World Health Organization and Health Action International. The objective of the survey is to generate reliable information on the price, availability and affordability of selected essential medicines and price components for under-5 in the supply chain, with the ultimate goal of improving access to affordable medicines for all. I am sure that this study will help in improving childhood health by helping professionals in availing essential medicines in uninterrupted manner. The results will be publicly available by September 2023, and that complete anonymity of individual pharmacies, medicine outlets and individual respondents will be strictly assured. I would be grateful if you would provide full access to the information needed for this survey.

Thank you for your information

Back ground information

Name of medicine outlets and its,level_____ _____	Contact details _____	Sector _____	Type of price _____	Buck up outlet name and contact details_____
Date_____	Servey Area no. _____	Medicine outlet ID_____		
Type of data	A) Sample outlet	B) Backup outlet	C) Validation visit	

Questions	Responses	Explanations
1. Dispensing Practice		
1.1. Are there legal provisions for the following		Licensing is a system that subjects all persons to evaluation against a set of requirements before they may be authorized to prescribe medicines/practice pharmacy
1.1. 1. Licensing and practice of prescribers	A) Yes B) No C) NK	
1.1.2. Licensing and practice of Pharmacy	A) Yes B) No C) NK	
1.2. Is prescribing by generic obligatory in the sector	A) Yes B) No C) NK	A generic name (international non-proprietary name (INN) is a non-proprietary or approved name rather than a proprietary or brand name under which a generic medicine is marketed
1.3. Is generic substitution permitted at the sector	A) Yes B) No C) NK	Generic substitution is the practice of substituting a product, whether marketed under a trade name or generic name, by an equivalent product, usually a cheaper one, containing the same active ingredient at the dispensing level.
1.4. Are there incentives to dispense generics	A) Yes B) No C) NK	Incentives may include dispensing fees or mark ups which provide financial incentive for dispensers to dispense lower-priced generic medicines
2. Promotion and advertising		

2.1. Are there provisions in the medicine's legislation/ regulations covering promotion and or advertising of medicines	A) Yes B) No C) NK	Promotion and advertisement are activities that provide health workers and consumers with information about medicine products, particularly with the intent of encouraging health workers and consumers to use a particular product.
3. Medicines Supply System		
3.1. Is public sector procurement pooled at national level (there is a centralized body for procuring medicines for regions/districts)	A) Yes B) No C) NK	Medicines are procured for the entire public sector by a national procurement body.
3.2. Who is responsible for public sector medicines procurement		
3.2.1. EPSA	A) Yes B) No C) NK	
3.2.2. NGO	A) Yes B) No C) NK	Mark "yes" if government funds or foreign contributions are allocated to NGOs to procure or distribute medicines for the public sector.
3.3. What type of tender process is used for public procurement		
3.3.1. Open/competitive	A) Yes B) No C) NK	
3.3.2. Restricted	A) Yes B) No C) NK	
3.3.3. Direct	A) Yes B) No C) NK	
3.4. Is public sector procurement limited to medicines on the essential medicine list (EML)	A) Yes B) No C) NK	Essential medicines are those that satisfy the priority health care needs of the population.
4. Medicines Pricing		
4.1. Is there a national policy to provide at least some medicines free of charge	A) Yes B) No C) NK	If there is no consistent national policy that applies to all primary public health facilities, mark "no" here.
4.2. Which of the following types of patients receive medicines for free		
A) Patients who cannot afford them	A) Yes B) No C) NK	
B) Children under 5 of age	A) Yes B) No C) NK	
C) Older children	B) Yes B) No C) NK	
D) Pregnant women	C) Yes B) No C) NK	
E) Elders persons	D) Yes B) No C) NK	

4.3. which fees are commonly charged in public primary care facilities		
A. Registration/consultation fees	A) Yes B) No C) NK	Registration and consultation fees are fees patients must pay for seeing a health professional for a health check-up and/or diagnosis regardless of whether or not medicines are prescribed.
B. Dispensing fees	A) Yes B) No C) NK	A dispensing fee is a fixed fee that pharmacies are allowed to charge per prescribed item or per prescription instead of or in addition to a percentage mark-up
C. Flat fees for medicines	A) Yes B) No C) NK	A flat fee for medicines is a fee which remains the same irrespective of the number of medicines or the quantity of each medicine dispensed
4.4. What proportion of the population has health insurance in your sector?	A) All B) Some C) None D) NK	Health insurance is any prepayment scheme for health care costs additional to but excluding insurance subsidies funded through the health ministry budget.
4.5. How much of the medicines are covered by health insurance	A) All B) Some C) None D) NK	
4.6. is there a national medicine price monitoring system for patient prices in place?	A) Yes B) No C) NK	A national medicine prices monitoring system monitoring system is any means of regularly tracking and comparing over time retail/patient medicine prices in the public, private and/or NGO sectors.
5. Rational Use of medicines		
5.1. Is there a national essential medicine list for children	A) Yes B) No C) Don't Know	
5.2. If yes, when was the national EML last updated	Year----------	
5.3. Do you think that essential medicines availability and affordability for under-5 children is good?	A) Yes B) No C) Don't Know	Good availability is the stock of >= 80% of essential medicines for under 5. Affordabity, is the ability to buy full dose of a medicine with one-day payment.

Medicines Availability and Price Data Collection Form

	A	B	C	D	E	F	G	H	I	J
	The generic name, strength, and dosage form	Medicine type	HPM	Supplier	Availability Yes/NO	Recommended pack size	Pack size found	Price of the pack found	Unit price (4 digits)	Comments
1	Amoxicillin 125mg/ml suspension	HP	Amoxil			100ml			_____/ml	
		LPG				100ml			_____/ml	
2	Amoxicillin 250mg/ml suspension	HP	Amoxil			100ml			_____/ml	Birr
		LPG				100ml			_____/ml	
3	Amoxicillin + Clavulanic Acid 125 mg + 31.25 mg/5 ml Suspension	HP	Augmentin			100ml			_____/tab	
		LPG				100ml			_____/ml	
4	Amoxicillin + Clavulanic Acid 250 mg + 62.5 mg/5 ml Suspension	HP	Augmentin			100ml			_____/ml	
		LPG				100ml			_____/ml	
5	Ampicillin 500 mg powder for injection	HP	Principen			10ml			_____/ml	Birr
		LPG				10ml			_____/ml	
6	Artemether + Lumefantrine 120mg+20mg tablet	HP	Coartem			12x30			_____/tab	Birr
		LPG				12x30			_____/tab	
7	Artemether + Lumefantrine 120mg+20mg tablet	HP	Coartem			6x30			_____/tab	Birr
		LPG				6x30			_____/tab	
8	Artesunate 60 mg Vial	LPG				6ml			_____/ml	Birr
		LPG				6ml			_____/ml	
9	Ceftriaxone 250mg Vial	HP	Rocephin			0.9ml			_____/ml	
		LPG				0.9ml			_____/ml	

10	Ceftriaxone 1g Vial	HP				3.6ml			_____/ml	
		LPG				3.6ml			_____/ml	
11	Chloramphenicol 1 gm Vial	HP				1ml			_____/ml	
		LPG				1ml			_____/ml	
12	Chlorpheniramine maleate 2mg/5ml syrup	HP				100ml			_____/ml	
		LPG				100ml			_____/ml	
13	Ciprofloxacin 250 mg tab	HP				10*10			_____/tab	
		LPG				10*10			_____/tab	
14	Diazepam 5 mg/ml Ampoule injection	HP	Valli um			10			_____/tab	
		LPG				10			_____/tab	
15	Erythromycin 200mg/5ml oral suspension	HP				100ml			_____/ml	
		LPG				100ml			_____/ml	
16	Gentamicin 10 mg/ml Ampoule injection	HP				10			_____/ml	
		LPG				10			_____/ml	
17	Ibuprofen 100 mg/5 ml Suspension	HP	Motr in			100ml			_____/ml	
		LPG				100ml			_____/ml	
18	Mebendazole 100mg/5ml syrup	HP				100ml			_____/ml	
		LPG				100ml			_____/ml	
19	Metronidazole 125mg/5ml oral suspension	HP				100ml			_____/ml	
		LPG				100ml			_____/ml	
20	Morphine Sulfate - 20mg/5ml – Syrup	HP	Avin za			100ml			_____/ml	
		LPG				100ml			_____/ml	
21	Oral rehydration salt (ORS)	HP				Sachet			_____/sach	
		LPG				Sachet			_____/sach	
22		HP				60ml			_____/ml	

	Paracetamol 120mg/5 ml syrup	LPG				60ml			_____/ml	
23	Paracetamol 125mg supository	HP				100ml			_____/ml	
		LPG				100ml			_____/ml	
24	Promethazine HCL 5mg/5ml elixir	HP	Phen adoz			100ml			_____/ml	
		LPG				100ml			_____/ml	
25	Salbutamol 2mg/5ml syrup	HP				100ml			_____/ml	
		LPG				100ml			_____/ml	
26	Salbutamol 100 mcg/dose Inhaler	HP				200dose			__/dose	
		LPG				200dose			__/dose	
27	Sodium chloride (normal saline) 0.009 Iv with giving set	HP				1000ml			_____/ml	
		LPG				1000ml			_____/ml	
28	Vitamin A 50,000 units Capsule	HP	Aqu asol A						_____/cap	
		LPG							_____/cap	
29	Zinc Phosphate 20 mg Dispersible tab	HP				10x10			_____/tab	
		LPG				10x10			_____/tab	
30	Oxygen medical gas	HP				Each			___/Syilinder	
		LPG				Each			___/Syilinder	
	Supplementary medicines									
1	Adrenaline (Epinephrine) - 0.1% in 1ml Ampoule - Injection	HP				10			_____/ml	
		LPG				10			_____/ml	
2		HP				10x10			_____/tab	

	Amoxicillin 125mg dispersible tablet	LPG				10x10			_____/tab	
3	Amoxicillin 250mg dispersible tablet	HP				10x10			_____/tab	
		LPG				10x10			_____/tab	
4	Cephalexin 125mg/5ml syrup	HP				100ml				
		LPG				100ml				
5	Chloroquine Phosphate 50mg base/5ml syrup	HP				60ml			_____/ml	
		LPG				60ml			_____/ml	
6	Cloxacillin 250mg/ml suspension	HP				100ml			_____/ml	
		LPG				100ml			_____/ml	
7	Ciprofloxacin 0.03 Ear drop	HP				5ml			_____/ml	
		LPG				5ml			_____/ml	
8	Dextrose 40% infusion	HP				1000ml			_____/ml	
		LPG				1000ml			_____/ml	
9	Diclofenac sodium 25mg/ml in 3ml ampoule injection	HP				10			_____/ml	
		LPG				10			_____/ml	
10	ET tube size 2.5,3 and 3.5 and 4	HP							_____/each	
		LPG							_____/each	
11	Ferrous sulphate 20mg/ml susp.	HP				1ml			_____/ml	
		LPG				1ml			_____/ml	
12	Loratadine 5mg/5ml Syrup	HP				100ml			_____/ml	
		LPG				100ml			_____/ml	
13	Miconazole 2% cream	HP				30g			_____/gm	
		LPG				30g			_____/gm	

14	Morphine 10mg in 1ml injection	HP				1ml			_____/ml	
		LPG				1ml			_____/ml	
15	Permethrin 5% cream	HP				30gm			_____/gm	
		LPG				30gm			_____/gm	
16	Phenobarbitone 30 mg tab	HP				1000			_____/tab	
		LPG				1000			_____/tab	
17	Phytomenadione (Vitamin K) ,10mg/ml in 1ml ampoule Injection	HP				3			_____/ml	
		LPG				3			_____/ml	
18	Sodium Valporate 250mg/5ml susp.	HP				5ml			_____/ml	
		LPG				5ml			_____/ml	
19	Tetracycline 1% eye ointment	HP				5gram			_____/gm	
		LPG				5gram			_____/gm	
20	Zink ORS copack 2 sachets ORS 20.5mg/ml to 10 zink 20mg dispersable tablets	HP				Pack			_____/Pack	
		LPG				Pack			_____/Pack	

Anex-2: Ethical approval letter

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Addis Ababa University

School of Pharmacy
Ethical Review Committee

ቀን Date: November 05, 2021

ቁጥር Ref. No.: ERB/SOP/371/13/2021

To: Berihun Sisay
School of Pharmacy

Re: Ethical Clearance

It is to be recalled that you submitted a research proposal entitled "**Assessment of Access to Essential Medicines for Under Five Children in Northwestern Ethiopia**". The committee thoroughly reviewed the proposal based on its operational guidelines and found that it fulfills all the ethical requirements stipulated in the guidelines. This is, therefore, to inform you that the proposal is ethically approved for implementation.

With best regards,

Shemsu Umer (PhD)
Chairperson, ERC
School of Pharmacy
College of Health Sciences
Addis Ababa University

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Annex-3. IRPs

	IRP Price increments per year in US Dollars									
s/no	List of Medicine	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	Adrenaline (Epinephrine) - 0.1% in 1ml Ampoule - Injection	0.1713	0.1723	0.1733	0.1743	0.1753	0.1763	0.1773	0.1784	0.1887
2	Amoxicillin + Clavulanic Acid 125 mg + 31.25 mg/5 ml Suspension	0.0203	0.0204	0.0205	0.0206	0.0207	0.0208	0.0209	0.0210	0.0211
3	Amoxicillin + Clavulanic Acid 250 mg + 62.5 mg/5 ml Suspension	0.0521	0.0524	0.0527	0.0530	0.0533	0.0536	0.0539	0.0543	0.0546
4	Amoxicillin 125mg dispersible tablet	0.0203	0.0204	0.0205	0.0207	0.0208	0.0209	0.0210	0.0211	0.0224
5	Amoxicillin 125mg/5ml suspension	0.0048	0.0048	0.0049	0.0049	0.0049	0.0049	0.0050	0.0050	0.0050
6	Amoxicillin 250mg dispersible tablet	0.0315	0.0317	0.0319	0.0321	0.0322	0.0324	0.0326	0.0328	0.0347
7	Amoxicillin 250mg/5ml suspension	0.0070	0.0070	0.0071	0.0071	0.0072	0.0072	0.0072	0.0073	0.0073
8	Ampicillin 500 mg powder for injection	0.1690	0.1700	0.1710	0.1720	0.1730	0.1740	0.1750	0.1760	0.1770
9	Artemether + Lumefantrine 120mg+20mg tablet		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	Artemether + Lumefantrine 120mg+20mg tablet	0.0851	0.0856	0.0861	0.0866	0.0871	0.0876	0.0881	0.0886	0.0891
11	Artesunate 60 mg Vial injection	1.9100	1.9211	1.9322	1.9434	1.9547	1.9660	1.9774	1.9889	2.0004
12	Ceftriaxone 1g Vial injection	0.0398	0.0400	0.0403	0.0405	0.0407	0.0410	0.0412	0.0414	0.0417
13	Ceftriaxone 250mg Vial	0.3538	0.3559	0.3579	0.3600	0.3621	0.3642	0.3663	0.3684	0.3706
14	Cephalexin 125mg/5ml syrup	0.0094	0.0095	0.0095	0.0096	0.0096	0.0097	0.0097	0.0098	0.0104
15	Chloramphenicol 1 gm Vial	0.4661	0.4688	0.4715	0.4743	0.4770	0.4798	0.4826	0.4854	0.4882
16	Chloroquine Phosphate 50mg base/5ml syrup	0.0115	0.0116	0.0116	0.0117	0.0118	0.0118	0.0119	0.0120	0.0127
17	Chlorpheniramine maleate2mg/5ml syrup	0.0044	0.0044	0.0045	0.0045	0.0045	0.0045	0.0046	0.0046	0.0046
18	Ciprofloxacilillin 0.3% ear drop	0.072	0.0724	0.0728	0.0733	0.0737	0.0741	0.0745	0.0750	0.0793

19	Ciprofloxacillin 250 mg tab	0.0260	0.0262	0.0263	0.0265	0.0266	0.0268	0.0269	0.0271	0.0272
20	Cloxacillin 250mg/ml suspension	0.0097	0.0098	0.0098	0.0099	0.0099	0.0100	0.0100	0.0101	0.0107
21	Dextrose 40% infusion	0.0146	0.0147	0.0148	0.0149	0.0149	0.0150	0.0151	0.0152	0.0161
22	Diazepam 5 mg/ml Ampoule injection	0.0581	0.0584	0.0588	0.0591	0.0595	0.0598	0.0602	0.0605	0.0609
23	Diclofenac sodium 25mg/ml in 3ml ampoule injection	0.0283	0.0285	0.0286	0.0288	0.0290	0.0291	0.0293	0.0295	0.0312
24	Erythromycin 200mg/5ml oral suspension	0.0782	0.0787	0.0791	0.0796	0.0800	0.0805	0.0810	0.0814	0.0819
25	ET tube size 2.5,3 and 3.5 and 4		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	Ferrous sulphate oral liquid	0.003	0.0030	0.0030	0.0031	0.0031	0.0031	0.0031	0.0031	0.0033
27	Gentamicin 10 mg/ ml Ampoule injection	0.0880	0.0885	0.0890	0.0895	0.0901	0.0906	0.0911	0.0916	0.0922
28	Ibuprofen 100 mg/5 ml Suspension	0.0056	0.0056	0.0057	0.0057	0.0057	0.0058	0.0058	0.0058	0.0059
29	Loratadine 5mg/5ml Syrup	0.0065	0.0065	0.0066	0.0066	0.0067	0.0067	0.0067	0.0068	0.0072
30	Mebendazole 100mg/5ml syrup	0.0068	0.0068	0.0069	0.0069	0.0070	0.0070	0.0070	0.0071	0.0071
31	Metronidazole 125mg/5ml oral suspension	0.0103	0.0104	0.0104	0.0105	0.0105	0.0106	0.0107	0.0107	0.0108
32	Miconazole 2% cream	0.0114	0.0115	0.0115	0.0116	0.0117	0.0117	0.0118	0.0119	0.0126
33	Morphine 10mg in 1ml injection	0.5315	0.5346	0.5377	0.5408	0.5439	0.5471	0.5503	0.5535	0.5856
34	Morphine Sulfate - 20mg/5ml – Syrup	0.0184	0.0185	0.0186	0.0187	0.0188	0.0189	0.0190	0.0192	0.0193
35	Oral rehydration salt (ORS)	0.0561	0.0564	0.0568	0.0571	0.0574	0.0577	0.0581	0.0584	0.0588
36	Oxygen gas	5.2941	5.3248	5.3557	5.3868	5.4180	5.4494	5.4810	5.5128	5.5448
37	Paracetamol 120mg/5 ml syrup	0.0064	0.0064	0.0065	0.0065	0.0065	0.0066	0.0066	0.0067	0.0067
38	Paracetamol 125m supository	0.1450	0.1458	0.1467	0.1475	0.1484	0.1493	0.1501	0.1510	0.1519
39	Permethrin 5% cream	0.0344	0.0346	0.0348	0.0350	0.0352	0.0354	0.0356	0.0358	0.0379
40	Phenobarbitone 30 mg tab	0.0075	0.0075	0.0076	0.0076	0.0077	0.0077	0.0078	0.0078	0.0083
41	Phytomenadione (Vitamin K) ,10mg/ml in 1ml ampoule Injection	0.4545	0.4571	0.4598	0.4625	0.4651	0.4678	0.4705	0.4733	0.5007

42	Promethazine HCL 5mg/5ml elixir	0.0084	0.0084	0.0085	0.0085	0.0086	0.0086	0.0087	0.0087	0.0088
43	Salbutamol 100 mcg/dose Inhaler	0.0058	0.0058	0.0059	0.0059	0.0059	0.0060	0.0060	0.0060	0.0061
44	Salbutamol 2mg/5ml syrup	0.0060	0.0060	0.0061	0.0061	0.0061	0.0062	0.0062	0.0062	0.0063
45	Sodium chloride (normal saline) 0.009 Iv with giving set	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0012
46	Sodium Valporate syrup	0.0394	0.0396	0.0399	0.0401	0.0403	0.0406	0.0408	0.0410	0.0434
47	Tetracycline 1% eye ointment	0.0457	0.0460	0.0462	0.0465	0.0468	0.0470	0.0473	0.0476	0.0503
48	Vitamin A 50,000 units Capsule	0.0188	0.0189	0.0190	0.0191	0.0192	0.0194	0.0195	0.0196	0.0197
49	Zinc Phosphate 20 mg Dispersible tab	0.0184	0.0185	0.0186	0.0187	0.0188	0.0189	0.0190	0.0192	0.0193
50	Zink ORS copack 2 sachets ORS 20.5mg/ml to 10 zink 20mg dispersable tablets	0.2900	0.2917	0.2934	0.2951	0.2968	0.2985	0.3002	0.3020	0.3195