Availability and Utilization of the WHO-Recommended Lifesaving Medicines for Under-Five Children at University of Gondar Comprehensive Specialized Hospital, Amhara Region, Ethiopia

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Abstract
According to the World Health Organization report, 5.4 million under-five children died, which is similar to under-five mortality rate of 39 deaths per 1000 live births. This rate is higher in sub-Saharan Africa with 76 deaths per 1000 live births. More than 1 out of every 2 deaths is because of diseases that can be managed with drug of low-cost and high quality. Institutional-based cross-sectional survey was conducted from January to February 2021, at the University of Gondar Comprehensive Specialized Hospital. Statistical Package for the Social Sciences software version 24 was used for data analysis. The results were presented using Figures, tables, and texts according to the nature of the data. The overall average availability of priority medicines was 75% on the day of visit and the average stock-out duration in the last 6 months was 23.85 days. Availability and utilization of priority medicines for the management of antiretroviral infections, Vitamin A deficiency, malaria, and diarrheal cases were high, whereas availability and utilization of suggested medication for neonatal sepsis were very low. A significant proportion of priority diseases was managed by non-priority medications. Medicines supply sources of the country, ministry of health, policymakers as well as facility managers should work in collaboration toward ensuring sustainable and consistent availability of priority medicines through the country. Continues in-service training of healthcare professionals is also mandatory to update themselves with newly developed guidelines, standards, and recommendations.

Keywords
availabilities, utilization, lifesaving medicines, Gondar, Ethiopia

What do we already know about this topic?
The topic was conducted in different parts of the world, and there was significant variation in the availability and utilization of priority medicines.
How does your research contribute to the field?
This research can identify gaps in the availability and utilization of medication at health facilities and gives insight for the policymakers to give special attention to medicines of children under 5.

What are your research’s implications toward theory, practice or Policy?
The implication of this research is, particularly toward practice and policy. This research found out poor availability and utilization of WHO Recommended priority medicines for children under 5. The policymakers should investigate the underlying cause of this practice and should tackled them accordingly.

Background
According to United Nations International Children’s Emergency Fund report, there is a significant improvement in child survival observed in the past few years globally. According to the World Health Organization report, 5.4 million under-five children died, which is similar to the under-five mortality rate of 39 deaths per 1000 live births. This rate is higher in sub-Saharan Africa with 76 deaths per 1000 live births. More than 1 out of every 2 deaths is because of diseases that can be managed with low-cost drugs and high quality. The main causes are preventable communicable diseases. Approximately 52% of these children died of diarrhea, malaria, and pneumonia. Under-five mortality rate is indirectly or directly correlated with malnutrition in 45% of the reported cases. Sub-Saharan Africa would still pay the highest price since it would concentrate more on half of the deaths.

The main factors of under-five child mortality are biological, demographic, and socioeconomic. Erogenity of child deaths is usually due to socioeconomic factors such as milk teeth extraction, eyebrow incision after birth, female genital mutilation, and uvula cutting. However, demographic factors affect both exogenous and endogenous deaths such as exogenous deaths which can be prevented by antibiotic treatment, immunization, and public health measures, and problems at birth which are difficult to prevent and control. Biological factors principally refer to the total number of children born and the mother’s fertility information which are concerned at the family level rather than children.

The availability of lifesaving medicines is highly governed by the components of the pharmaceutical logistics system such as distribution, procurement, quantification, and selection; failure in one part of the pharmaceutical management process fails in the entire pharmaceutical management process. The poor quality of care, unaffordable, and inaccessible are the critical factors for child morbidity, child mortality, and high burden of maternal in low-income countries. According to the United Nations commission report, utilization problems, and insufficient supplies of health commodities are the main issues facing developing countries. A study conducted in Uganda revealed that the utilization and availability of priority lifesaving medicines for malaria and pneumonia are low. Though, the priority medicines for sepsis and diarrhea were available and highly prescribed by the healthcare professionals. A similar study conducted in Ethiopia and Guatemala showed a lower availability of children’s essential medicine.

In spite of the availability of essential medicines for children under 5 at the global level, studies done in Chad, Uganda, and India revealed limited availability of medicines in public health facilities.

Most of the studies conducted previously focused on the evaluation of essential medicine availability for a general pediatric population. However, studies focusing on the availability and utilization of the WHO-recommended lifesaving priority medicines for under 5 children are limited. Therefore, the current study assesses the availability and utilization of the WHO-recommended lifesaving priority medicines for under-five children in the University of Gondar Comprehensive Specialized Hospital, Amhara region, Ethiopia.

Methods
Study Design and Setting
A cross-sectional survey was conducted from January to February 2021, at university of Gondar Comprehensive Specialized Hospital; Gondar town is located in North Gondar zone of Amhara regional state, which is located at 737 km far from the capital, Addis Ababa, and 180 km in the north direction of Bahir Dar (Capital of Amhara Region). North Gondar is one of the eleven zones in Amhara Regional State. Gondar town has a total population of 206,987, and out of these, 47.4% are males and 52.6% are females. Presently, Gondar town has one comprehensive specialized Hospital and 8 governmental Health Centers. University of Gondar Comprehensive Specialized Hospital is a teaching hospital, which serves more than 5 million people of the North Gondar zone and the people around the neighboring zones.

Source Population and Study Units
The source population of the study was University of Gondar Comprehensive Specialized Hospital, logistics documents, patient card, and medicines. The study units were WHO-recommended priority lifesaving medicines from University
of Gondar Comprehensive Specialized Hospital. The study observations include bin cards and patient cards.

Sample Size Determination and Sampling Procedures.

Regarding product selection, twenty WHO-recommended priorities lifesaving medicines for vitamin A deficiency, malaria, diarrhea, pain management, pneumonia, neonatal sepsis, and HIV/AIDS were considered. Selected medicines are shown in Table 1.

Table 1. Sampled WHO-Recommended lifesaving medicines at University of Gondar Comprehensive Specialized Hospital, Ethiopia, by 2021.

| S.N | Priority diseases of children under the age of five | WHO Recommended lifesaving medicines for children under the age of five |
|-----|-----------------------------------------------|---------------------------------------------------------------------|
| 1   | Diarrhea                                      | Oral rehydration salt packet                                        |
|     |                                               | Zinc phosphate 20 mg dispersible tablet                            |
| 2   | Pain                                          | Paracetamol 100 mg dispersible tablet                              |
|     |                                               | Morphine: Granules 10 mg, 20 mg                                     |
| 3   | Pneumonia                                     | Amoxicillin 250 mg dispersible tablet or 500 mg                    |
|     |                                               | Ampicillin 250 or 500 mg powder for injection                       |
|     |                                               | Gentamicin sulfate 40 mg/mL in 1 mL injection                       |
|     |                                               | Ceftriaxone powder 1 gm/50 mL or 2 gm/50 mL powder for injection    |
|     |                                               | Artemether/lumefantrine 20 mg/120 mg tablet                         |
| 4   | Malaria                                       | Artemether/lumefantrine 20 mg/120 mg tablet                         |
|     |                                               | Artesunate 110 mg/via injection                                     |
|     |                                               | Artesunate 100 mg rectal capsule                                   |
| 5   | Neonatal sepsis                               | Ceftriaxone: Powder for injection 250 mg and 1 g                  |
|     |                                               | Gentamicin: Injection 20 mg/mL                                      |
|     |                                               | Procaine benzylpenicillin: Powder for injection 1 g and 3 g         |
| 6   | Vitamin A deficiency                          | Vitamin A: 100 000 IU or 200 000 IU strength capsules               |
| 7   | Antiretroviral infection                      | AZT + 3TC + NVP 3TC30 mg + AZT60mg+NVP50 mg, dispersible tablet     |
|     |                                               | ABC + 3TC 3TC60 mg + 120 mgABC, scored and dispersible tablet       |
|     |                                               | AZT + 3TC 3TC30 mg + AZT60 mg, dispersible tablet                   |
|     |                                               | NVP oral syrup, 50 mg/5 mL (10 mg/mL)                              |
|     |                                               | 3TC 30 mg                                                           |
|     |                                               | LPV/r LPV100mg + Ritonavir 25 mg                                   |
|     |                                               | EVF 200 mg, scored tablet. Or 50 mg, tablet or capsule              |

where \( n \) is the sample size from the formula, \( Z_{\alpha/2} \) is the value of confidence, the level of 95% is 1.96, \( p \) is the proportion of patient cards (50%), and \( m \) is the margin of error (at 5% \( m = 0.05 \)).

Data Collection Procedures

Data regarding availability were collected using questionnaires and checklists adapted from the USAID deliver guideline,15 and previously published articles.12,16 the tools for assessing the utilization practices were developed by the investigators after reviewing related literature. The checklists had 2 parts; the first part contained questions regarding the availability of medicines on the day of the visit and in the last 6 months, the second part was designed to collect data on the utilization of lifesaving medicines.

Physical verification was conducted to determine availability on the day of the visit. Bin cards of the past 6 months were randomly picked and reviewed for each product to determine stock-outs. The sampled patient cards of 1 year were checked to determine the utilization practice.

Data were collected by 2 trained druggists under the supervision of principal investigators. Half-hour training was given to the data collectors regarding the data collection procedures and ethical issues.
Data Entry and Analysis

Statistical Package for the Social Sciences (SPSS) software version 24 was used for data analysis. The utilization was calculated as the percentage of individual medicines prescribed for specific diseases stipulated in the patient cards. The results were presented using Figures, tables, and texts according to the nature of the data.

Quality Control

Experienced data collectors were recruited and trained in data collection methods. The questionnaires were pretested for purposes of validation, suitability, clarity, and logical flow of the questions used in this study. Medicines were checked with the help of the pharmacist by physically verifying the medicines on the shelves and bin cards. Data were checked for accuracy and completeness prior to leaving the facility. The principal investigator carefully supervised the data collection process.

Results

Availability of Lifesaving Medicines for Under—Five-Year-Old Children

The finding of the current study revealed that the overall average availability of lifesaving medicines was 75% on the day of visit and the average stock-out duration in the last 6 months was 23.85 days.

ORS was available at all the time throughout the last 6 months, but zinc phosphate was stock out 18 days in the last 6 months. ART medications were the most available class of medication among all priority medications, whereas gentamicin injection and artesunate rectal both were the most stocked class of priority medicines as shown in Table 2.

Utilization for both oral rehydration salt and zinc phosphate for the management of diarrhea was 91.66%. Only 54 (14.06%) and 32 (8.33%) pain was managed by paracetamol dispersible tablet and morphine, respectively, whereas most 296 (77.08%) of the case were managed by

| Priority drugs for children under the age of five | Availability at the day of visit | Stock out in the last six months | Frequency of stock out in last six months | Total days of stock out in the last six months |
|--------------------------------------------------|----------------------------------|---------------------------------|------------------------------------------|-----------------------------------------------|
| Oral rehydration salt packets                    | Yes                              | No                              | 0                                        | 0                                             |
| Zinc phosphate 20 mg dispersible tablet          | No                               | Yes                             | 4                                        | 18                                           |
| Paracetamol 100 mg dispersible tablet            | Yes                              | No                              | 4                                        | 22                                           |
| Morphine: 10 mg, granules 20 mg                   | Yes                              | No                              | 0                                        | 0                                            |
| Ceftriaxone: Powder for injection 250 mg and 1 g | No                               | Yes                             | 5                                        | 27                                           |
| Gentamicin: Injection 20 mg/mL                    | No                               | Yes                             | No available in the last 6 months         | 180                                          |
| Procaine benzyl penicillin: Powder for injection 1 and 3 g | No | Yes | 6 | 43 |
| Amoxicillin 250 mg dispersible tablet or 500 mg | Yes                              | No                              | 0                                        | 0                                            |
| Ampicillin 250 or 500 mg powder for injection    | Yes                              | Yes                             | 1                                        | 7                                            |
| Artemether/lumefantrine 200 mg/120 mg/tablet     | Yes                              | No                              | 0                                        | 0                                            |
| Artesunate 110 mg/via injection                  | Yes                              | No                              | 0                                        | 0                                            |
| Artesunate 100 mg rectal capsule                 | No                               | Yes                             | No available in the last 6 months         | 180                                          |
| Vitamin A: 100 000 IU or 200 000 IU strength capsules | Yes | No | 0 | 0 |
| AZT + 3TC + NVP 3TC30 + AZT60 + NVP50 mg, dispersible tablet | Yes | No | 0 | 0 |
| ABC + 3TC3TC60 +120 mg ABC, scored and dispersible tablet | Yes | No | 0 | 0 |
| AZT + 3TC3TC30 + AZT60 mg, dispersible tablet    | Yes                              | No                              | 0                                        | 0                                            |
| NVP oral syrup, 50 mg/5mL (10 mg/mL)             | Yes                              | No                              | 0                                        | 0                                            |
| 3TC30 mg                                         | Yes                              | No                              | 0                                        | 0                                            |
| LPV/r (LPV100mg+Ritonavir25 mg)                  | Yes                              | No                              | 0                                        | 0                                            |
| EVF 200 mg, scored tablet. Or 50 mg, tablet or capsule | Yes | No | 0 | 0 |

Utilization of WHO-suggested medicines for children under the age of 5
non-recommended medicines like paracetamol suppository and paracetamol syrup (Figure 1).

About 167 (43.48%) of pneumonia cases were treated by amoxicillin dispersible tablet and 92 (23.95%) of the cases were treated by ceftriaxone injections. Surprisingly, 125 (32.55%) of the cases were treated by non-priority medicines, such as cephalaxin syrup, amoxicillin syrup, and trimethoprim–sulfamethoxazole syrup, and azithromycin (Figure 2).

All (100%) of vitamin A deficiency problems were managed by vitamin A 2000IU. About 231 (60.15%) of malaria cases was managed by artemether/lumefantrine tablet and 153 (39.84%) of the cases were managed by artesunate injection. AZT+3TC+NEV–based regimen was utilized for 73.17% of the cases and ABC+3TC and LPV/r were utilized for (22.65% and 4.16%) of the cases, respectively. 134 (34.89%) of neonatal sepsis were managed by ceftriaxone: powder for injection, whereas most of 227 (59.11%) of neonatal sepsis were managed by non-priority medicines like ampicillin–gentamicin combination injection and Metronidazole 30 mg/kg (Figure 3).

**Discussion**

The overall average availability of priority medicines was 75% on the day of visit and the average stock-out duration in the last 6 months was 23.85 days. This was comparable with the study conducted in Ethiopia; the result revealed that the overall availability of essential medicine was 19 (79.17%) and average stock out of medicine in the survey period was 5 (20.83%). However, the findings of the current study showed a lower overall availability of essential medicines when compared to a study conducted in Gondar town 23.67 (91%). The observed difference is probably because the health centers manage a limited number of medicines and they have a management effort.

This finding is higher than the study conducted in the western part of Ethiopia on the accessibility of essential medicines for children; the overall availabilities of EMs were below 50% in both the public sector and private sectors. The observed difference might be because of better attentions gave to priority medicines by supply managers because the study conducted in the western part includes all essential medicines. The above findings of the current study were also higher than the study conducted in the Tigray region, of Ethiopia; the finding revealed that overall availability was 34.1%. Based on this finding, we observed that different results in the same country with the same medicine supply sources might be due to Ethiopia essential drug list provide an aggregate list of medications and only focus on systemic classification of medication, not for specific population groups which resulted in there is a different practice at different regions. Medicines supply sources of the country, ministry of health, policymakers, as well as facility managers should work in collaboration toward ensuring sustainable and consistent availability of priority medicines through the country.

Based on the findings of the current the study, availability of amoxicillin dispersible tablets was higher, there is no stock out in the last 6 months, while we were compared with the study conducted in Sri Lanka, in which amoxicillin was available in 90% of cases. The observed difference could be due to countries having different strategies to combat the disease. The low availability of medicines in the appropriate formulations may limit access to medicines to children, which may result in morbidity and mortalities which can be treated and prevented by cost-effective essential medications.

In this study, the availabilities of Vitamin A were higher when compared with a study conducted in western parts of Ethiopia. All pediatric ART regimens were available on the day of data collection as well as in the last 6 months, which was comparable with the study conducted in Jimma. In this study, utilization for AZT+3TC+NEV–based regimen was 73.17%, and ABC+3TC-based regimen was 22.65%. This finding is consistent with a study conducted in the Jimma zone.

The current study’s findings were compared to those of a study conducted in Uganda the current study’s utilization of priority medicines for diarrhea was higher 91.66% for both ORS and Zinc phosphate, whereas in Uganda, utilization for ORS and Zinc phosphate was 20 and 0%, respectively. The observed
difference might be due to the high utilization of non-priority medicine (32.55%) in the current study, which showed that poor adherence to WHO Recommendations and guidelines. National-based regulatory measure should be established and enforced to ensure rational utilization of recommended medicines, as well as in-service training for healthcare professionals, should be continuously provided to make them updated with newly developed guidelines, standard, and recommendations.

According to the current study, the utilization of antimalarial drugs was (60.15% for artemether/lumefantrine, 39.84% for artesunate injection, and 0% for artesunate rectal). This finding is higher than a study conducted in Uganda. The observed difference could be due to different countries following diverse strategies to manage the disease.

Based on the findings of the current study, utilization for AZT+3TC+NEV–based regimen 73.17% ABC+3TC was 22.65% which was in line (100%) with the finding of the study conducted in the Jimma zone. Because both AZT and ABC-based regimen was based on Ethiopia National pediatric ART guideline, the observed similarity of the finding is most probably due to in Ethiopia; ART drugs are supplied from the common supply source and issued for all public sectors for free.

Based on the findings of the current study, availability and utilization of suggested medication for neonatal sepsis was low, while compared with Uganda’s study, utilizations of Procaine benzyl penicillin ranged from 82 to 86% at 3 different health centers. But in the current study, utilization for this medication was 0%. The observed difference might be due to high utilization of non-priority medicines in the current study.

**Conclusion and Recommendations**

Availability and utilization of priority medicines for the management of antiretroviral infections, Vitamin A deficiency, malaria, and diarrheal cases were high, whereas availability and utilization of suggested medication for neonatal sepsis were very low. A significant proportion of children who hold pneumonia and pain was managed by non-priority medicines, despite the high availability of priority medicines for these conditions. Availability and utilization of artesunate rectal and gentamycin injection were null for the management of pneumonia and malaria, respectively. Medicines supply sources of the country, ministry of health, policymakers as well as facility managers should work in collaboration toward ensuring sustainable and consistent availability of priority medicines through the country. National-based regulatory measures should be established and enforced to ensure rational utilization of recommended medicines, as well as in-service training for healthcare professionals, should be continuously provided to make them updated with newly developed guidelines, standards, and recommendations.

### Appendix A

**Notation**

| Notation | Description       |
|----------|-------------------|
| 3TC      | Lamivudine        |
| ABC      | Abacavir          |
| ART      | Antiretroviral Therapy |
| EVF      | Efavirenz         |
| HIV      | Human immunodeficiency virus |
| LPV/r    | Lopinavir/ritonavir |
| NVP      | Nevirapine        |
| ORS      | Oral rehydration salt |
| SPSS     | Statistical Package Software for Social Sciences |
| TDF      | Tenofovir disoproxil fumarate |
| USAID    | United States Agency for International Development |
| WHO      | World Health Organization |
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Declaration of Conflicting Interests
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Ethical approval
The study protocol was approved by an ethical review committee of the School of Pharmacy, University of Gondar. Both written and verbal consent for data collection were obtained before conducting this study. Participants’ information gained was kept confidential.

Availability of Data and Materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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