

# Availability and Affordability of Children Essential Medicines in Health Facilities of Southern Nations, Nationalities, And People Region, Ethiopia: Key Determinants for Access.

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## Research article

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# Abstract

**Background:** Children in resource-limited countries are more likely to die from treatable conditions than those in higher resource settings due to a lack of the right essential medicine at the right time. Globally millions of children die every year from conditions that could be treatable with existing medicines before they reach their fifth birthday. This study aimed in assessing the availability and affordability of essential medicine for children in selected health facilities of southern nations, nationalities, and peoples' regions (SNNPR), Ethiopia.

**Method:** A medicine outlets-based cross-sectional study was conducted to assess the availability, affordability, and prices of the 30 selected EMs for children in 30 public and 30 private medicine outlets in SNNPR from March 29 to May 5, 2019, applying WHO and Health Action International (HAI) tools. Availability was expressed as the percentage of sampled medicine outlets per sector that the surveyed medicine was found on the day of data collection. The number of daily wages required for the lowest-paid government unskilled worker (LPGW) to buy one standard treatment of an acute condition or treatment for a chronic condition for a month was used to measure affordability and median price ratio for the price of EDs.

**Results:** Availability was varied by sectors, type of medicines, and level of health facilities. The average availability of EMs was 57.67% in the public sector and 53.67% in private sectors. Ceftriaxone, ORS, zink sulfate, and cotrimoxazole were the most widely available medicine types in both sectors. The median price ratios (MPR) for lowest-priced (LP) medicines were 1.26 and 2.24 times higher than their international reference price (IRP) in the public and private sectors respectively. Eighty-two percent of LP medicines in the public and ninety-one percent of LP medicines in the private sectors used in the treatments of prevalent common conditions in the region were unaffordable as they cost a day's or more wages for the LPGW.

**Conclusion:** Availability, affordability, and price are determinant pre-requisite for EMs access. According to the current work, although fair availability was achieved, the observed high price affected affordability and hence access to EMs.

## Introduction

The pleasure of the highest achievable standard of health is one of the basic rights of every human being.<sup>1</sup> Individual and every global society have a task to see the right to health progressively realized. One of the tools that make this right well-functioning is accessing essential medicines (EMs). It is EMs that satisfies the priority health care needs of the communities.<sup>2</sup> They are chosen with the view of community health relevance, evidence on efficacy, safety, and comparative cost-effectiveness.<sup>3</sup> EMs are expected to be available within the situation of working health systems at all times in adequate amounts, in the proper dosage forms, with assured quality and sufficient information, and at a price, the individual and the society can afford.<sup>2</sup>

However, access to EMs is challenging; especially for children. Some of the factors which impaired children's access to EMs were lack of suitable dosage forms, the high price of medicines, inefficient government procurement culture, extreme mark-ups in the distribution chain, and exaggerated taxes and duties being applied to these medicines.<sup>4-7</sup> Even though its necessity was emphasized in Millennium Development Goals/MDG/ four and six, and WHO launched the 'Make Medicines Child Size' campaign to enhance the availability of safe, effective, and quality medicines for children by promoting awareness and action through research, regulatory measures, and changes in policy, effective results for it has not yet been achieved.<sup>6,8,9</sup>

Thus, millions of children die every day before they reach their fifth birthday, of conditions that could be treatable with existing EMs globally. Of newborn deaths, 22% are due to infections such as pneumonia, diarrhea, and malaria.

Childhood pneumonia and diarrhea are the most important causes of childhood mortality and account for about 30% of all child deaths worldwide.<sup>10,11</sup> The majority of these children would endure if they have given an appropriate available EMs.<sup>12</sup> For instance, oral antibiotics administered in community settings can reduce all sources of neonatal mortality by 25% and pneumonia-related mortality by 42%; zinc administration for diarrhea management can reduce all-cause mortality by 46%.<sup>13,14</sup> The scenario worsens in resource-constrained nations. Children in developing countries are more liable to die from treatable conditions than those in higher resource settings due to a lack of access to the correct medication at the right time.<sup>15</sup>

Access to EMs can be determined by availability, affordability, accessibility, acceptability, and quality of the medicines. As per the studies, assuring availability and affordability of medicines play a vital role in improving children's access to EMs in both private and public sectors. Availability is reported as the percentage of medicine outlets in which medicine was found on the day of data collection and affordability, in other words, is estimated by comparing medicine costs to the daily wage of the lowest-paid unskilled government worker.<sup>6,7</sup>

A study conducted in South-west Ethiopia, 55.65% of EMs were available, and considerable price variation among studied sectors impedes access to EMs.<sup>16</sup> In Western Ethiopia, the average availability of EMs for children was found to be 43%. Again the price was making EMs unaffordable.<sup>17</sup> This study, therefore, sought to assess the availability and affordability of CEMs based on WHO/HAI methodology to determine children's access EMs in Southern Ethiopia to have a semi-complete picture of the problem together with already published work.<sup>17,18</sup>

## Methods

### Study design, area and period

A medicine outlets-based cross-sectional descriptive study was conducted in the SNNP region, South Ethiopia. Quantitative data was collected adapting price and availability format prepared by WHO/HAI 'make medicine child-size project' from March 29 to May 5, 2019.<sup>19</sup>

### Drug Outlet selection

Out of 13 administrative zones found in the region, choosing Hawasa, the capital city of the SNNP region as a center for the study, six administrative zones that can be reached within one day were randomly selected.<sup>18,19</sup> For each district, the higher health facility (HF) in the three-tier system of the country was purposely, one primary hospital and three health centers (HCs) within three hours' travel of the higher HF were randomly selected from the lists of HFs obtained from the regional health bureau of SNNPR for the public sector since primary hospital to HC ratio was 1:12 (SNNP Regional Health Bureau).<sup>18-20</sup> Similarly, lists of licensed medicine outlets for each district were obtained and closest to each public HFs one pharmacy purposely and four drug-stores were randomly selected for private sectors as a pharmacy to drug-store ratio was 1:15 (SNNP Regional Health Bureau). If there were no private medicine outlets found within a 10km radius of public HF, another was considered in the near urban setting.<sup>18</sup> Therefore, 60 medicine outlets, 30 from private, and 30 from public sectors were considered in the current study. The chosen medicine outlets were from the different levels of HFs that are expected to stock all of the medicines included in the study.

### Selection of medicines

Twenty-three EMs were taken based on proposed formulations and strength for key tracer children medicines WHO EMLc core list as specified by the 'Better Medicines for Children Project'.<sup>19</sup> Seven medicines were added in the study list as per the prevalence and burden of diseases associated with childhood illness in the region (SNNP Regional Health bureau). For each surveyed medicine, we collected data on the lowest-priced, highest priced (instead of innovator/brand medicines), and its availability.<sup>19</sup> But for programed medicines, which are free of charge for the public in the public sector, we checked only their availability.

## Data collection and analysis

Six data collectors were trained as per WHO/HAI methodology to do the collection task. The pre-test was undertaken in Werabe town where the trainees were trained. Being supervised and controlled for quality of data daily by Principal Investigators, 60 medicine outlets were visited to collect data on the availability and patient prices of medicines. The availability of medicine was addressed by interviewing the staff working at the facility and physically checking the study medicines for their presence as stated in the dispensing area.<sup>19</sup> Patient prices were taken by interviewing the staff working at the facility, reviewing the most recent price data that were recorded on the posted selling price, or referring model 22. For data collection, WHO/HAI standard data collection format was employed (Additional file 1). For tracking the quality, processing in advance, and statistical analysis, collected data were entered into customized MS Excel from the workbook provided as part of the WHO/HAI methodology. All studied medicine outlets fulfil the WHO/HAI recommendation criteria to collect data on the selected 30 medicines (Table 1).<sup>18</sup>

Table 1  
List of medicine surveyed in Southern Ethiopia

S.No.	Name of Medicine	Strength	Dosage Form	Indication
1.	Amoxicillin	125mg/ml	Suspension	Infectious disease
2.	Amoxicillin	250mg	Dispersible tab	Infectious disease
3.	Amoxicillin+Clavulanic acid	125+31.25mg/5ml	Suspension	Infectious disease
4.	Amoxicillin+Clavulanic acid	125mg +31.25mg	Dispersible tab	Infectious disease
5.	Ampicillin	500mg	Injection	Infectious disease
6.	Artemether +Lumefantrine	20mg+120 mg	Tablet	Malaria
7.	Artesunate	60mg	Injection	Malaria
8.	Beclomethasone inhaler	100mcg/dose	Inhaler	Asthma
9.	Benzylpenicillin	1MIU	Powder	Infectious disease
10.	Carbamazepine	100mg/5ml	Suspension	Seizure disorder
11.	Ceftriaxone injection	1g	Powder	Severe infection
12.	Chloramphenicol injection	1g	Powder	Infectious disease
13.	Cloxacillin	125mg/5ml	Suspension	Infectious disease
14.	Cotrimoxazole (Sulphamethoxazole + Trimethoprim)	200mg+40 mg/5ml	Suspension	Pneumonia
15.	Diazepam I injection	5mg/ml	Solution	Seizure disorder
16.	Ferrous salt	30mg Fe/5ml	Suspension	Anemia
17.	Gentamycin	40mg/ml	Injection	Infectious disease
18.	Ibuprofen	100mg/5ml	Syrup	Pain/inflammation
19.	Isoniazide	100mg	Tablet	TB
20.	Morphine	10mg/5ml	Oral Solution	
21.	Oral Rehydration Solution	1 litter	Powder	Dehydration
22.	Paracetamol	120mg/5ml	Syrup	Pain
23.	Paracetamol	125mg	Suppository	Pain
24.	Penicillin G, Benzathine penicillin	1.2MIU	Injection	Infectious disease
25.	Phenobarbitone	30mg	Syrup	Seizure disorder
26.	Phenytoin	50mg	Suspension	Seizure disorder
27.	Procaine penicillin injection	1 MIU	Powder	Infectious disease
28.	Salbutamol Puff	100mcg/dose	Inhaler	Asthma
29.	Vitamin A	100,000IU	Capsule	Xerophthalmia

30.	Zinc sulfate	20mg	Tablet	Dehydration
MIU—Million international unit, IU—International unit, TB—Tuberculosis, mcg—Micrograms				

## Measuring availability and affordability of medicines

The availability of individual medicine was measured by the physical presence of them in the medicine outlets during data collections.<sup>19</sup> It was expressed as the percentage of sampled medicine outlets per sector that the surveyed medicine was found on the day of data collection.<sup>21</sup> This work applied percentage ranges: < 30% very low, 30-49% low, 50-80% fairly high, and >80% high availability to express its findings.<sup>22</sup>

IRP was used for comparing the prices of 17 lowest-priced medicines.<sup>23</sup> Patient prices were reported as median price ratios (MPRs), which expressed as median local unit prices across health facilities divided by their median IRPs.<sup>24</sup>

$$MPR = \frac{\text{Median Local Unit Price}}{\text{International Reference Unit Price}}$$

The local unit price was obtained by dividing the retail price per pack by the pack size. The supplier medicine prices obtained from the MSH drug price guide 2015 were taken as the IRPs for core medicines (Additional file 1).<sup>23</sup> MPR was calculated by converting the median local price to United States Dollar (USD) using the exchange rate of commercial banks of Ethiopia at first data of data collection, March 29, 2019.<sup>25</sup>

Affordability was estimated by comparing the total price required to cover the complete course of standard treatment for prevalent diseases in the region (SNNP Regional Health bureau) with the number of daily wages of the LPGW, which was 28.57 ETB per day (0.99 USD) during data collection (Ethiopian ministry of finance and economics salary scale for the public sector).<sup>26</sup> Medicines used to manage asthma (chronic condition) and six acute conditions were chosen based on WHO/HAI Standards.<sup>18,19</sup> For each condition, the lowest-priced medicine costs were computed and compared. The total costs of medicine for the complete duration of therapy of acute conditions and a one-month course of chronic conditions were determined and converted to the daily wage. Then, description has given as medicines that costed 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 affordable and unaffordable if they cost more.<sup>24</sup>

## Results

### Availability of EMs

Availability was varied by type of medicine, sectors, and level of health facilities. Ceftriaxone, ORS, zink sulfate, and cotrimoxazole were available in more than 90% of medicine outlets. On the other hand, none of the sectors stocked beclomethasone inhaler, morphine 10mg syrup, and carbamazepine 100mg syrup while isoniazid 100mg tablet and vitamin A capsules being stocked by public sectors. The availability of nine studied medicines was less than 50%. Public sectors hold lowest-priced medicines, unlike private sectors which had both the lowest and highest priced medicines (see Table 2).

Table 2

Average availability of individual children essential medicines in the public and private sectors.

Name of medicine, strength, dosage form	Percentage of outlets where medicine found		
	Public Sector (n=30)	Private Sector (n=30)	
	LP	LP	HP
Amoxicillin 250mg Dispersible tablet	53.33	13.33	0
Amoxicillin 125mg/5ml Suspension	86.67	93.3	6.67
Amoxicillin + Clavulinc acid 125mg +31.25mg Dispersible tablet	6.67	6.67	0
Amoxicillin + Clavulanic acid 125mg +31.25mg/5ml Suspension	66.67	86.67	20
Ampicillin 500mg Powder for Injection	73.33	70	0
Artemether + Lumefantrine 20mg+120 mg Dispersible Tab	76.67	83.33	0
Artesunate 60mg powder for Injection	30	10	0
Benzylpenicillin 1 MIU Powder for Injection	56.67	26.67	0
Beclomethasone 100mcg/dose inhaler	0	0	0
Carbamazepine 100mg/5ml Suspension	0	0	0
Ceftriaxone 1g Powder for Injection	90	100	23.33
Chloramphenicol 1g Powder for Injection	13.33	6.67	0
Cloxacillin 125mg/5ml Suspension	66.67	60	0
Cotrimoxazole (Sulphamethoxazole + Trimethoprim) 100mg+20 mg Suspension	86.67	100	3.33
Diazepam 5mg/ml Injection	76.67	76.67	0
Ferrous salt 30mg/5ml Suspension	66.67	83.33	6.67
Gentamycin 40mg/ml Injection	86.67	73.33	0
Ibuprofen 100mg/5ml Syrup	73.33	86.67	0
Isonaized 100mg Tablet	76.67	0	0
Morphine 10mg/5ml Oral Solution	0	0	0
Oral Rehydration Solution Powder to make 1 liter	90	100	3.33
Paracetamol 120mg/5ml Syrup	73.33	86.67	6.67
Paracetamol 125mg Suppository	70	93.33	23.33
Penicillin G, Benzanthine n 1.2MIU for Injection	76.67	73.33	0
Phenobarbitone 30mg Tablet	60	36.67	0
Phenytoin 50mg Tablet	46.67	40	0
Procaine penicillin 1 MIU Powder for Injection	26.67	13.33	0
Salbutamol puff 100mcg/dose Inhaler	66.67	96.67	3.33

Vitamin A 100,000IU Capsule	43.33	0	0
Zinc sulfate 20mg Tablet	90	93.33	0
MIU—Million international unit, IU—International unit, LP—Lowest-priced, HP—Highest-priced			

The average availability for lowest-priced medicines in the public and private sectors were 57.67% and 53.67% respectively. The highest-priced medicines' average availability in private sectors was found to be 3.87%. When the level of health facility for medicine availability was considered, private pharmacies lead both sectors having 71.6 % followed by General Hospitals, 68.39% (Table 3).

Table 3  
Availability of children essential medicine per study area, sector, and level of health facility in Southern Ethiopia

Study Area	Average Availability of Medicines			Level of Health Facility	Sector	
	Public Sector (n=30)	Private Sector (n=30)				
	LP	LP	HP			
					<b>Public Sector (n=30)</b>	<b>57.67</b>
Gurage Zone	60.00	64.44	0.74		1. General Hospital	68.39
Hadiya Zone	58.62	62.22	0.74		2. Primary Hospital	58.62
Halaba Zone	61.38	65.19	6.67		3. Health Center	57.28
Hawasa City	63.45	66.67	2.22		Private Sector (n=30)	53.67
Kembata-Tembaro Zone	59.31	60.74	4.44		4. Pharmacy	71.60
Wolaita Zone	62.07	64.44	4.44		5. Drug Store	62.04

LP—Lowest-priced, HP—Highest-priced

## Costs of EMs

MPR of 17 lowest priced medicines were calculated to estimate price variation of individual medicine across sectors. Accordingly, the MPR (25<sup>th</sup> -75<sup>th</sup> percentile) in public and private sectors was 1.26 and 2.24 respectively. Out of 17 lowest-priced medicines, only ORS and paracetamol 125mg suppository had an LP MPR <1 in the public sectors implying that they were cheaper in the study region compared to the IRPs. Phenobarbitone 30mg tablet in the public sectors was the most expensive medicine which was sold at 3.23 times its IRP. All medicines encountered in private sectors had an LP MPR >1 implying that they were expensive in the study region compared to the IRPs. The most expensive medicine in the private sector, paracetamol 125mg suppository (MPR=5.21) found to be the cheapest in the public sector (Table 4).

Table 4

Median Price Ratio (the 25<sup>th</sup>-75<sup>th</sup> Percentile) of Lowest and Highest Priced Medicines (n=17)

List of medicine available in At least four Medicine outlets	Public LP MPR	Private LP MPR
Amoxicillin 125mg/5ml suspension	1.78(1.6-2.28)	2.27(2.23-2.51)
Amoxicillin + Clavulinc acid 156.25 suspension	1.10(0.83-2.17)	2.52(2.33-2.59)
Ampicillin 500mg powder for injection	1.85(1.16-2.09)	3.01(2.5-3.31)
Ceftriaxone 1gm powder for injection	1.69(1.32-1.86)	2.29(2.17-2.42)
Cloxacillin 125mg/5ml suspension	1.04(0.58-1.06)	1.17(0.92-1.29)
Cotrimoxazole 240mg/5ml suspension.	1.26(1.17-1.68)	2.09(1.72-1.26)
Diazepam 5mg/ml injection	1.37(1.03-1.54)	1.65(1.36-1.97)
Ferrous sulfate 30mg /5ml	1.02(0.28-1.04)	1.09(0.29-1.3)
Gentamycin 40mg/ml injection.	1.24(0.74-1.46)	1.75(1.13-2.04)
Ibuprofen 100mg/5ml syrup	2.36(1.99-2.68)	3.15(2.68-3.43)
ORS to make 1L	0.95(0.72-2.06)	3.67(2.45-4.12)
Paracetamol 125mg suppository	0.65(0.64-0.74)	5.21(3.82-6.79)
Paracetamol 120mg/5ml syrup	1.51(0.94-1.95)	2.24(1.80-3.23)
Penicillin G,Benzthine 1.2MIU	1.99(1.49-2.5)	2.78(2.5-3.23)
Phenobarbitone 30mg tablet	3.23(2.71-3.55)	3.78(2.89-4.85)
Phenytoin 50mg tablet	1.10(0.5-1.2)	1.19(0.75-2.28)
Salbutamol puff 100mcg/dose inhaler	1.69(1.22-1.83)	1.92(1.83-2.47)
LP—lowest-priced, HP—highest-priced, MPR—median price ratio, ORS—Oral rehydration salt		

As seen in Figure 1, the MPR for lowest-priced medicines in the public sector was twice lesser than private MPR (1.26:2.24—Public sectors to Private sectors). The average LP MPR for the 17 medicines in the public and private sectors was 1.57 and 2.54 respectively. Patients in the study area were paying higher prices than the median IRPs for 15/17 medicines in the public and all medicines in private sectors. Generally, medicines in this survey sold at price higher than their IRPs.

## Treatment affordability for prevalent disease with EMs

Assuming all wages go for drug purchasing, Table 5 revealed 81.82% (9/11) and 91.91% (10/11) of standard treatments for prevalent diseases in the public and private sectors with the LP medicines was unaffordable respectively.<sup>27</sup> It would take a day and above to purchase all the studied medicines except ORS and paracetamol 125 mg suppository, which would require 0.2 and 0.5 days' wages to pay for the recommended dosage respectively. In both sectors, treating acute

otitis media with Augmentin 156mg/5ml for the duration of 10days was found to be very costly. It required 3.4 and 7.8 day's wage for LPGW to afford it in public and private sectors respectively.

Table 5

Affordability: cost required to cover full course standard treatment against the number of daily wages.

Condition to be treated	Drug name, strength, dosage form, dose, route of administration, frequency & treatment duration	Treatment schedule <sup>24</sup>  The total amount of drug required to cover the complete treatment regimen.	Unit	Average drug Price per Unit (USD)		Number of day's wage to pay for treatment	
				Public facilities	Private facilities	Public facilities	Private facilities
Mild pneumonia	Amoxicillin 125mg/5ml, OS, 30mg/kg P.O. TID for 7 days	30mg/kg x 14.5kg x 3 x 7days = 9135mg = 365.4mL	mL	0.0082	0.0104	3.0	3.8
Severe pneumonia	Benzylpenicillin 1.2MIU, Injection, 50,000units/kg, IM, every 6hours at least for 3days	50000units/kg x 14.5kg x 4 x 3days = 8.7MIU ~ 9MIU=8vial	Vial	0.2620	0.4984	2.1	4.0
1. if improves, switch to 'a'							
2. if doesn't improve within 48hrs, switch to 'b'	a. Amoxicillin 125mg/5ml, OS, 30mg/kg P.O. TID for 7days	30mg/kg x 14.5kg x 3 x 7days = 9135mg = 365.4mL	mL	0.0082	0.0104	3.0	3.8
	b. Ceftriaxone 1gm, Injection, 50mg/kg/day, IV, for 5days	50mg/kg x 14.5kg x 5days = 3625mg ~4g=4 vial	Vial	0.6726	0.9114	2.7	3.7
Impetigo	Cloxacillin 125mg/5ml, Syrup, 100mg /kg/day P.O. for 7days	100mg/kg x 14.5kg x 7days = 10,105mg = 101.5mL	mL	0.0101	0.0113	1.0	1.2
Diarrhea with some dehydration	ORS to make 1 liter, 1sachet P.O.	some dehydration 75ml/kg x 14.5 =1087.5ml ~ 2sachet	Sachet	0.0808	0.3137	0.2	0.6
Acute otitis media	Amoxicillin 250mg/5ml, OS, 5ml, P.O. TID for 10days	3 x 5ml x 10days = 150ml	mL	0.0080	0.0107	1.2	1.6
	Augmentin 156.25mg/5ml, OS, 5ml, P.O. TID for 10days	3 x 5ml x 10days = 150ml	mL	0.0223	0.0512	3.4	7.8
Asthma	Salbutamol puff, 1-2puffs, 3-4 times a day	200doses of 1 inhaler	Dose	0.0155	0.0177	3.1	3.6
Pain management	Paracetamol suppository 125mg, 15mg/kg, QID for 1day	15mg/kg x 14.5 x 4 = 870mg =	Supp	0.0521	0.4173	0.5	4.2

		7supp ~ 10supp				
Pain management	Ibuprofen 100mg/5ml, Syrup, 10mg/kg, P.O. PRN	100mg/5ml of 100mL	mL		1.2	1.6
				0.0120	0.0161	

\*Average weight of five year age children in Ethiopia =14.5kg, OS—Oral Suspension, P.O—Per oral, TID—Three times a day, QID—Four times a day, PRN—When necessary, IM—Intramuscular, IV—Intravenous, Supp—Suppository, USD—United States of American Dollar.

## Discussion

The result of this study showed the average availability of lowest-priced medicines for children was fairly high in both sectors.<sup>22</sup> It was 57.67% and 53.67% in public and private sectors respectively. However, none of the selected districts' HFs stocked beclomethasone inhaler, morphine 10 mg/5 ml oral solution, and carbamazepine 100 mg/5 ml suspensions. Regarding the higher availability of medicines in the public sector compared to the private sector, these findings are consistent with the results of a study done by Edao Sado and Alemu Sufa, in the Western part of Ethiopia, for a similar target.<sup>17</sup> Studies like the compiled reports of WHO and Anson A *et al*/results disagree with the current work by finding low average availability of medicines in the public than private sectors.<sup>7,24</sup>

The average availability of medicines used to treat chronic conditions such as seizure disorders and asthma in children was low ( $\approx 42\%$ ).<sup>22</sup> Medicines offered free of charge from the public sectors like artesunate 60 mg and vitamin A were found below 50%. Infectious diseases are known causes of childhood morbidity and mortality.<sup>10,11,15</sup> The availability of medicine used to tackle these conditions has to be maintained at the optimum level ( $\geq 50\%$ ). However, the average availability of chloramphenicol 1 g was below the 'very low' level.<sup>22</sup>

The current study also showed that the overall retail prices of the lowest-priced medicines were higher than their IRPs. They were sold at 1.26 times their IRPs in the public sectors and 2.24 times their IRPs in the private sectors. Concerning substantially higher prices in private sectors compared to public sectors, this finding is similar to the studies done by Edao Sado and Alemu Sufa, and Sun X *et al*.<sup>17,28</sup> A noticeable price variability between both sectors was common for captured medicine in this study. It is consistent with a study undertaken on the availability, prices, and affordability of essential medicines in Ethiopia, Haiti, and china<sup>17,22,28</sup>

Managing commonly prevalent conditions—acute and chronic— with standard treatment protocol using the lowest-priced medicines in the region was unaffordable (81.82% in public and 91.91% in private) as they cost a day's or above wage for the LPGW. This finding agrees with the findings of Edao Sado and Alemu Sufa, and Sun X *et al*.<sup>17,28</sup> The assumption of the LPGW method to assess the affordability of EMs is that all wages go for medicine purchasing. For households that have an average of 4.6 children, spending a day's wage for purchasing medicine only is not evident.<sup>29</sup> Low-income earners are likely to spend 93% and 60% of their income on food, housing, transport, utilities, and sport or leisure activities as per Mokaya J *et al*. and Xu K *et al*. findings respectively.<sup>30,31</sup> Accordingly, only 7% and 40% of day's wage is left for healthcare costs. Therefore, to afford the cheapest lowest-priced medicine ORS in the public sector, the LPGW needs 0.4 to 2.3 day's wage. The expensive standard treatment for acute otitis media with Augmentin 156.25 mg/5 ml in private sectors required the LPGW's 19.4 to 110.8 days' wage. Thus, almost all the 11 standard treatment options identified in this work were unaffordable. This may drive parents to forgo treatment or to suspend their basic needs.

## Limitation Of The Study

This study did not assess factors affecting or related to availability, price, and affordability

## Conclusion

The average availability EMs for children in this work was fairly good. Public sectors have relatively higher availability than private sectors provided that government-subsidized, free of charge offered and public sectors only allowed to stock medicines were included in the study. However, the average LP MPR for public and private sectors being 1.57 and 2.54 times their IRPs compromises children's access to EMs respectively. Furthermore, being unaffordability of LP medicines for 81.82% and 90.91% of full-course standard treatments of prevalent conditions in the public and private sectors as they cost a day's or above wages for the LPGW respectively, lowering childhood morbidity and mortality questionable.

## Abbreviations

CEMs—Children essential medicines; EMLc—Essential medicine lists for children; EMs—Essential medicines; ETB—Ethiopian birr; HAI—Health action international; HC—Health center; HFs—Health facilities; HP—Highest-priced; IRPs—International reference prices; LPGW—Lowest-paid government unskilled worker; LP—Lowest-priced; MPR—Median price ratio; MS—Microsoft; SNNP—Southern nations nationalities and peoples; WHO—World health organization.

## Declarations

## Ethical consideration

Ethical clearance was obtained from Jimma University Institute of Health Sciences Ethical Review Board after the pharmacy department reviewed and approved the study protocol as it was compiled with the Declaration of Helsinki. A letter of cooperation was written to the regional health bureau and then the regional health bureau to the survey areas health departments to facilitate cooperation for public sectors. Private medicine outlet owners provided informed verbal consent and the confidentiality of collected data was maintained.

## Consent for Publication

Not applicable.

## Availability of data and material

The datasets used and/or analyzed during the current study available from the first author on reasonable request.

## Competing interests

The authors declare that they have no competing interests.

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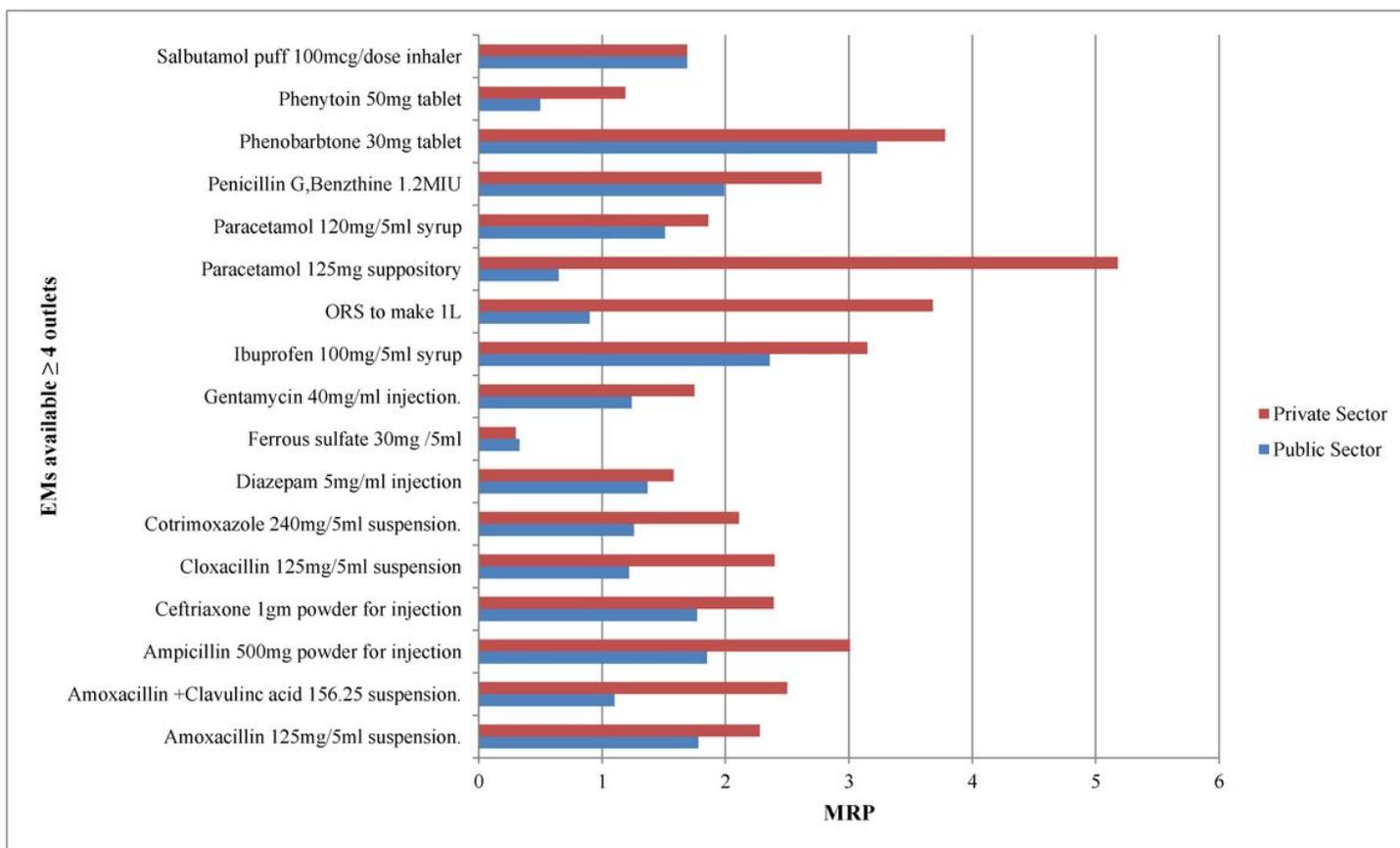
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## Figures



**Figure 1**

Comparison of MPR of lowest price medicines found in  $\geq 4$  drug outlets in public and private sectors.

## Supplementary Files

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