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# BMJ Open

## Availability and price of medicines for non-communicable diseases at health facilities and retail drug outlets in Kenya

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3 **Availability and price of medicines for non-communicable diseases at health facilities and**  
4 **retail drug outlets in Kenya**  
5

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## ABSTRACT

**Objectives:** The objective of this study was to determine the availability and price of medicines for non-communicable diseases (NCDs) in health facilities and private for-profit drug outlets in Kenya.

**Design:** Cross sectional study of health facilities

**Methods:** All public and non-profit health facilities in eight counties (Embu, Kakamega, Kwale, Makeni, Narok, Nyeri, Samburu and West Pokot) that purchased medicines from the Mission for Essential Drugs and Supplies, a major wholesaler, were surveyed. For each health facility, one nearby private for-profit drug outlet was also surveyed. Data on availability and price were analyzed for 24 NCD and eight acute medicine formulations. Availability was analyzed separately for medicines in the national Essential Medicines List (EML) and those in the Standard Treatment Guidelines (STGs). Median price ratios were estimated using the International Medical Products Price Guide as a reference.

**Results:** 59 public and 78 non-profit facilities and 135 drug outlets were surveyed. Availability of NCD and acute medicines was lowest in public facilities. Availability increased with the level of care of facility. The mean proportion of availability for NCD medicines listed in the STGs (0.25) was significantly lower than for acute medicines (0.61),  $p < 0.0001$ . Prices varied substantially by provider type and level of care. The mean price ratio of NCD medicines was significantly higher than for acute medicines in non-profit facilities (4.1 vs 2.0 respectively;  $p = 0.0076$ ), and in private-for-profit drug outlets (3.5 vs. 1.7;  $p = 0.0013$ ).

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2  
3 21 **Conclusion:** Patients with NCD in Kenya have limited access to medicines. Increasing access  
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6 22 should be a focus of efforts to achieve universal health coverage.  
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9 23 **Keywords:** Kenya, non-communicable diseases, medicines, access, price  
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11

## 12 24 **STRENGTHS AND LIMITATIONS**

### 15 25 *Strengths*

- 18 26 • To the best of our knowledge this is the first study to evaluate availability of medicines  
19  
20 27 based on the level of care medicines are assigned in the National Essential Medicines List  
21  
22 28 (EML).  
23  
24 29 • This study also evaluated availability separately for medicines for non-communicable  
25  
26 30 diseases (NCDs) included in the EML and those included in the Standard Treatment  
27  
28 31 Guidelines, highlighting the crucial differences between the two service delivery  
29  
30 32 documents.  
31  
32

### 33 33 *Limitations*

- 34 34 • The cross sectional study design did not allow us to assess trends in availability and price  
35  
36 35 of medicines over time and precludes making strong causal inferences.  
37  
38 36 • Availability of medicines was evaluated as binary variable (yes/no) and did not count the  
39  
40 37 quantity in stock.  
41  
42 38 • The sample of participating private for-profit drug outlets was restricted to those nearest  
43  
44 39 to public and non-profit facilities. While this may not be representative of all private for-  
45  
46 40 profit sector facilities, it gave us the opportunity to study the availability and prices  
47  
48 41 consumers would encounter when referred from public and non-profit facilities.  
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## 42 INTRODUCTION

43 The objective of this study was to determine the availability and price of medicines for non-  
44 communicable diseases (NCDs) compared to medicines for acute disease conditions in health  
45 facilities and drug outlets in Kenya. Availability and affordability are two important dimensions  
46 of access to medicines(1–3). In Kenya, availability of medicines has been shown to be among the  
47 most important factors that affect patients' choice of health care providers(4).

48 Several studies have demonstrated limited availability and affordability of NCD medicines in  
49 low- and middle-income countries(3,5,6). Despite the high burden of NCDs in Kenya, there are  
50 many challenges regarding access to NCD medicines(7–9). Stock-outs at the Kenya Medical  
51 Supplies Agency (KEMSA) and the Mission for Essential Drugs and Supplies (MEDS), two  
52 major suppliers of medicines to hospitals and clinics, have reportedly been minimal(10).

53 However, the availability of medicines in health facilities (including dispensaries, health centers  
54 and hospitals) is generally poor with medicines for NCDs much less available compared with  
55 medicines for communicable diseases (46% vs. 70%)(11). The Kenya Service Delivery and  
56 Readiness Assessment Report, published in 2014, reported an even lower mean availability of  
57 NCD medicines at primary care facilities and hospitals: 25% and 32% respectively(12). Based on  
58 data from Kenya collected in 2009, the prices of medicines are lower in public facilities  
59 compared to faith based facilities, however, stock-outs are about three times more common in  
60 public facilities (46% vs. 14%)(10).

61 Previous studies on availability and price of medicines in Kenya have had two major limitations.  
62 First, these did not take into account the level of care of health facilities surveyed. The National  
63 Essential Medicines List, which guides public procurement in Kenya restricts most NCD  
64 medicines to levels 4 facilities (primary (county) referral hospitals) and above(13,14). However,

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2  
3 65 it is not clear if providers or suppliers follow this restriction. Based on this restriction, and  
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5 66 possibly other factors, availability and prices of medicines might differ by level of care.  
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8 67 Secondly, previous studies did not evaluate availability of medicines in the National Essential  
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10 68 Medicines List (EML) separately from medicines in the National Standard Treatment Guidelines  
11  
12 69 (STGs). Even though the EML and STGs are meant to complement each other in standardizing  
13  
14 70 the provision of quality health services in Kenya, there are more medicines listed in the STGs  
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16 71 than in the EML which can make the standardization of care challenging(13–18).  
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19  
20 72 By taking into account the EML restrictions discussed above, and the level of care of health  
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22 73 facilities surveyed, this study highlights the disparities in access to medicines by level of care.  
23  
24 74 Because of the inconsistency between the EML and STGs, the study also evaluates separately the  
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26 75 availability of medicines included in the EML and availability of medicines included in the  
27  
28 76 STGs. Findings from this study complement existing evidence on the availability and price of  
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30 77 NCD medicines in low- and middle-income countries, which is necessary to inform the design of  
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32 78 policies to enhance access to medicines(3,11,12,19–22).  
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## 37 **METHODS**

### 38 **Study setting**

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41 81 The data presented in this paper were collected during the baseline study on the evaluation of  
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43 82 *Novartis Access*, a low-cost NCD medicines program implemented by Novartis  
44  
45 83 Pharmaceuticals(23,24). *Novartis Access* targets medicines for four non-communicable diseases  
46  
47 84 – cardiovascular disease (dyslipidemia, heart failure and hypertension), diabetes, asthma and  
48  
49 85 breast cancer. Data were collected from eight study counties - Embu, Kakamega, Kwale,  
50  
51 86 Makueni, Narok, Nyeri, Samburu and West Pokot. Health facilities (public and private-non-  
52  
53 87 profit facilities) in Kenya are hierarchically classified into dispensaries (level 2), health centers  
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1  
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3 88 (level 3), primary (county) referral hospitals (level 4), secondary referral hospitals (level 5) and  
4  
5 89 tertiary hospitals (level 6)(25). Dispensaries are the lowest level of care and offer treatment for  
6  
7 90 simple ailments to outpatients, antenatal care, etc, while tertiary hospitals are the highest level of  
8  
9 91 care and offer more specialized services(26,27).

## 92 **Data collection**

93 Data were collected in September 2016 by trained data collectors using study instrument in  
94 English language, programmed in the software application, Survey CTO(28). The study  
95 instrument was pilot tested twice by the trained data collectors and revised based on the feedback  
96 received from each pilot test.

97 All of the public and private non-profit health facilities in eight counties that purchase medicines  
98 through MEDS were surveyed. After data collection at each health facility, data collectors asked  
99 respondents to identify the nearest private for-profit drug outlet where patients are referred when  
100 prescribed medicines are not available at the facility. These private for-profit drug outlets were  
101 then visited and administered the same survey instrument used at the facilities.

102 Data were collected on availability (having or not having the medicine in stock on the day of  
103 data collection) and price (in Kenyan Shillings – KES) of 27 NCD medicine formulations and  
104 nine medicine formulations for acute diseases. All the study medicines were listed in the most  
105 recent STGs of the Ministry of Health. The nine acute disease medicine formulations included in  
106 this study have been used as reference medicines in evaluating the availability and price of  
107 medicines in health systems(22). For each medicine, data were collected on the originator brand  
108 and the lowest-priced generic. The list of medicines on which data were collected are shown in  
109 Appendix 1.

## 110 **Patient and public involvement**

111 Patients were not involved in the design or conduct of the study. Patients may be engaged after  
112 endline data collection to disseminate final study results at the county level and to the wider  
113 NCD patient community.

## 114 **Data analysis**

115 Data were analyzed using SAS version 9.4 (The SAS Institute Inc.) (29). Three of the NCD  
116 medicines for cancer (anastrozole, letrozole and tamoxifen) were excluded from this analysis  
117 because cancer management in Kenya mainly occurs in tertiary health facilities which were not  
118 the focus of this study. Additionally, diclofenac 50mg tablets was excluded from the analysis  
119 because it was the only acute disease medicine that was in the STG but not listed on the national  
120 EML. Inclusion of medicines in the EML was determined by their enlistment in either the 2010  
121 or 2016 editions of the EML(13,30).

122 The following outcome measures were estimated: 1) the proportion of availability (defined as the  
123 proportion of health facilities having each branded or generic version of the medicine available  
124 in stock), and 2) the median price (and minimum and maximum prices) of each generic or  
125 originator medicine across health facilities. Availability for NCD medicines was assessed using  
126 two approaches. The first analysis focused only on NCD medicine formulations listed in the  
127 EML. The availability of eight NCD medicine formulations were evaluated by provider type and  
128 also by level of care.

129 In the second analysis, availability was studied for 24 NCD medicine formulations which were  
130 listed in the most recent editions of STGs(18,31–34). As STGs do not restrict medicines to

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3 131 specific levels of care, availability was assessed across health facilities regardless of level of  
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5 132 care.

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8 133 Differences in mean availability between acute and NCD medicines were estimated using the  
9  
10 134 two sample t-test.

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13 135 Median, minimum and maximum prices of study medicines were estimated for observations for  
14 136 which medicines were not given for free (i.e. price was not equal to zero). All price analyses  
15  
16 137 were conducted in September 2016 Kenyan Shillings. Using the supplier prices from the 2015  
17  
18 138 edition of the International Medical Products Price Guide (IMPPG) which is published by  
19  
20 139 Management Sciences for Health (MSH) as a reference, the median price ratio for each medicine  
21  
22 140 formulation was estimated(35).

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25 141 Due to the limited availability of originator brands in health facilities, median price ratios were  
26  
27 142 estimated for only generics. Only 23 of the study medicines had supplier prices reported in the  
28  
29 143 IMPPG which was used for the median price ratio computation. First the prices from the IMPPG  
30  
31 144 (in 2015 United States Dollars) were inflated to 2016 rates, using the average of 2015 and 2016  
32  
33 145 annual inflation rates (0.7) obtained from the US Inflation Calculator(36). The September 2016  
34  
35 146 price data were converted from Kenyan Shillings to United States Dollars using September 15  
36  
37 147 2016 exchange rate of (1KES= \$0.00987063) obtained from *xe.com*.

38  
39  
40 148 Median price ratios were compared among public, private non-profit, and private for-profit drug  
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42 149 stores, and across levels of care (levels 2, 3, 4 and 5) using analysis-of-variance (ANOVA) with  
43  
44 150 the Tukey-Kramer adjustment procedure to compare pairs of means. Differences in mean price  
45  
46 151 ratios between acute and NCD medicines were estimated using the two sample t-test. The

152 proportion of facilities giving each medicine for free was also estimated, stratified by provider  
153 type and level of care.

## 154 RESULTS

155 A total of 272 health facilities were surveyed – 59 public facilities, 78 private non-profit facilities  
156 and 135 private for-profit drug outlets. The total number of facilities varied across study  
157 counties, from a minimum of 12 in Samburu to a maximum of 48 in Embu county (Appendix 2).  
158 More than half (n=77; 61%) of study facilities were level 2 (dispensaries), 18% (n=23) were  
159 level 3 (health centers), while 20.6% (n=26) were level 4 (primary referral facilities). There were  
160 few (n=5; 4%) level 5 (secondary referral) facilities.

### 161 Medicines availability

162 Figure 1 compares the availability of NCD medicines listed in the EML, NCD medicines listed  
163 in the STGs, and medicines for acute conditions listed in the EML, by provider type. Across all  
164 provide types, availability of medicines listed in the EML was higher than availability of  
165 medicines listed in the STGs. For each of the three categories of medicines, availability was  
166 highest in private for-profit drug outlets compared to non-profit and public providers. Comparing  
167 medicines on the EML, the mean proportion of NCD medicine availability (0.55) was not  
168 significantly different from the mean proportion of acute medicine availability (0.61) (p=0.5500).  
169 Considering medicines in the STGs, the overall mean proportion of NCD medicine availability  
170 (0.25) was significantly lower than the overall mean proportion of acute medicine availability  
171 (0.61); p<0.0001.

172

[Figure 1: Facility level mean proportion of availability by provider type for NCD medicines included in the EML, NCD medicines listed in STGs and acute medicines included in the EML]

174 Figure 2 presents the proportion of availability of NCD medicines listed in the STGs and acute  
175 disease medicines (listed in the EML) by level of care. For both NCD medicines in the STGs and  
176 acute medicines, availability increases with increasing level of care. A similar trend was  
177 observed for NCD medicines listed in the EML.

[Figure 2: Facility level mean proportion of availability by level of care for medicines listed in  
the standard treatment guidelines and acute disease medicines]

178 Appendix 3, presents the overall availability of each study medicine disaggregated by provider  
179 type and branded versus generic formulations. Generally, generics were more common than  
180 originator brands across all of the study facilities. Only two originator brands of study medicines  
181 were available in public facilities compared with 19 in private non-profit, and 21 in private for-  
182 profit drug outlets. Several medicines included in the EML had a proportion of availability of  
183 over 50%. However, salbutamol, an important medicine for asthma relief had an availability of  
184 less than 40% across the different types of providers. Thirteen medicines had very low  
185 availability including CVD medicines such as bisoprolol, ramipril, simvastatin, valsartan and  
186 diabetes medicines such as glimeperide.

187 Appendix 4 presents the availability of study medicines by county. The mean proportion of  
188 availability of study medicines ranges from 0.24 in West Pokot to 0.42 in Makueni.

### 189 *Non-compliance of public and non-profit facilities with the EML*

190 Twelve of the NCD medicines in this study were not on the EML. However, each of these  
191 medicines was found at all levels of care. The proportion of health facilities stocking these

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3 192 medicines ranged from 0.01 to 0.2. As mentioned earlier, all of the study NCD medicines  
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5 193 included in the EML were assigned level 4 and above except salbutamol inhaler which was  
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8 194 assigned level 2 and above. However, more than half of levels 2 and 3 facilities were stocking  
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10 195 four of these medicines (amitriptyline 25mg, furosemide 40mg, metformin 500mg, and  
11  
12 196 omeprazole 20mg).

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15 197 Among acute medicines, diazepam 5mg was restricted to level 4 and above, however, the  
16  
17 198 proportion of level 2 and level 3 facilities stocking this medicine were 0.5 and 0.6 respectively.

### 19 20 21 199 **Medicine prices**

22  
23 200 The mean proportion of public facilities giving medicines for free (0.47) was significantly higher  
24  
25 201 than the mean proportion of private non-profit facilities giving medicines for free (0.09), ( $p <$   
26  
27 202 0.0001). For example, generic metformin 500mg Tab/Cap was provided for free at 38.5%  
28  
29 203 (n=15/39) of public facilities and 14.9% (n=7/47) of private-non-profit facilities. Drug outlets  
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31 204 did not offer any medicines for free. There was large variability in the free provision of  
32  
33 205 medicines among public health facilities which was unrelated to county (data not shown).

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36 206 Among non-profit facilities, the mean proportion of giving NCD medicines for free (0.05) was  
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38 207 significantly less than the mean proportion giving acute medicines for free (0.18),  $p < 0.0001$ .

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40 208 However, this difference was not significantly different in public facilities (0.45 for NCD  
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42 209 medicines and 0.54 for acute medicines),  $p = 0.3119$ . More levels 2 and 3 facilities provided  
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44 210 medicines for free compared to level 4 facilities.

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48 211 The median price ratio ranged from 0.6 for paracetamol syrup in private for-profit drug outlets to  
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50 212 8.3 for simvastatin 20mg tablets/caps in private non-profit health facilities. There was more  
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52 213 variability in median price ratios for NCD medicines (Figure 3). The mean of the price ratio was  
53  
54 214 2.29 in the public sector, 3.61 in the private non-profit sector, and 2.95 in drug outlets (Table 1

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3 215 and Figure 3). The mean price ratio of NCD medicines (2.1) was not significantly different from  
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5 216 the mean price ratio of acute medicines (2.0) in public facilities  $p=0.3517$ . However, the mean  
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7 217 price ratio of NCD medicines was significantly higher than the mean price ratio of acute  
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9 218 medicines in non-profit facilities (4.1 vs 2.0 respectively)  $p=0.0094$ , and in drug outlets (3.5 vs.  
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11 219 1.7).

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14  
15 220 No clear trends emerged when mean price ratios were stratified by level of care. However, prices  
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17 221 tended to be generally higher in level 3 compared to levels 2, 4 and 5 facilities.

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21 222 The wide variations in medicine prices was not only prevalent across provider types, it existed  
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23 223 within the same provider and within the same level of care. The within provider type variations  
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25 224 appeared to be more pronounced in private drug outlets compared to public sector facilities. For  
26  
27 225 example, the price of 1g vial of generic ceftriaxone ranged from 30 to 800 KES in private drug  
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29 226 outlets, 10 to 550 in private not-for-profit facilities and 50 to 400 in public facilities.

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33 [Figure 3: Mean price ratios of NCD medicines and acute disease medicines by provider type]  
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Table 1 – Percentage dispensing free of charge and median price ratios of study medicines (using MSH supplier prices as a reference)

Medicine tablets or capsules except otherwise noted	Public facilities		Private non-profit facilities		Median price ratios		
	Number surveyed*	Percentage dispensed for free % (number)	Number surveyed	Percentage dispensed for free % (number)	Public	Non profit	Drug Stores
<i>Medicines for CVD</i>							
Amlodipine 10mg	2	50 (1)	12	8.3 (1)	1.3	2.7	2.7
<b>Amlodipine 5mg</b>	<b>17</b>	<b>17.6 (3)</b>	<b>16</b>	<b>0</b>	<b>2.3</b>	<b>6.3</b>	<b>5.0</b>
Atenolol 50mg	31	32.3 (10)	38	15.8 (6)	.	3.7	4.6
Bisoprolol 10mg	0	-	1	0	.	3.4	-
Bisoprolol 5mg	1	0 0	0	-	-	-	-
Captopril 25mg	0	-	3	0	.	4.4	2.0
<b>Furosemide 40mg</b>	<b>41</b>	<b>43.9 (18)</b>	<b>57</b>	<b>12.3 (7)</b>	<b>1.6</b>	<b>3.3</b>	<b>3.3</b>
Hydrochlorothiazide 50mg	12	58.3 (7)	16	0	2.3	6.4	4.7
Ramipril 10mg	0	-	1	0	-	-	-
Ramipril 5mg	0	-	1	0	-	-	-
<b>Simvastatin 20mg</b>	<b>0</b>	<b>-</b>	<b>1</b>	<b>0</b>	<b>.</b>	<b>8.3</b>	<b>5.7</b>
Valsartan 80mg	0	-	1	0	-	-	-
<i>Medicines for diabetes</i>							
<b>Glibenclamide 5mg</b>	<b>34</b>	<b>35.3 (12)</b>	<b>44</b>	<b>11.4 (5)</b>	<b>3.5</b>	<b>5.3</b>	<b>5.3</b>
Glimeperide 1mg	0	-	1	0	-	-	-
Glimeperide 2mg	0	-	3	0	-	-	-
Glimeperide 4mg	0	-	3	0	-	-	-
Metformin 1000mg	0	-	1	0	.	2.6	1.3
<b>Metformin 500mg</b>	<b>39</b>	<b>38.5 (15)</b>	<b>47</b>	<b>14.9 (7)</b>	<b>2.0</b>	<b>3.3</b>	<b>3.3</b>
<i>Medicines for asthma</i>							
<b>Salbutamol 100MCG/DOS inhaler</b>	<b>24</b>	<b>41.7 (10)</b>	<b>35</b>	<b>14.3 (5)</b>	<b>1.1</b>	<b>1.0</b>	<b>1.4</b>
<i>Other NCD medicines</i>							
<b>Amitriptyline 25mg</b>	<b>40</b>	<b>45 (18)</b>	<b>50</b>	<b>16 (8)</b>	<b>1.3</b>	<b>3.5</b>	<b>2.3</b>
<b>Omeprazole 20 mg</b>	<b>45</b>	<b>35.6</b>	<b>65</b>	<b>15.4</b>	<b>3.5</b>	<b>3.5</b>	<b>3.5</b>



Medicine tablets or capsules except otherwise noted	Public facilities		Private non-profit facilities		Median price ratios		
	Number surveyed*	Percentage dispensed for free % (number)	Number surveyed	Percentage dispensed for free % (number)	Public	Non profit	Drug Stores
		<b>(16)</b>		<b>(10)</b>			
<i>Acute medicines</i>							
Amoxicillin 250mg Dispersible tab	21	52.4 (11)	27	22.2 (6)	1.4	0.9	0.9
<b>Amoxicillin 250mg</b>	<b>41</b>	<b>43.9 (18)</b>	<b>53</b>	<b>18.9 (10)</b>	<b>1.9</b>	<b>1.9</b>	<b>1.9</b>
<b>Amoxicillin 500mg</b>	<b>7</b>	<b>71.4 (5)</b>	<b>37</b>	<b>13.5 (5)</b>	<b>1.5</b>	<b>1.7</b>	<b>1.7</b>
<b>Ceftriaxone 1 g/vial Inj</b>	<b>40</b>	<b>40.0 (16)</b>	<b>57</b>	<b>12.3 (7)</b>	<b>2.9</b>	<b>3.7</b>	<b>1.7</b>
<b>Ciprofloxacin 500mg</b>	<b>15</b>	<b>40.0 (6)</b>	<b>45</b>	<b>8.9 (4)</b>	<b>2.7</b>	<b>2.7</b>	<b>2.7</b>
<b>Co-trimoxazole 8+40mg/ml Susp.</b>	<b>31</b>	<b>67.7 (21)</b>	<b>51</b>	<b>27.5 (14)</b>	<b>1.1</b>	<b>2.1</b>	<b>1.7</b>
<b>Diazepam 5mg</b>	<b>34</b>	<b>44.1 (15)</b>	<b>51</b>	<b>21.6 (11)</b>	<b>3.7</b>	<b>2.1</b>	<b>2.1</b>
<b>Paracetamol 24mg/ml Susp.</b>	<b>44</b>	<b>75.0 (33)</b>	<b>57</b>	<b>24.6 (14)</b>	<b>1.0</b>	<b>1.0</b>	<b>0.6</b>
<b>Mean</b>		<b>43.8%</b>		<b>8.7%</b>	<b>2.1</b>	<b>3.4</b>	<b>2.9</b>

\* Refers to the number of facilities that have the medicine in stock and which reported a price for it. Medicines on the EML (2010 or 2016) are highlighted in bold

## 227 DISCUSSION

228 This study has revealed important findings on the availability and price of NCD medicines in  
 229 Kenya. It is the first study to report on disparities in availability of medicines by level of care  
 230 within public and non-profit facilities, and take into account the EML restriction on medicines  
 231 with respect to level of care.

### 232 Medicines availability for NCD and acute conditions

233 While the availability for many EML medicines was higher than 50%, availability was far below  
 234 the international target of 80% availability(6,37). This is concerning in particular for NCD  
 235 medicines. We found significantly lower availability of NCD medicines listed in the STGs  
 236 compared to medicines for acute conditions. This is despite the fact that one-half of total hospital

1  
2  
3 237 admissions and over 55% of hospital deaths in Kenya are due to NCDs (7). The mean  
4  
5 238 availability of NCD medicines included in the STGs was two to three times lower than those  
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7  
8 239 found in other studies in Kenya(3,11,12). The low availability of some of these NCD medicines  
9  
10 240 may indicate low demand, or the preference of prescribers and patients for other therapeutic  
11  
12 241 options within the same classes of medicines which were not assessed in our study. Considering  
13  
14 242 the high burden of NCDs globally, and the rapidly increasing burden in low- and middle-income  
15  
16 243 countries, efforts are needed to ensure the reliable supply of NCD medicines in health facilities at  
17  
18  
19 244 all levels in Kenya.

22 245 Our study assessed the availability of medicines specifically at levels 2, 3, 4 and 5 facilities with  
23  
24 246 availability higher at higher levels of care (though the differences were not statistically  
25  
26 247 significant). Among the programmatic objectives of the EML is the promotion of appropriate use  
27  
28 248 of medicines. For this reason several NCD medicines are limited to certain levels of care.  
29  
30 249 Despite the limitation of NCD medicines to level 4 facilities and above, we found many of these  
31  
32 250 medicines in several level 2 and 3 facilities suggesting there is demand for NCD medicines at  
33  
34 251 these lower level facilities. If the barrier to availability is the limitation of NCD medicines to  
35  
36 252 level 4 facilities and above, then additional measures such as building the capacity of lower level  
37  
38 253 care facilities to provide these medicines may be needed to ensure access. It is also important to  
39  
40 254 note that 12 NCD medicine formulations that were not listed in the EML were available across  
41  
42 255 all levels of care. Though the availability of these medicines are lower than those on the EML, it  
43  
44 256 still raises the question of whether the EML is being implemented to its optimal potential in the  
45  
46 257 country.

52 258 The generally low availability of originator brands, especially in the public sector is in line with  
53  
54 259 international recommendations to promote the use of generic medicines to increase efficiency in  
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56  
57

1  
2  
3 260 medicines expenditure(20,38,39). Nonetheless, the limited availability of originator medicines in  
4  
5 261 the public sector does not necessarily translate into higher rates of prescribing of generics. The  
6  
7  
8 262 2012 Pharmaceutical Country Profile of Kenya indicates that prescribing by International Non-  
9  
10 263 proprietary Names (INN) is neither obligatory in the public sector nor in the private sector(40).  
11  
12 264 Only 32% of medicines are prescribed by INN. Thus, it is important to promote prescribing by  
13  
14  
15 265 INN to further promote the use of generic medicines.

### 266 **Prices of medicines**

267 Though it is government policy to provide medicines for free at levels 2 and 3 facilities in  
28  
29 268 Kenya, our findings suggest that each facility decided whether to charge for the medicines  
30  
31 269 dispensed. Free dispensing varied across and within provider type (except for private drug outlets  
32  
33 270 where no medicine was given for free), across level of care and by county. Patient knowledge of  
34  
35 271 which facilities charge for medicines and which do not increases the complexity of efforts to find  
36  
37 272 affordable medicines. There was no hospital at which paracetamol syrup and co-trimoxazole  
38  
39 273 suspension, medicines frequently prescribed for children, were given for free.

40  
41 274 There were large price variations across and within provider type, level of care and county. Drug  
42  
43 275 outlets and private non-profit facilities exhibited similar patterns in relation to pricing. Both  
44  
45 276 types of providers charged higher prices than public facilities. Private non-profit providers were  
46  
47 277 significantly less likely to offer medicines for free compared to public facilities. Additionally, the  
48  
49 278 mean price ratios of NCD medicines were significantly higher than the mean price ratio of acute  
50  
51 279 medicines in both private non-profit facilities and private drug outlets, though no significant  
52  
53 280 differences were observed in the public sector. This may indicate relatively higher mark-ups on  
54  
55 281 NCD medicines in non-profit and private drug outlets. Other studies have reported higher prices  
56  
57 282 at private for-profit drug outlets(10,11,41). A study by Health Action International also

1  
2  
3 283 demonstrated higher mark-ups on medicines in private non-profit providers(42). The government  
4  
5 284 of Kenya charges import declaration fees on medicines which may contribute to higher  
6  
7  
8 285 prices(40). Considering the low availability of NCD medicines in public facilities, patients' best  
9  
10 286 option may have been to access their medicines at private non-profit facilities and private drug  
11  
12 287 outlets at higher prices. The high cost of NCD medicines has been shown to be a financial  
13  
14  
15 288 burden on households in Kenya(43,44).

### 18 289 **Strengths and limitations**

19  
20 290 As mentioned earlier, this study is the first study that evaluates availability taking into  
21  
22 291 consideration the level of care medicines are assigned in the EML. In addition this study also  
23  
24 292 evaluates availability separately NCD for medicines included in the EML and those included in  
25  
26 293 the STGs, highlighting the differences between the two documents. The cross sectional nature of  
27  
28  
29 294 the study does not allow us to assess trends in availability and price over time and precludes  
30  
31 295 strong causal inference. In addition we evaluated availability as binary variable (yes/no) and did  
32  
33  
34 296 not count the quantity available. Furthermore, the sample of the private for-profit drug outlets  
35  
36 297 was restricted to the nearest ones from public and non-profit facilities. Even though this sample  
37  
38 298 is not representative of all private for-profit sector facilities in each county, it allows studying the  
39  
40 299 availability and prices consumers would encounter when referred from public and non-profit  
41  
42  
43 300 facilities

### 46 301 **CONCLUSION**

47  
48 302 We found evidence that the availability of NCD medicines in Kenya is significantly lower than  
49  
50 303 the target level of 80%. Availability is poorest in the public sector, and generally highest in the  
51  
52  
53 304 private for-profit sector. Availability increased with increasing level of care. Our findings  
54  
55 305 suggest that NCD patients in Kenya do not have reliable access to NCD medicines, particularly

1  
2  
3 306 at public health facilities. Increasing access at public facilities, particularly level 2 and 3  
4  
5 307 facilities, should be a focus of the Kenyan government's efforts to achieve universal health  
6  
7 308 coverage. Pricing policies or guidelines may be useful to streamline medicine prices in the  
9  
10 309 country.

### 13 310 **STATEMENT OF AUTHORSHIP**

15 311 PA, PR, RL, MO, JB and VW participated in the conception and design of the study. These  
17 312 authors also participated in the development and piloting of study instruments and the  
19 313 supervision of data collection. PA, PR, RL, MO, JB, HC and VW contributed significantly to  
21 314 data analysis and writing of the manuscript and have approved of the final version submitted for  
23 315 publication.

### 28 316 **DATA SHARING**

30 317 Deidentified data are publicly available and can be requested at:  
32 318 <http://sites.bu.edu/evaluatingaccess-novartisaccess/kenya/data/>. The terms of use of the data are  
34 319 also available at this website. If you have any questions about the data please contact the  
36 320 Department of Global Health, Boston University School of Public Health at: [sphgh@bu.edu](mailto:sphgh@bu.edu)

### 40 321 **COMPETING INTERESTS**

42 322 The authors have no conflicts of interest to declare.

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52 326 <http://sites.bu.edu/novartisaccessevaluation/agreements/>)

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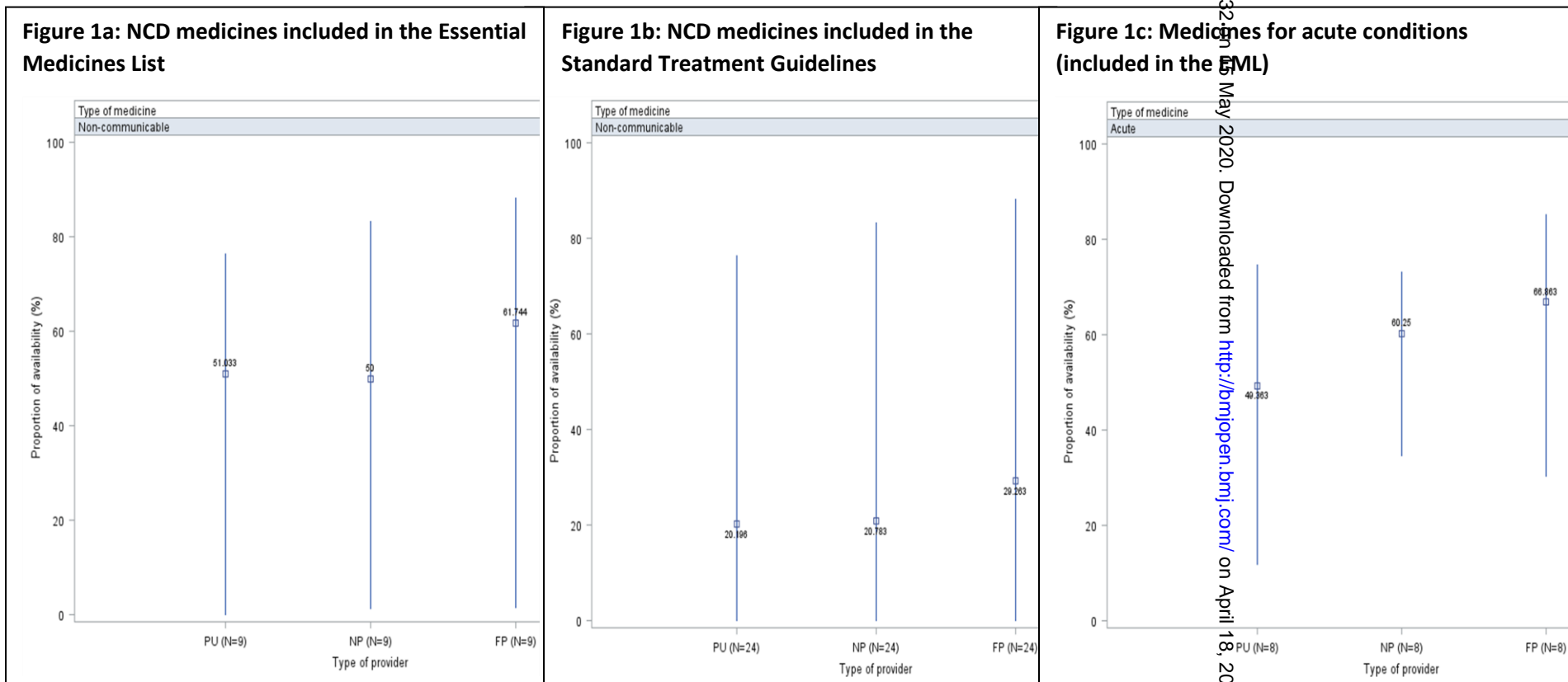
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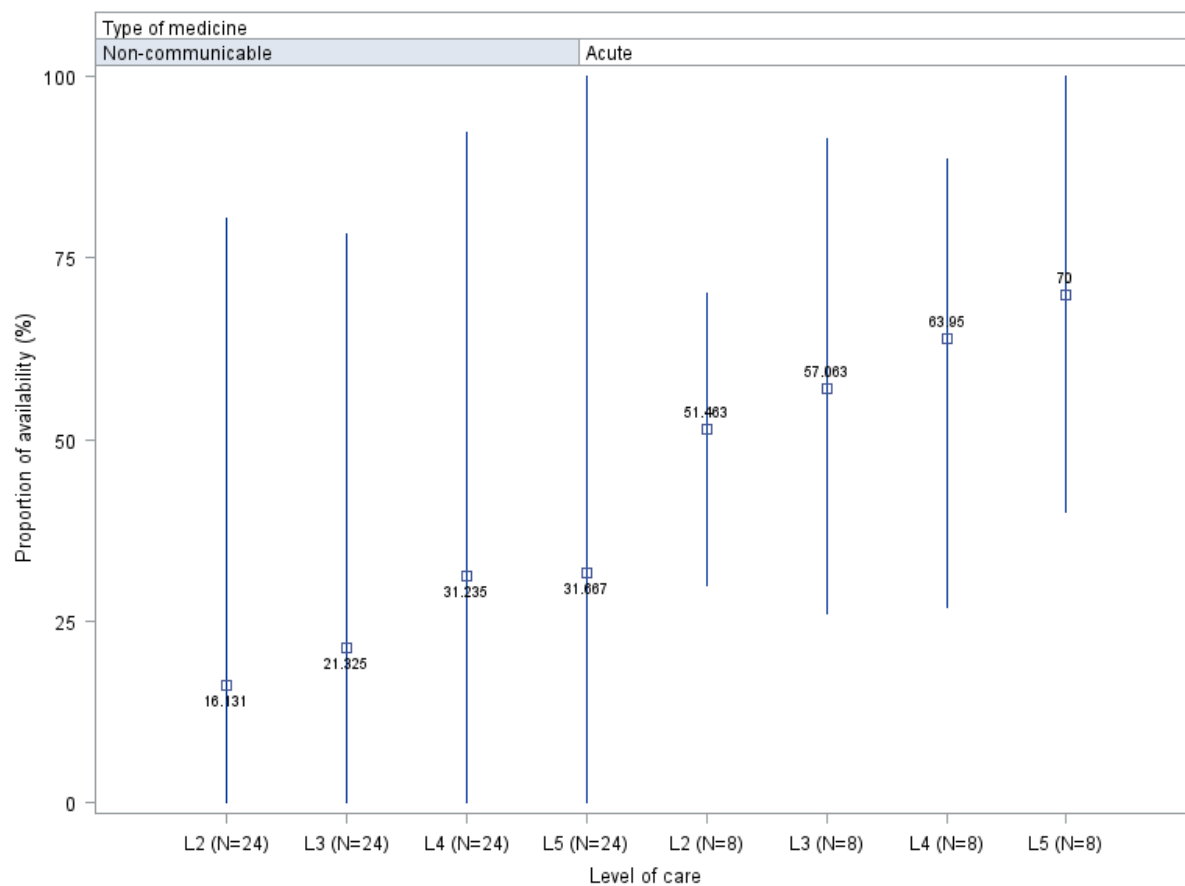
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Figure 1: Facility level mean proportion of availability by provider type for NCD medicines included in the EML, NCD medicines listed in STGs and acute medicines included in the EML



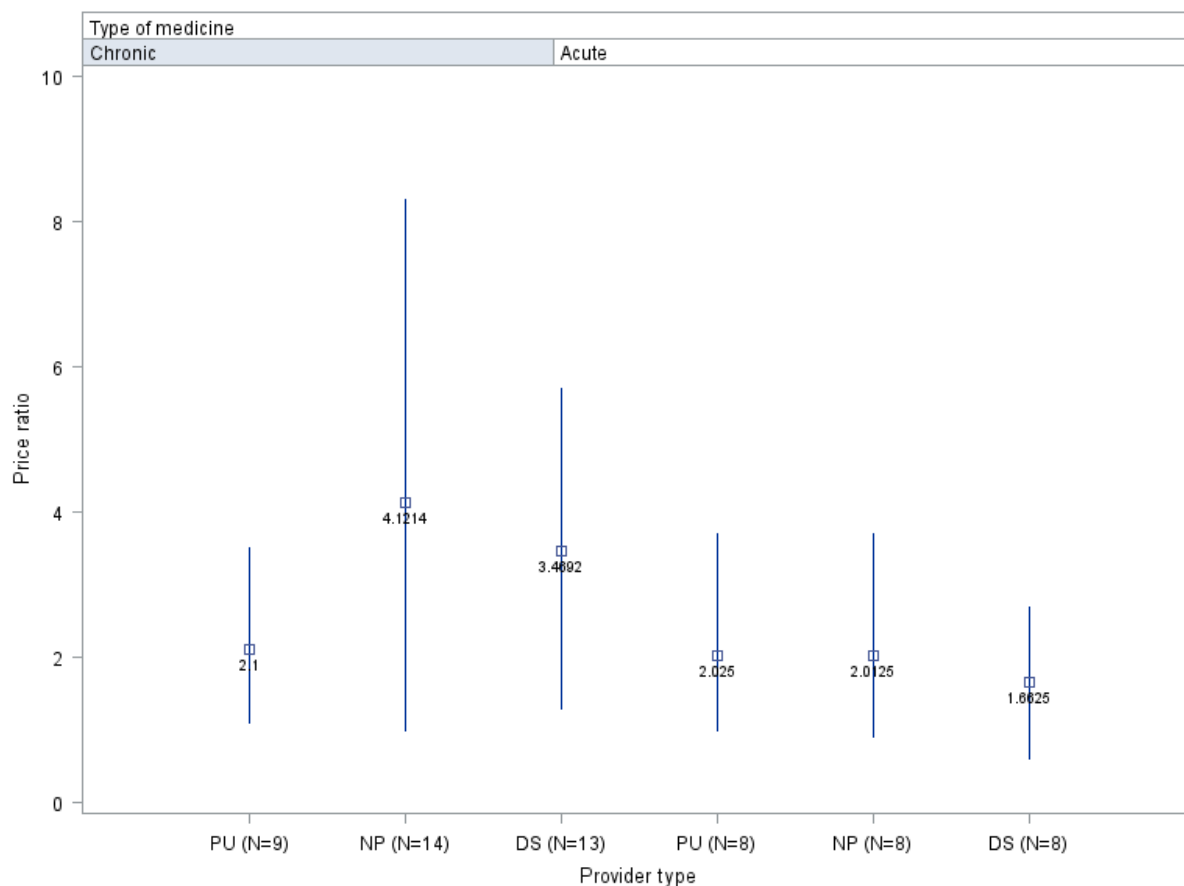
PU – Public facility; NP=private non-profit facility; FP=private for-profit drug outlet; NCD=non-communicable disease; STG=Standard Treatment Guidelines; EML=Essential Medicines List (The box indicates the mean and the bars indicate the minimum and maximum)

Figure 2: Facility level mean proportion of availability by level of care for medicines listed in the standard treatment guidelines and acute disease medicines



L2 = Level 2 facilities; L3 = Level 3 facilities; L4 = Level 4 facilities; L5 = Level 5 facilities; N=number of medicines surveyed (The box indicates the mean and the bars indicate the minimum and maximum)

Figure 3: Mean price ratios of NCD medicines and acute disease medicines by provider type



PU – Public facility; NP=private-non-profit facility; FP=Private-of-profit drug outlet N=number of medicines surveyed (The box indicates the mean and the bars indicate the minimum and maximum)

## APPENDIX

Appendix 1: List of study medicines, level of care found and level of care assigned in the 2010 and 2016 essential medicines list (EML)

Medicine	Level of care medicine was available				Lowest level of care assigned in the 2016 EML	Lowest level of care assigned in the 2010 EML
	Level 2	Level 3	Level 4	Level 5		
<i>Medicines for CVD (n=15)</i>						
Amlodipine 10mg Tab/Cap	X	X	X	X	-	-
Amlodipine 5mg Tab/Cap	X	X	X	X	4	4
Atenolol 50mg Tab/Cap	X	X	X	X	-	4
Bisoprolol 10mg Tab/Cap	-	-	X	-	-	-
Bisoprolol 5mg Tab/Cap	-	X	-	-	-	-
Bisoprolol 2.5mg Tab/Cap	-	-	-	-	-	-
Captopril 25mg Tab/Cap	X	-	X	-	-	-
Furosemide 40mg Tab/Cap	X	X	X	X	4	4
Hydrochlorothiazide 50mg Tab/Cap	X	X	X	X	-	-
Ramipril 10mg Tab/Cap	-	-	X	-	-	-
Ramipril 5mg Tab/Cap	-	-	X	-	-	-
Simvastatin 20mg Tab/Cap <sup>1</sup>	-	-	X	-	4	-
Simvastatin 40mg Tab/Cap	-	-	-	-	-	-
Valsartan 80mg Tab/Cap	-	-	X	-	-	-
Valsartan 160mg Tab/Cap	-	-	-	-	-	-
<i>Medicines for diabetes (n=6)</i>						
Glibenclamide 5mg Tab/Cap	X	X	X	X	4	4
Glimeperide 1mg Tab/Cap	-	-	X	-	-	-
Glimeperide 2mg Tab/Cap	-	-	X	-	-	-
Glimeperide 4mg Tab/Cap	-	-	X	-	-	-
Metformin 1000mg Tab/Cap	-	-	X	-	-	-
Metformin 500mg Tab/Cap	X	X	X	X	4	4
<i>Medicines for asthma (n=1)</i>						
Salbutamol 100mcg/dos inhalation	X	X	X	X	4	2
<i>Other NCD medicines</i>						
Amitriptyline 25mg Tab/Cap	X	X	X	X	4	4
Omeprazole 20mg Tab/Cap	X	X	X	X	4	4
<i>Acute medicines (n=8)</i>						
Amoxicillin 250mg Dispersible tab	X	X	X	X	2	-

<sup>1</sup> As an alternative to atorvastatin.

Medicine	Level of care medicine was available				Lowest level of care assigned in the 2016 EML	Lowest level of care assigned in the 2010 EML
	<i>Level 2</i>	<i>Level 3</i>	<i>Level 4</i>	<i>Level 5</i>		
Amoxicillin 250mg Tab /Cap	X	X	X	X	2	2
Amoxicillin 500mg Tab/Cap	X	X	X	X	2	-
Ceftriaxone 1 g/vial Inj	X	X	X	X	2	4
Ciprofloxacin 500mg Tab/Cap	X	X	X	X	3	-
Co-trimoxazole (8+40mg/ml susp.	X	X	X	X	2	2
Diazepam 5mg Tab/Cap	X	X	X	X	4	5
Paracetamol 24mg/ml Susp	X	X	X	X	1	1

X = medicine available in at least one facility

- = medicine not available or not in the EML

All of the NCD medicines are included in the current Kenyan standard treatment guidelines.

Appendix 2: Overview of types of study facilities by county

<i>County</i>	<i>Public health facility</i>	<i>Private-non-profit health facility</i>	<i>Private-for-profit drug seller</i>	<i>Total</i>
Embu	6	18	24	48
Kakamega	6	10	16	32
Kwale	5	4	12	21
Makueni	8	17	26	51
Narok	7	9	15	31
Nyeri	16	14	30	60
Samburu	3	4	5	12
West Pokot	8	2	7	17
<b>Total</b>	<b>59</b>	<b>78</b>	<b>135</b>	<b>272</b>

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Appendix 3: Availability of medicines (proportion of facilities having medicine available on day of visit) by type of facility

Medicine (Tablets/capsules otherwise noted)	Public (N=59)		Private non-profit (N=78)		Private for profit drug outlets (N=135)		Overall availability N=(272)	
	Generic	Originator	Generic	Originator	Generic	Originator	Generic	Originator
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
<i>Medicines for CVD</i>								
Amlodipine 10mg	3.4 (2)	-	14.1 (11)	1.3 (1)	46.7 (63)	1.5 (2)	27.9 (76)	1.1 (3)
<b>Amlodipine 5mg</b>	<b>28.8 (17)</b>	-	<b>20.5 (16)</b>	-	<b>39.3 (53)</b>	<b>1.5 (2)</b>	<b>31.6 (86)</b>	<b>0.7 (2)</b>
Atenolol 50mg	52.5 (31)	-	48.7 (38)	-	70.4 (59)	0.7 (1)	60.3 (164)	0.4 (1)
Bisoprolol 10mg	-	-	1.3 (1)	-	-	-	0.4 (1)	-
Bisoprolol 5mg	1.7 (1)	-	-	-	0.7 (1)	-	0.7 (2)	-
Captopril 25mg	-	-	3.9 (3)	-	16.3 (22)	-	9.2 (25)	-
<b>Furosemide 40mg</b>	<b>69.5 (41)</b>	-	<b>70.5 (55)</b>	<b>2.6 (2)</b>	<b>73.3 (99)</b>	<b>5.9 (8)</b>	<b>71.7 (195)</b>	<b>3.6 (10)</b>
Hydrochlorothiazide	20.3 (12)	-	20.5 (16)	-	29.6 (40)	-	24.7 (68)	-
Ramipril 10mg	-	-	-	1.3 (1)	0.7 (1)	-	0.4 (1)	0.4 (1)
Ramipril 5mg	-	-	1.3 (1)	-	1.5 (2)	0.7 (1)	1.1 (3)	0.4 (1)
<b>Simvastatin 20mg</b>	-	-	<b>1.3 (1)</b>	-	<b>1.5 (2)</b>	-	<b>1.1 (3)</b>	-
Valsartan 80mg	-	-	1.3 (1)	-	0.7 (1)	-	0.7 (2)	-
Mean availability CVD medicines								
<i>Medicines for diabetes</i>								
<b>Glibenclamide 5mg</b>	<b>57.6 (34)</b>	-	<b>56.4 (44)</b>	<b>1.3 (1)</b>	<b>75.6 (102)</b>	<b>4.4 (6)</b>	<b>66.1 (180)</b>	<b>2.6 (7)</b>
Glimeperide 1mg	-	-	-	1.3 (1)	3 (4)	4.4 (6)	1.5 (4)	2.6 (7)
Glimeperide 2mg	-	-	1.3 (1)	2.6 (2)	10.4 (14)	5.2 (7)	5.5 (15)	3.3 (9)
Glimeperide 4mg	-	-	-	3.9 (3)	5.2 (7)	3.0 (4)	2.6 (7)	2.6 (7)
Metformin 1000mg	-	-	1.3 (1)	1.3 (1)	15.5 (21)	8.9 (12)	8.1 (22)	5.1 (14)



Medicine (Tablets/capsules otherwise noted)	Public (N=59)		Private non-profit (N=78)		Private for profit drug outlets (N=135)		Overall availability N=(272)	
	Generic	Originator	Generic	Originator	Generic	Originator	Generic	Originator
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Metformin 500mg	66.1 (39)	-	60.3 (47)	1.3 (1)	73.3 (99)	10.4 (14)	68.4 (188)	5.5 (15)
<i>Medicines for asthma</i>								
Salbutamol 100mcg/dos inhalation	39 (23)	1.2 (1)	23.1 (18)	21.8 (17)	34.8 (47)	35.6 (48)	32.4 (88)	24.3 (66)
<i>Other NCD medicines</i>								
Amitriptyline 25mg	67.8 (40)	-	64.1 (50)	-	63.7 (86)	-	64 (176)	-
Omeprazole 20 mg	76.3 (45)	-	83.3 (65)	-	96.3 (130)	0.7 (1)	88.2 (242)	0.4 (1)
<i>Acute medicines</i>								
Amoxicillin 250mg Dispersible tab	35.6 (21)	-	33.3 (26)	1.3 (1)	29.6 (40)	1.5 (2)	32.0 (87)	1.1 (3)
Amoxicillin 250mg	69.5 (41)	-	66.7 (52)	2.6 (2)	68.9 (93)	3.7 (5)	68 (187)	5.6 (7)
Amoxicillin 500mg	11.9 (7)	-	46.2 (36)	2.6 (2)	82.2 (111)	11.1 (15)	56.6 (154)	6.3 (17)
Ceftriaxone 1g/vial Inj	67.8 (40)	3.4 (2)	73.1 (57)	5.1 (4)	69.6 (94)	4.4 (6)	70.2 (191)	4.4 (12)
Ciprofloxacin 500mg	25.4 (15)	-	55.1 (43)	2.6 (2)	83.7 (113)	3.7 (5)	62.9 (171)	2.6 (7)
Co-trimoxazole 8+40mg/ml susp	52.5 (31)	-	62.8 (49)	2.6 (2)	68.9 (93)	6.7 (9)	63.6 (173)	4.0 (11)
Diazepam 5mg	57.6 (34)	-	65.4 (51)	1.3 (1)	47.4 (64)	-	54.8 (150)	0.4 (1)
Paracetamol 24mg/ml Susp	74.6 (44)	-	73.1 (57)	2.6 (2)	73.3 (99)	15.6 (21)	73.5 (200)	8.5 (23)

Note: Bisoprolol 2.5mg Tab/Cap, Simvastatin 40mg Tab/Cap, and Valsartan 160mg Tab/Cap were not available in any facility. Medicines either on the 2010 or 2016 edition of the EML in bold

**Appendix 4: Proportion of availability of study medicines (proportion of facilities having medicine available on day of visit) by county**

Medicine	Embu		Kakamega		Kwale		Makueni		Narok		Nyeri		Samburu		West Pokot	
	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB
Amitriptyline 25mg	66.7 (32)		40.6 (13)		57.1 (12)		76.5 (39)		51.6 (16)		85 (51)		83.3 (10)		17.7 (3)	
Amlodipine 10mg	33.3 (16)	0 (0)	15.6 (5)	0 (0)	28.6 (6)	0 (0)	25.5 (13)	2 (1)	12.9 (4)	3.2 (1)	48.3 (29)	7 (1)	25 (3)	0 (0)	0 (0)	0 (0)
Amlodipine 5mg	39.6 (19)	0 (0)	25 (8)	0 (0)	33.3 (7)	4.8 (1)	25.5 (13)	2 (1)	19.4 (6)	0 (0)	51.7 (31)	0 (0)	8.3 (1)	0 (0)	5.9 (1)	0 (0)
Amoxicillin dispersible tabs 250mg	14.6 (7)	0 (0)	43.8 (14)	0 (0)	19.1 (4)	0 (0)	21.6 (11)	0 (0)	12.9 (4)	0 (0)	53.3 (32)	3 (3)	58.3 (7)	0 (0)	47.1 (8)	0 (0)
Amoxicillin 500mg	58.3 (28)	0 (0)	62.5 (20)	3.1 (1)	52.4 (11)	14.3 (3)	58.8 (30)	9.8 (5)	61.3 (19)	9.7 (3)	60 (36)	3 (5)	41.7 (5)	0 (0)	29.4 (5)	0 (0)
Amoxicillin 250mg	68.8 (33)	0 (0)	56.3 (18)	0 (0)	57.1 (12)	4.8 (1)	82.4 (42)	2 (1)	77.4 (24)	3.2 (1)	65 (39)	7 (4)	16.7 (2)	0 (0)	94.1 (16)	0 (0)
Atenolol 50mg	58.3 (28)	0 (0)	46.9 (15)	0 (0)	71.4 (15)	0 (0)	72.6 (37)	0 (0)	22.6 (7)	3.2 (1)	91.7 (55)	0 (0)	41.7 (5)	0 (0)	11.8 (2)	0 (0)
Bisoprolol 10mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8.3 (1)	0 (0)	0 (0)	0 (0)
Bisoprolol 2.5mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Bisoprolol 5mg	2.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.7 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Captopril 25mg	16.7 (8)	0 (0)	3.1 (1)	0 (0)	4.8 (1)	0 (0)	5.9 (3)	0 (0)	9.7 (3)	0 (0)	13.3 (8)	0 (0)	8.3 (1)	0 (0)	0 (0)	0 (0)
Ceftriaxone 1g/vial Inj	58.3 (28)	2.1 (1)	75 (24)	3.1 (1)	71.4 (15)	0 (0)	78.4 (40)	5.9 (3)	67.7 (21)	3.2 (1)	68.3 (41)	7 (4)	66.7 (8)	16.7 (2)	82.4 (14)	0 (0)
Ciprofloxacin 500mg	70.8 (34)	2.1 (1)	59.4 (19)	0 (0)	57.1 (12)	4.8 (1)	66.7 (34)	2 (1)	61.3 (19)	6.5 (2)	66.7 (40)	3 (2)	66.7 (8)	0 (0)	29.4 (5)	0 (0)
Cotrimoxazole 8+40mg/ml susp	72.9 (35)	0 (0)	50 (16)	0 (0)	57.1 (12)	4.8 (1)	54.9 (28)	11.8 (6)	54.8 (17)	6.5 (2)	75 (45)	3 (2)	66.7 (8)	0 (0)	70.6 (12)	0 (0)
Diazepam 5g	47.9 (23)	0 (0)	31.3 (10)	0 (0)	42.9 (9)	0 (0)	76.5 (39)	0 (0)	38.7 (12)	0 (0)	73.3 (44)	7 (1)	58.3 (7)	0 (0)	29.4 (5)	0 (0)
Furosemide 40mg	62.5 (30)	2.1 (1)	56.3 (18)	3.1 (1)	71.4 (15)	4.8 (1)	84.3 (43)	2 (1)	61.3 (19)	3.2 (1)	91.7 (55)	3 (5)	66.7 (8)	0 (0)	41.2 (7)	0 (0)
Glibenclamide 5mg	56.3 (27)	0 (0)	62.5 (20)	0 (0)	66.7 (14)	4.8 (1)	78.4 (40)	5.9 (3)	51.6 (16)	3.2 (1)	86.7 (52)	3 (2)	58.3 (7)	0 (0)	23.5 (4)	0 (0)
Glimepiride 1mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4.8 (1)	2 (1)	3.9 (2)	3.2 (1)	3.2 (1)	3.3 (2)	3 (3)	0 (0)	0 (0)	0 (0)	0 (0)
Glimepiride 2mg	6.3 (3)	2.1 (1)	0 (0)	3.1 (1)	0 (0)	0 (0)	9.8 (5)	3.9 (2)	9.7 (3)	3.2 (1)	6.7 (4)	7 (4)	0 (0)	0 (0)	0 (0)	0 (0)

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Medicine	Embu		Kakamega		Kwale		Makueni		Narok		Nyeri		Samburu		West Pokot	
	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB
Glimepiride 4mg	2.1 (1)	2.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	3.9 (2)	3.2 (1)	3.2 (1)	6.7 (4)	3.2 (3)	0 (0)	0 (0)	0 (0)	0 (0)
Metformin 1000mg	10.4 (5)	0 (0)	0 (0)	3.1 (1)	4.8 (1)	0 (0)	3.9 (2)	7.8 (4)	12.9 (4)	6.5 (2)	16.7 (10)	4.5 (6)	0 (0)	0 (0)	0 (0)	0 (0)
Metformin 500mg	68.8 (33)	0 (0)	53.1 (17)	6.3 (2)	76.2 (16)	0 (0)	78.4 (40)	13.7 (7)	35.5 (11)	9.7 (3)	91.7 (55)	3.3 (3)	83.3 (10)	0 (0)	17.7 (3)	0 (0)
Omeprazole 20mg	91.7 (44)	0 (0)	93.8 (30)	0 (0)	85.7 (18)	0 (0)	88.2 (45)	2 (1)	74.2 (23)	0 (0)	95 (57)	0 (0)	75 (9)	0 (0)	82.4 (14)	0 (0)
Paracetamol 24mg/ml susp	75 (36)	0 (0)	56.3 (18)	0 (0)	71.4 (15)	14.3 (3)	68.6 (35)	15.7 (8)	71 (22)	3.2 (1)	91.7 (55)	8.3 (1)	58.3 (7)	0 (0)	70.6 (12)	0 (0)
Ramipril 10mg	0 (0)	0 (0)	3.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ramipril 5mg	2.1 (1)	0 (0)	3.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	8.3 (1)	0 (0)	0 (0)	0 (0)
Salbutamol Inhaler	47.9 (23)	12.5 (6)	46.9 (15)	9.4 (3)	19.1 (4)	19.1 (4)	19.6 (10)	51 (26)	16.1 (5)	19.4 (6)	23.3 (14)	3.3 (0)	58.3 (7)	8.3 (1)	58.8 (10)	0 (0)
Simvastatin 20mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3.9 (2)	0 (0)	0 (0)	0 (0)	1.7 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Simvastatin 40mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Valsartan 80mg	0 (0)	0 (0)	3.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8.3 (1)	0 (0)	0 (0)	0 (0)
Valsartan 180mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
<b>Mean % availability</b>	<b>34.4</b>	<b>0.7</b>	<b>29.8</b>	<b>1.0</b>	<b>31.8</b>	<b>2.7</b>	<b>36.8</b>	<b>4.7</b>	<b>27.6</b>	<b>2.9</b>	<b>42.0</b>	<b>1.4</b>	<b>32.0</b>	<b>0.8</b>	<b>23.9</b>	<b>0</b>

Gen=Generic; OB=Originator Brand

# BMJ Open

## Availability and prices of medicines for non-communicable diseases at health facilities and retail drug outlets in Kenya – A cross sectional survey in eight counties

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3 **Availability and prices of medicines for non-communicable diseases at health facilities and**  
4 **retail drug outlets in Kenya – A cross sectional survey in eight counties**  
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## ABSTRACT

**Objectives:** The objective of this study was to determine the availability and prices of medicines for non-communicable diseases (NCDs) in health facilities and private for-profit drug outlets in Kenya.

**Design:** Cross sectional study

**Methods:** All public and non-profit health facilities in eight counties (Embu, Kakamega, Kwale, Makeni, Narok, Nyeri, Samburu and West Pokot) that purchased medicines from the Mission for Essential Drugs and Supplies, a major wholesaler, were surveyed in September 2016. For each health facility, one nearby private for-profit drug outlet was also surveyed. Data on availability and price were analyzed for 24 NCD and eight acute medicine formulations. Availability was analyzed separately for medicines in the national Essential Medicines List (EML) and those in the Standard Treatment Guidelines (STGs). Median price ratios were estimated using the International Medical Products Price Guide as a reference.

**Results:** 59 public and 78 non-profit facilities and 135 drug outlets were surveyed. Availability of NCD medicines was highest in private for-profit drug outlets (61.7% and 29.3% for medicines on the EML and STGs respectively). Availability of STG medicines increased with increasing level of care of facilities - 16.1% at dispensaries to 31.7% at secondary referral facilities. The mean proportion of availability for NCD medicines listed in the STGs (0.25) was significantly lower than for acute medicines (0.61),  $p < 0.0001$ . The proportion of public facilities giving medicines for free (0.47) was significantly higher than the proportion of private non-profit facilities giving medicines for free (0.09), ( $p < 0.0001$ ). The mean price ratio of NCD medicines

22 was significantly higher than for acute medicines in non-profit facilities (4.1 vs 2.0 respectively;  
23  $p=0.0076$ ), and in private for-profit drug outlets (3.5 vs. 1.7;  $p=0.0013$ ).

24 **Conclusion:** Patients with NCDs in Kenya appear to have limited access to medicines.

25 Increasing access should be a focus of efforts to achieve universal health coverage.

26 **Keywords:** Kenya, non-communicable diseases, medicines, access, price

## 27 STRENGTHS AND LIMITATIONS

### 28 *Strengths*

- 29 • To the best of our knowledge this is the first study to evaluate availability of medicines  
30 based on the level of care medicines are assigned in the National Essential Medicines List  
31 .
- 32 • This study also evaluated availability separately for medicines for non-communicable  
33 diseases included in the Essential Medicines List and those included in the Standard  
34 Treatment Guidelines, highlighting the crucial differences between the two service  
35 delivery documents.

### 36 *Limitations*

- 37 • The cross sectional study design did not allow us to assess trends in availability and price  
38 of medicines over time and precludes making strong causal inferences.
- 39 • Availability of medicines was evaluated as binary variable (yes/no) and did not count the  
40 quantity in stock.
- 41 • The sample of participating private for-profit drug outlets was restricted to those nearest  
42 to public and non-profit facilities. While this may not be representative of all private for-



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43 profit sector facilities, it gave us the opportunity to study the availability and prices  
44 consumers would encounter when referred from public and non-profit facilities.

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## 45 INTRODUCTION

46 The burden of non-communicable diseases (NCDs) has been on the rise, especially in low and  
47 middle income countries (LMICs)(1,2). Globally, an estimated 40·5 million deaths in 2016 were  
48 due to NCDs(2). Eighty percent of these deaths were caused by diseases including cancers,  
49 cardiovascular diseases, chronic respiratory diseases, and diabetes. Nearly 80% of NCD deaths  
50 occur in LMICs, and people living in sub-Saharan Africa face the highest risk of death(2,3). In  
51 Kenya, one-half of total hospital admissions and over 55% of hospital deaths are due to  
52 NCDs(4). Cardiovascular diseases are the leading cause of NCD related deaths followed by  
53 cancer, which accounts for 7% of overall mortality in the country(5). According to the Kenya  
54 Stepwise Survey for Non-communicable Diseases Risk Factors 2015 Report, the prevalence of  
55 hypertension stands at 24%(4). With a national prevalence of about 4%, diabetes accounts for  
56 more than 8,000 deaths annually in Kenya(6,7).

57 In 2011, the United Nations General Assembly adopted a resolution for the prevention and  
58 control of NCDs (8). This commitment was renewed in 2015 with the adoption of the  
59 Sustainable Development Goals (SDGs), Target 3.4 of which aims to “By 2030, reduce by one  
60 third premature mortality from non-communicable diseases through prevention and treatment  
61 and promote mental health and well-being”(9). In 2014, Kenya launched its National Health  
62 Policy (NHP) with the goal of attaining the “highest possible standard of health in a responsive  
63 manner”(10). Among the six key objectives of this policy, one directly targets non-  
64 communicable diseases: “halt and reverse the rising burden of non-communicable conditions”.

65 Two critical indicators listed in the global monitoring framework (GMF) for the prevention and  
66 control of NCDs adopted by the 66<sup>th</sup> World Health Assembly in 2013 include affordability and  
67 availability of NCD medicines in health facilities (11,12).

68 Several studies have demonstrated limited availability and affordability of NCD medicines in  
69 LMICs(13–15). Despite the high burden of NCDs in Kenya, there are many challenges regarding  
70 access to NCD medicines(4,16,17). The government owned Kenya Medical Supplies Agency  
71 (KEMSA) and the Mission for Essential Drugs and Supplies (MEDS), are the leading suppliers  
72 (wholesalers) of medicines to public and not-for-profit hospitals and clinics. MEDS, a faith-  
73 based organization, supply about 40% of the volume of medicines consumed at public and non-  
74 profit facilities and operates in about 33 of the 47 counties in the country(18), Stockouts at these  
75 two wholesalers have reportedly been minimal(19). However, the availability of medicines in  
76 health facilities that serve patients (including dispensaries, health centers and hospitals) is  
77 generally poor, which may be a reflection of the supplier – retailer supply chain weaknesses and  
78 public financing of medicines among other factors(20). Medicines for NCDs were found to be  
79 much less available at health facilities compared with medicines for communicable diseases  
80 (46% vs. 70%)(20). The Kenya Service Delivery and Readiness Assessment Report, published in  
81 2014, reported an even lower mean availability of NCD medicines at primary care facilities and  
82 hospitals: 25% and 32% respectively(21).

83 There is no pricing policy or the regulation of mark-ups on medicines in Kenya. The country  
84 implemented a reduced user fee policy in 2004 which among other things, includes providing  
85 medicines for free at levels 2 and 3 facilities(19,22). However, studies have shown poor  
86 adherence to this policy(22,23). Only 19% of the population has insurance coverage, hence most  
87 patients pay for medicines out-of-pocket(24). Based on data collected in 2009, the prices of

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3 88 medicines are lower in public facilities compared to faith based facilities, though stock-outs are  
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5 89 about three times more common in public facilities (46% vs. 14%)(19).  
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9 90 Previous studies on availability and price of medicines in Kenya have had two major limitations.  
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11 91 First, these did not take into account the level of care of health facilities surveyed. With the goal  
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13 92 of ensuring appropriate use of medicines are various levels of care, the National Essential  
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15 93 Medicines List (EML), which guides public procurement in Kenya restricts most NCD  
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17 94 medicines to levels 4 facilities (primary (county) referral hospitals) and above(25,26). However,  
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19 95 it is not clear if providers or suppliers follow this restriction. Based on this restriction, the free  
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21 96 medicines policy at lower levels of care and possibly other factors, availability and prices of  
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23 97 medicines might differ by level of care. Secondly, previous studies did not evaluate availability  
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25 98 of medicines in the EML separately from medicines in the National Standard Treatment  
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27 99 Guidelines (STGs). Even though the EML and STGs are meant to complement each other in  
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29 100 standardizing the provision of quality health services in Kenya, there are more medicines listed  
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31 101 in the STGs than in the EML which can make the standardization of care challenging(25–30).  
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37 102 The objective of this study was to determine the availability and price of medicines for NCDs in  
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39 103 health facilities and private for-profit drug outlets in Kenya. The study compared the availability  
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41 104 and prices of NCD medicines to acute medicines in order to highlight potential gaps in the  
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43 105 delivery of NCD services. By taking into account the EML restrictions discussed above, and the  
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45 106 level of care of health facilities surveyed, this study highlights the disparities in access to  
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47 107 medicines by level of care. Because of the inconsistency between the EML and STGs, the study  
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49 108 also evaluates separately, the availability of medicines included in the EML and availability of  
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51 109 medicines included in the STGs. Findings from this study complement existing evidence on the  
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3 110 availability and price of NCD medicines in low- and middle-income countries, which is  
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5 111 necessary to inform the design of policies to enhance access to medicines(13,20,21,31–34).  
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## 8 112 **METHODS**

### 9 113 **Study setting**

10  
11 114 The data presented in this paper were collected during the baseline study on the evaluation of  
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13 115 *Novartis Access*, a low-cost NCD medicines program implemented by Novartis  
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15 116 Pharmaceuticals(18,35). *Novartis Access* targets medicines for four non-communicable diseases  
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17 117 – cardiovascular disease (dyslipidemia, heart failure and hypertension), diabetes, asthma and  
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19 118 breast cancer. Data were collected from eight study counties - Embu, Kakamega, Kwale,  
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21 119 Makeni, Narok, Nyeri, Samburu and West Pokot. These counties are a mix of semi-urban and  
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23 120 rural areas with a total population of seven million inhabitants, representing 15% of the national  
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25 121 population(36). These counties were selected based on their patronage of medicines from MEDS,  
26  
27 122 and safety for field data collection. The selection of these counties had been described in more  
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29 123 detail by Rockers et al.(18).  
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37 124 Health facilities (public and private-non-profit facilities) in Kenya are hierarchically classified  
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39 125 into dispensaries (level 2), health centers (level 3), primary (county) referral hospitals (level 4),  
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41 126 secondary referral hospitals (level 5) and tertiary hospitals (level 6)(10). Dispensaries are the  
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43 127 lowest level of care and offer treatment for simple ailments to outpatients, antenatal care, etc,  
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45 128 while tertiary hospitals are the highest level of care and offer more specialized services(37,38).  
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### 50 129 **Data collection**

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53 130 Data were collected in September 2016 by trained data collectors in English language, using  
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55 131 study instrument programmed in the software application, Survey CTO(39). The study  
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3 132 instrument was pilot tested twice by the trained data collectors and revised based on the feedback  
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5 133 received from each pilot test.  
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9 134 All of the public and private non-profit health facilities (level 2 to level 5) in eight counties that  
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11 135 purchase medicines through MEDS were surveyed. No level 6 facility was included in the study.  
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13 136 After data collection at each health facility, data collectors asked respondents to identify the  
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15 137 nearest private for-profit drug outlet where patients are referred when prescribed medicines are  
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17 138 not available at the facility. These private for-profit drug outlets were then visited and  
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19 139 administered the same survey instrument used at the facilities.  
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23 140 Data were collected on availability (having or not having the medicine in stock on the day of  
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25 141 data collection, based on physical observation by data collectors) and price (in Kenyan Shillings  
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27 142 – KES) of 27 NCD medicine formulations and nine medicine formulations for acute diseases.  
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30 143 Price data (how much patients pay if they have to pay for the medicine out of pocket) were  
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32 144 collected from the staff in charge of medicines at each facility. For each medicine, data were  
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34 145 collected on the originator brand and the lowest-priced generic. The selection of the 27 NCD  
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36 146 medicines for this study was based on two criteria: (1) inclusion of the medicines in the *Novartis*  
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38 147 *Access* portfolio as this study was part of a larger study of the *Novartis Access* program; (2) the  
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40 148 inclusion of the medicines in the standard treatment guidelines (STGs) of the Ministry of Health.  
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44 149 The acute disease medicine formulations included in this study have been used as reference  
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46 150 medicines in evaluating the availability and price of medicines in health systems(34). These  
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48 151 medicines were selected by a group of researchers from Boston University based on their  
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50 152 frequency of use in primary care and their use in other research studies(13,14,20). All the study  
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52 153 medicines were listed in the most recent STGs of the Ministry of Health. The list of medicines  
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54 154 on which data were collected are shown in Appendix 1.  
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### 155 **Patient and public involvement**

156 Patients were not involved in the design or conduct of the study. Patients may be engaged after  
157 endline data collection to disseminate final study results at the county level and to the wider  
158 NCD patient community.

### 159 **Data analysis**

160 Data were analyzed using SAS version 9.4 (The SAS Institute Inc.) (40). Three of the NCD  
161 medicines which were for cancer (anastrozole, letrozole and tamoxifen) were excluded from this  
162 analysis because cancer management in Kenya mainly occurs in tertiary health facilities which  
163 were not the focus of this study. Additionally, diclofenac 50mg tablets was excluded from the  
164 analysis because it was the only acute disease medicine that was in the STG but not listed on the  
165 national EML. Inclusion of medicines in the EML was determined by their enlistment in either  
166 the 2010 or 2016 editions of the EML(25,41). The analysis focused on the number of  
167 observations and excluded missing data.

168 The following outcome measures were estimated: 1) the proportion of availability (defined as the  
169 proportion of health facilities having a branded or generic version of each medicine available in  
170 stock), and 2) the median price (and minimum and maximum prices) of each generic or  
171 originator medicine across health facilities. Availability for NCD medicines was assessed using  
172 two approaches. The first analysis focused only on NCD medicine formulations listed in the  
173 EML. In the second analysis, availability was analyzed for 24 NCD medicine formulations  
174 which were listed in the most recent editions of STGs(30,42–45). The availability of study  
175 medicine formulations was evaluated by provider type and also by level of care. Differences in  
176 mean availability between acute and NCD medicines were estimated using the two-sample t-test.

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3 177 Median, minimum and maximum prices of study medicines were estimated for observations for  
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5 178 which medicines were not given for free (i.e. price was not equal to zero). All price analyses  
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8 179 were conducted in September 2016 Kenyan Shillings. Using the supplier prices from the 2015  
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10 180 edition of the International Medical Products Price Guide (IMPPG) which is published by  
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12 181 Management Sciences for Health (MSH) as a reference, the median price ratio for each medicine  
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14 182 formulation was estimated(46). Due to the limited availability of originator brands in health  
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16 183 facilities, median price ratios were estimated for only generics. Only 23 of the study medicines  
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18 184 had supplier prices reported in the IMPPG which was used for the median price ratio  
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20 185 computation. First the prices from the IMPPG (in 2015 United States Dollars) were inflated to  
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22 186 2016 rates, using the average of 2015 and 2016 annual inflation rates (0.7) obtained from the US  
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24 187 Inflation Calculator(47). The September 2016 price data were converted from Kenyan Shillings  
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26 188 to United States Dollars using September 15, 2016 exchange rate of obtained from *xe.com*.  
27  
28 189 Median price ratios were compared among public, private non-profit, and private for-profit drug  
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30 190 stores, and across levels of care (levels 2, 3, 4 and 5) using analysis-of-variance (ANOVA) with  
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32 191 the Tukey-Kramer adjustment procedure to compare pairs of means. Differences in mean price  
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34 192 ratios between acute and NCD medicines were estimated using the two-sample t-test. The  
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36 193 proportion of facilities giving each medicine for free was also estimated, stratified by provider  
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38 194 type and level of care.

## 195 RESULTS

196 A total of 272 health facilities were surveyed – 59 public facilities, 78 private non-profit facilities  
197 and 135 private for-profit drug outlets. There was one hundred percent response rate from  
198 facilities, while two of the private for-profit drug outlets declined to participate in the study. The  
199 total number of facilities varied across study counties, from a minimum of 12 in Samburu to a



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3 200 maximum of 48 in Embu county (Appendix 2). More than half (n=77; 61%) of study facilities  
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5 201 were level 2 (dispensaries), 18% (n=23) were level 3 (health centers), while 20.6% (n=26) were  
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7 202 level 4 (primary referral facilities). There were few (n=5; 4%) level 5 (secondary referral)  
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10 203 facilities.

### 13 204 **Medicines availability**

16 205 We first present results on the availability of STG and EML medicines by provider type. This is  
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18 206 followed by results on availability stratified by level of care. Finally, we focus on how  
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20 207 availability patterns indicate non-compliance with the EML.

#### 23 208 *Availability by provider type*

26 209 Figure 1 compares the availability of NCD medicines listed in the EML, NCD medicines listed  
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28 210 in the STGs, and medicines for acute conditions listed in the EML, by provider type. Across all  
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30 211 provide types, availability of medicines listed in the EML was higher than availability of  
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32 212 medicines listed in the STGs. For each of the three categories of medicines, availability was  
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34 213 highest in private for-profit drug outlets (61.7, 29.3 and 66.9% for NCD medicines on the EML,  
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36 214 NCD medicines on the STG and acute disease medicines) compared to public and non-profit  
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38 215 providers. Comparing medicines on the EML, the mean proportion of NCD medicine availability  
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40 216 (0.55) was not significantly different from the mean proportion of acute medicine availability  
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42 217 (0.61) (p=0.55). Considering medicines in the STGs, the overall mean proportion of NCD  
43  
44 218 medicine availability (0.25) was significantly lower than the overall mean proportion of acute  
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46 219 medicine availability (0.61); p<0.0001. Appendix 3 presents the overall availability of each study  
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48 220 medicine disaggregated by provider type and branded versus generic formulations. Generally,  
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50 221 generics were more common than originator brands across all of the study facilities. Only two  
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222 originator brands of study medicines were available in public facilities compared with 19 in  
223 private non-profit, and 21 in private for-profit drug outlets. Several medicines included in the  
224 EML had a proportion of availability of over 50%. However, salbutamol, an important medicine  
225 for asthma relief had an availability of less than 40% across the different types of providers.  
226 Thirteen medicines had very low availability including CVD medicines such as bisoprolol,  
227 ramipril, simvastatin, valsartan and diabetes medicines such as glimepiride.

[Figure 1: Facility level mean proportion of availability by provider type for NCD medicines included in the EML, NCD medicines listed in STGs and acute medicines included in the EML]

### 229 *Availability by level of care*

230 Figure 2 presents the proportion of availability of NCD medicines listed in the STGs and acute  
231 disease medicines (listed in the EML) by level of care. For NCD medicines in the STGs  
232 availability increases with increasing level of care, from 16.1% at level 2 facilities to 31.7% at  
233 level 5 facilities. A similar trend was observed for acute disease medicines. At each level of care,  
234 the availability of acute disease medicines was more than two times the availability of NCD  
235 medicines listed in the STGs.

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[Figure 2: Facility level mean proportion of availability by level of care for medicines listed in the standard treatment guidelines and acute disease medicines]

237 Appendix 4 presents the availability of study medicines by county. The mean proportion of  
238 availability of study medicines ranges from 0.24 in West Pokot to 0.42 in Makueni.

### 239 *Non-compliance of public and non-profit facilities with the EML*

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3 240 Twelve of the NCD medicines in this study were not on the EML. However, each of these  
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5 241 medicines was found at all levels of care. The proportion of health facilities stocking these  
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7 242 medicines ranged from 0.01 to 0.2. As mentioned earlier, all of the study NCD medicines  
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9 243 included in the EML were assigned level 4 and above except salbutamol inhaler which was  
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11 244 assigned level 2 and above. However, more than half of levels 2 and 3 facilities were stocking  
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13 245 four of these medicines (amitriptyline 25mg, furosemide 40mg, metformin 500mg, and  
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15 246 omeprazole 20mg) (Appendix 3). Among acute medicines, diazepam 5mg was restricted to level  
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17 247 4 and above, however, the proportion of level 2 and level 3 facilities stocking this medicine were  
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19 248 0.5 and 0.6 respectively.  
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#### 24 249 **Medicine prices**

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27 250 In this section, we first present results on medicine prices by provider type, followed by results  
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29 251 on prices stratified by level of care.  
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#### 32 252 *Medicine prices by provider type*

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36 253 There were wide variations in medicine prices across and within provider types. The within  
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38 254 provider type variations appeared to be more pronounced in private drug outlets compared to  
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40 255 public sector facilities. For example, the price of 1g vial of generic ceftriaxone ranged from 30 to  
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42 256 800 KES in private drug outlets, 10 to 550 in private not-for-profit facilities and 50 to 400 in  
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44 257 public facilities.  
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48 258 The mean proportion of public facilities giving medicines for free (0.47) was significantly higher  
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50 259 than the mean proportion of private non-profit facilities giving medicines for free (0.09), ( $p <$   
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52 260 0.0001). For example, generic metformin 500mg Tab/Cap was provided for free at 38.5%  
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54 261 (n=15/39) of public facilities and 14.9% (n=7/47) of private-non-profit facilities. Drug outlets  
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3 262 did not offer any medicines for free. There was large variability in the free provision of  
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5 263 medicines among public health facilities which was unrelated to county (data not shown).  
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7 264 Among non-profit facilities, the mean proportion of giving NCD medicines for free (0.05) was  
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9 265 significantly less than the mean proportion giving acute medicines for free (0.18),  $p < 0.0001$ .  
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11 266 However, this difference was not significantly different in public facilities (0.45 for NCD  
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13 267 medicines and 0.54 for acute medicines),  $p = 0.3119$ .  
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17 268 The median price ratio ranged from 0.6 for paracetamol syrup in private for-profit drug outlets to  
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19 269 8.3 for simvastatin 20mg tablets/caps in private non-profit health facilities. There was more  
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21 270 variability in median price ratios for NCD medicines (Figure 3). The mean of the price ratio was  
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23 271 2.29 in the public sector, 3.61 in the private non-profit sector, and 2.95 in drug outlets (Table 1  
24  
25 272 and Figure 3). The mean price ratio of NCD medicines (2.1) was not significantly different from  
26  
27 273 the mean price ratio of acute medicines (2.0) in public facilities  $p = 0.3517$ . However, the mean  
28  
29 274 price ratio of NCD medicines was significantly higher than the mean price ratio of acute  
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31 275 medicines in non-profit facilities (4.1 vs 2.0 respectively)  $p = 0.0094$ , and in drug outlets (3.5 vs.  
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33 276 1.7).

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39 [Figure 3: Mean price ratios of NCD medicines and acute disease medicines by provider type]  
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Table 1 – Percentage of facilities dispensing medicines free of charge and median price ratios by provider type (using MSH supplier prices as a reference)

Medicine tablets or capsules except otherwise noted	Public facilities		Private non-profit facilities		Median price ratios		
	Number surveyed*	Percentage dispensed for free % (number)	Number surveyed*	Percentage dispensed for free % (number)	Public	Non profit	Drug Stores
<i>Medicines for CVD</i>							
Amlodipine 10mg	2	50 (1)	12	8.3 (1)	1.3	2.7	2.7
<b>Amlodipine 5mg</b>	<b>17</b>	<b>17.6 (3)</b>	<b>16</b>	<b>0</b>	<b>2.3</b>	<b>6.3</b>	<b>5.0</b>
Atenolol 50mg	31	32.3 (10)	38	15.8 (6)	.	3.7	4.6
Bisoprolol 10mg	0	-	1	0	.	3.4	-
Bisoprolol 5mg	1	0 0	0	-	-	-	-
Captopril 25mg	0	-	3	0	.	4.4	2.0
<b>Furosemide 40mg</b>	<b>41</b>	<b>43.9 (18)</b>	<b>57</b>	<b>12.3 (7)</b>	<b>1.6</b>	<b>3.3</b>	<b>3.3</b>
Hydrochlorothiazide 50mg	12	58.3 (7)	16	0	2.3	6.4	4.7
Ramipril 10mg	0	-	1	0	-	-	-
Ramipril 5mg	0	-	1	0	-	-	-
<b>Simvastatin 20mg</b>	<b>0</b>	<b>-</b>	<b>1</b>	<b>0</b>	<b>.</b>	<b>8.3</b>	<b>5.7</b>
Valsartan 80mg	0	-	1	0	-	-	-
<i>Medicines for diabetes</i>							
<b>Glibenclamide 5mg</b>	<b>34</b>	<b>35.3 (12)</b>	<b>44</b>	<b>11.4 (5)</b>	<b>3.5</b>	<b>5.3</b>	<b>5.3</b>
Glimeperide 1mg	0	-	1	0	-	-	-
Glimeperide 2mg	0	-	3	0	-	-	-
Glimeperide 4mg	0	-	3	0	-	-	-
Metformin 1000mg	0	-	1	0	.	2.6	1.3
<b>Metformin 500mg</b>	<b>39</b>	<b>38.5 (15)</b>	<b>47</b>	<b>14.9 (7)</b>	<b>2.0</b>	<b>3.3</b>	<b>3.3</b>
<i>Medicines for asthma</i>							
<b>Salbutamol 100MCG/DOS inhaler</b>	<b>24</b>	<b>41.7 (10)</b>	<b>35</b>	<b>14.3 (5)</b>	<b>1.1</b>	<b>1.0</b>	<b>1.4</b>
<i>Other NCD medicines</i>							
<b>Amitriptyline 25mg</b>	<b>40</b>	<b>45 (18)</b>	<b>50</b>	<b>16 (8)</b>	<b>1.3</b>	<b>3.5</b>	<b>2.3</b>
<b>Omeprazole 20 mg</b>	<b>45</b>	<b>35.6</b>	<b>65</b>	<b>15.4</b>	<b>3.5</b>	<b>3.5</b>	<b>3.5</b>

Medicine tablets or capsules except otherwise noted	Public facilities		Private non-profit facilities		Median price ratios		
	Number surveyed*	Percentage dispensed for free % (number)	Number surveyed*	Percentage dispensed for free % (number)	Public	Non profit	Drug Stores
		<b>(16)</b>		<b>(10)</b>			
<i>Acute medicines</i>							
<b>Amoxicillin 250mg Dispersible tab</b>	<b>21</b>	<b>52.4 (11)</b>	<b>27</b>	<b>22.2 (6)</b>	<b>1.4</b>	<b>0.9</b>	<b>0.9</b>
<b>Amoxicillin 250mg</b>	<b>41</b>	<b>43.9 (18)</b>	<b>53</b>	<b>18.9 (10)</b>	<b>1.9</b>	<b>1.9</b>	<b>1.9</b>
<b>Amoxicillin 500mg</b>	<b>7</b>	<b>71.4 (5)</b>	<b>37</b>	<b>13.5 (5)</b>	<b>1.5</b>	<b>1.7</b>	<b>1.7</b>
<b>Ceftriaxone 1 g/vial Inj</b>	<b>40</b>	<b>40.0 (16)</b>	<b>57</b>	<b>12.3 (7)</b>	<b>2.9</b>	<b>3.7</b>	<b>1.7</b>
<b>Ciprofloxacin 500mg</b>	<b>15</b>	<b>40.0 (6)</b>	<b>45</b>	<b>8.9 (4)</b>	<b>2.7</b>	<b>2.7</b>	<b>2.7</b>
<b>Co-trimoxazole 8+40mg/ml Susp.</b>	<b>31</b>	<b>67.7 (21)</b>	<b>51</b>	<b>27.5 (14)</b>	<b>1.1</b>	<b>2.1</b>	<b>1.7</b>
<b>Diazepam 5mg</b>	<b>34</b>	<b>44.1 (15)</b>	<b>51</b>	<b>21.6 (11)</b>	<b>3.7</b>	<b>2.1</b>	<b>2.1</b>
<b>Paracetamol 24mg/ml Susp.</b>	<b>44</b>	<b>75.0 (33)</b>	<b>57</b>	<b>24.6 (14)</b>	<b>1.0</b>	<b>1.0</b>	<b>0.6</b>
<b>Mean</b>		<b>43.8%</b>		<b>8.7%</b>	<b>2.1</b>	<b>3.4</b>	<b>2.9</b>

\* Refers to the number of facilities that have the medicine in stock and which reported a price for it.  
Medicines on the EML (2010 or 2016) are highlighted in bold

## 277 *Medicine prices by level of care*

278 Appendix 5 presents the proportion of facilities dispensing medicines for free and the median  
 279 prices of medicines by level of care. There were wide price variations across the different levels  
 280 of care and within each level of care. Even though level 2 and 3 facilities were expected to be  
 281 providing medicines for free, the proportion of level 2 facilities which gave specific medicines  
 282 for free ranged from none to 42%. The proportion of level 3 facilities that provided medicines for  
 283 free ranged from none to 67%. More levels 2 and 3 facilities provided medicines for free  
 284 compared to level 4 facilities. There were no clear trends in price ratios by level of care.

285

## 286 **DISCUSSION**

287 This study has revealed important findings on the availability and price of NCD medicines in  
288 Kenya. It is the first study to report on disparities in availability of medicines by level of care  
289 within public and non-profit facilities, and take into account the EML restriction on medicines  
290 with respect to level of care.

### 291 **Medicines availability for NCD and acute conditions**

292 While the availability for many EML medicines was higher than 50%, availability was far below  
293 the international target of 80% availability(15,48). This is concerning in particular for NCD  
294 medicines. We found significantly lower availability of NCD medicines listed in the STGs  
295 compared to medicines for acute conditions. This is despite the fact that one-half of total hospital  
296 admissions and over 55% of hospital deaths in Kenya are due to NCDs (4). The mean  
297 availability of NCD medicines included in the STGs was two to three times lower than those  
298 found in other studies in Kenya(13,20,21). The low availability of some of these NCD medicines  
299 may indicate low demand, or the preference of prescribers and patients for other therapeutic  
300 options within the same classes of medicines which were not assessed in our study. Considering  
301 the high burden of NCDs globally, and the rapidly increasing burden in low- and middle-income  
302 countries, efforts are needed to ensure the reliable supply of NCD medicines in health facilities at  
303 all levels in Kenya.

304 Our study assessed the availability of medicines specifically at levels 2, 3, 4 and 5 facilities with  
305 availability higher at higher levels of care (though the differences were not statistically  
306 significant). Among the programmatic objectives of the EML is the promotion of appropriate use  
307 of medicines. For this reason several NCD medicines are limited to certain levels of care.  
308 Despite the limitation of NCD medicines to level 4 facilities and above, we found many of these

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3 309 medicines in several level 2 and 3 facilities suggesting there is demand for NCD medicines at  
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5 310 these lower level facilities. If the barrier to availability is the limitation of NCD medicines to  
6  
7 311 level 4 facilities and above, then additional measures such as building the capacity of lower level  
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9 312 care facilities to provide these medicines may be needed to ensure access. It is also important to  
10  
11 313 note that 12 NCD medicine formulations that were not listed in the EML were available across  
12  
13 314 all levels of care. Though the availability of these medicines are lower than those on the EML, it  
14  
15 315 still raises the question of whether the EML is being implemented to its optimal potential in the  
16  
17 316 country.

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21  
22 317 The generally low availability of originator brands, especially in the public sector is in line with  
23  
24 318 international recommendations to promote the use of generic medicines to increase efficiency in  
25  
26 319 medicines expenditure(32,49,50). Nonetheless, the limited availability of originator medicines in  
27  
28 320 the public sector does not necessarily translate into higher rates of prescribing of generics. The  
29  
30 321 2012 Pharmaceutical Country Profile of Kenya indicates that prescribing by International Non-  
31  
32 322 proprietary Names (INN) is neither obligatory in the public sector nor in the private sector(51).  
33  
34 323 Only 32% of medicines are prescribed by INN. Thus, it is important to promote prescribing by  
35  
36 324 INN to further promote the use of generic medicines.

### 37 38 39 40 41 325 **Prices of medicines**

42  
43 326 Though it is government policy to provide medicines for free at levels 2 and 3 facilities in  
44  
45 327 Kenya, our findings suggest that there is a large variation in policy adherence and each facility  
46  
47 328 decided whether to charge for the medicines dispensed. Free dispensing varied across and within  
48  
49 329 provider type (except for private drug outlets where no medicine was given for free), across level  
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51 330 of care and by county. Patient knowledge of which facilities charge for medicines and which do  
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53 331 not increases the complexity of efforts to find affordable medicines. There was no hospital at  
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3 332 which paracetamol syrup and co-trimoxazole suspension, medicines frequently prescribed for  
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5 333 children, were given for free.  
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9 334 There were large price variations across and within provider type, level of care and county. Drug  
10  
11 335 outlets and private non-profit facilities exhibited similar patterns in relation to pricing. Both  
12  
13 336 types of providers charged higher prices than public facilities. Private non-profit providers were  
14  
15 337 significantly less likely to offer medicines for free compared to public facilities. Additionally, the  
16  
17 338 mean price ratios of NCD medicines were significantly higher than the mean price ratio of acute  
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19 339 medicines in both private non-profit facilities and private drug outlets, though no significant  
20  
21 340 differences were observed in the public sector. This may indicate relatively higher mark-ups on  
22  
23 341 NCD medicines in non-profit and private drug outlets. Other studies have reported higher prices  
24  
25 342 at private for-profit drug outlets(19,20,52). A study by Health Action International also  
26  
27 343 demonstrated higher mark-ups on medicines in private non-profit providers(53). The government  
28  
29 344 of Kenya also charges import declaration fees on medicines which may contribute to higher  
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31 345 prices(51). Considering the low availability of NCD medicines in public facilities, patients' best  
32  
33 346 option may have been to access their medicines at private non-profit facilities and private drug  
34  
35 347 outlets at higher prices. The high cost of NCD medicines has been shown to be a financial  
36  
37 348 burden on households in Kenya(54,55).  
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#### 44 349 **Strengths and limitations**

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46 350 As mentioned earlier, this study is the first study that evaluates availability taking into  
47  
48 351 consideration the level of care medicines are assigned in the EML. In addition, this study also  
49  
50 352 evaluates availability separately NCD for medicines included in the EML and those included in  
51  
52 353 the STGs, highlighting the differences between the two documents. The cross sectional nature of  
53  
54 354 the study does not allow us to assess trends in availability and price over time and precludes  
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3 355 strong causal inference. While this study adds to the evidence base on the availability and prices  
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5 356 of NCD medicines in Kenya, the findings may not be generalizable to the whole country because  
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7 357 the study counties were not randomly selected from across the country. In addition we evaluated  
8  
9 358 availability as binary variable (yes/no) and did not count the quantity available. Furthermore, the  
10  
11 359 sample of the private for-profit drug outlets was restricted to the nearest ones from public and  
12  
13 360 non-profit facilities. Even though this sample is not representative of all private for-profit sector  
14  
15 361 facilities in each county, it allows studying the availability and prices consumers would  
16  
17 362 encounter when referred from public and non-profit facilities  
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## 22 363 **CONCLUSION**

23  
24 364 We found evidence that the availability of NCD medicines in Kenya is significantly lower than  
25  
26 365 the target level of 80%. Availability is poorest in the public sector, and generally highest in the  
27  
28 366 private for-profit sector. Availability increased with increasing level of care. Our findings  
29  
30 367 suggest that NCD patients in Kenya do not have reliable access to NCD medicines, particularly  
31  
32 368 at public health facilities. Increasing access at public facilities, particularly level 2 and 3  
33  
34 369 facilities, should be a focus of the Kenyan government's efforts to achieve universal health  
35  
36 370 coverage. Pricing policies or guidelines may be useful to streamline medicine prices in the  
37  
38 371 country.  
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## 44 372 **STATEMENT OF AUTHORSHIP**

45  
46 373 PA, PR, RL, MO, JB and VW participated in the conception and design of the study. These  
47  
48 374 authors also participated in the development and piloting of study instruments and the  
49  
50 375 supervision of data collection. PA, PR, RL, MO, JB, HC and VW contributed significantly to  
51  
52 376 data analysis and writing of the manuscript and have approved of the final version submitted for  
53  
54 377 publication.  
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3 378 **DATA SHARING**  
4

5 379 Deidentified data are publicly available and can be requested at:

6 380 <http://sites.bu.edu/evaluatingaccess-novartisaccess/kenya/data/>. The terms of use of the data are

7  
8 381 also available at this website. If you have any questions about the data please contact the

9  
10 382 Department of Global Health, Boston University School of Public Health at: [sphgh@bu.edu](mailto:sphgh@bu.edu)  
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14

15 383 **COMPETING INTERESTS**  
16

17 384 The authors have no conflicts of interest to declare.  
18  
19  
20

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22

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27  
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32 390 <http://sites.bu.edu/novartisaccessevaluation/agreements/>)  
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37 391

38 392 **ETHICAL STATEMENT**  
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40 393 This research study was reviewed and approved by the Institutional Review Boards of the Boston

41 394 University Medical Campus and Strathmore University in Kenya.  
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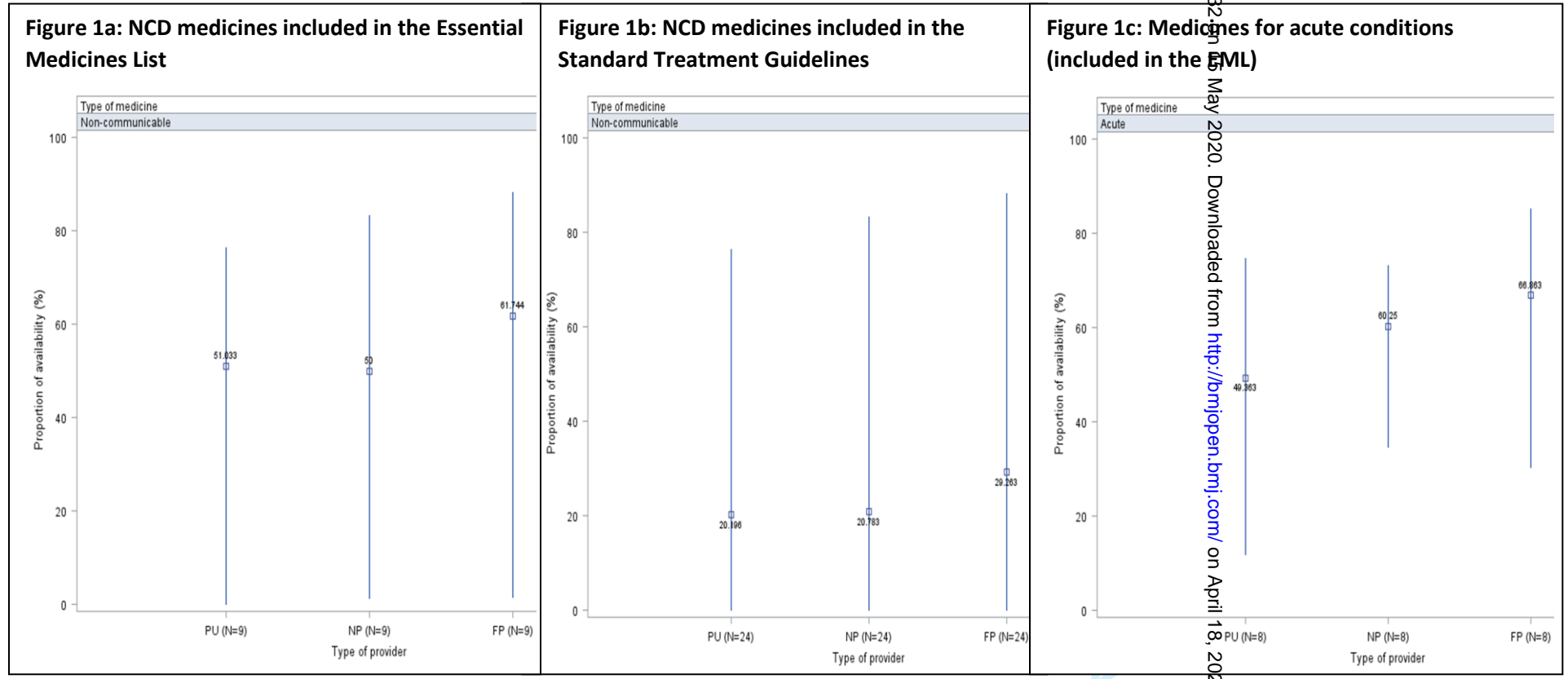
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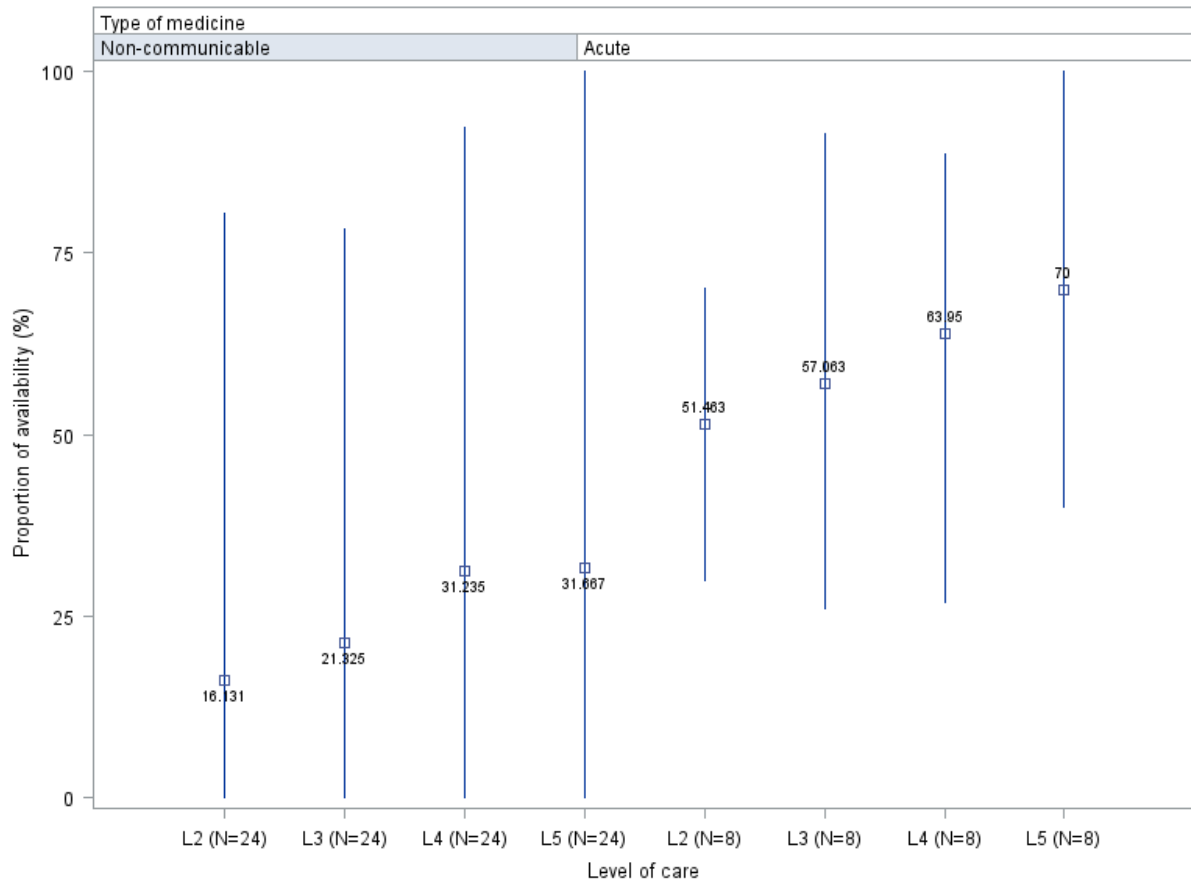
Figure 1: Facility level mean proportion of availability by provider type for NCD medicines included in the EML, NCD medicines listed in STGs and acute medicines included in the EML



PU – Public facility; NP=private non-profit facility; FP=private for-profit drug outlet; NCD=non-communicable disease; STG=Standard Treatment Guidelines; EML=Essential Medicines List (The box indicates the mean and the bars indicate the minimum and maximum)

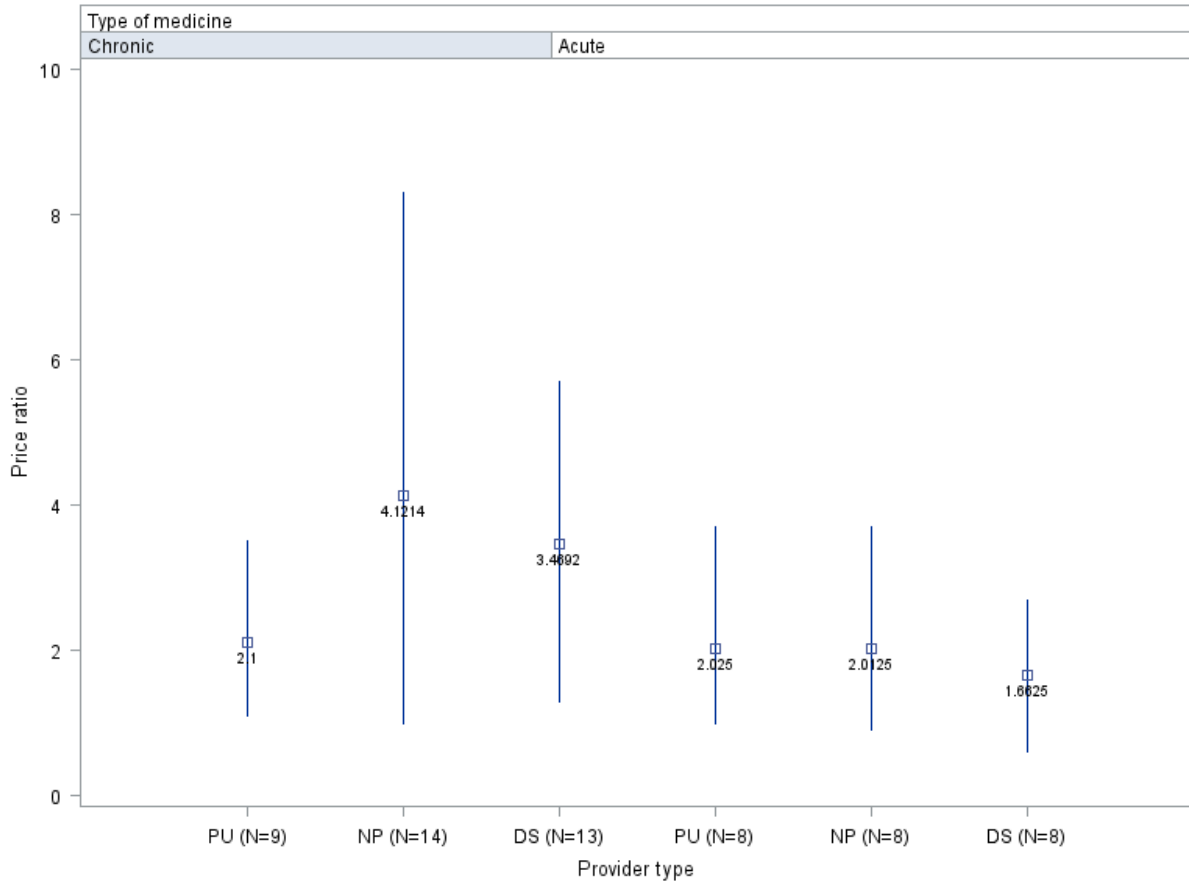
1136/bmjopen-2019-035132 on May 18, 2020. Downloaded from http://bmjopen.bmj.com/ on April 18, 2024 by guest. Protected by copyright.

Figure 2: Facility level mean proportion of availability by level of care for medicines listed in the standard treatment guidelines and acute disease medicines



L2 = Level 2 facilities; L3 = Level 3 facilities; L4 = Level 4 facilities; L5 = Level 5 facilities; N=number of medicines surveyed (The box indicates the mean and the bars indicate the minimum and maximum)

Figure 3: Mean price ratios of NCD medicines and acute disease medicines by provider type



PU – Public facility; NP=private-non-profit facility; FP=Private-of-profit drug outlet N=number of medicines surveyed (The box indicates the mean and the bars indicate the minimum and maximum)

## APPENDIX

Appendix 1: List of study medicines, level of care found and level of care assigned in the 2010 and 2016 essential medicines list (EML)

Medicine	Level of care medicine was available				Lowest level of care assigned in the 2016 EML	Lowest level of care assigned in the 2010 EML
	Level 2	Level 3	Level 4	Level 5		
<i>Medicines for CVD (n=15)</i>						
Amlodipine 10mg Tab/Cap	X	X	X	X	-	-
Amlodipine 5mg Tab/Cap	X	X	X	X	4	4
Atenolol 50mg Tab/Cap	X	X	X	X	-	4
Bisoprolol 10mg Tab/Cap	-	-	X	-	-	-
Bisoprolol 5mg Tab/Cap	-	X	-	-	-	-
Bisoprolol 2.5mg Tab/Cap	-	-	-	-	-	-
Captopril 25mg Tab/Cap	X	-	X	-	-	-
Furosemide 40mg Tab/Cap	X	X	X	X	4	4
Hydrochlorothiazide 50mg Tab/Cap	X	X	X	X	-	-
Ramipril 10mg Tab/Cap	-	-	X	-	-	-
Ramipril 5mg Tab/Cap	-	-	X	-	-	-
Simvastatin 20mg Tab/Cap <sup>1</sup>	-	-	X	-	4	-
Simvastatin 40mg Tab/Cap	-	-	-	-	-	-
Valsartan 80mg Tab/Cap	-	-	X	-	-	-
Valsartan 160mg Tab/Cap	-	-	-	-	-	-
<i>Medicines for diabetes (n=6)</i>						
Glibenclamide 5mg Tab/Cap	X	X	X	X	4	4
Glimeperide 1mg Tab/Cap	-	-	X	-	-	-
Glimeperide 2mg Tab/Cap	-	-	X	-	-	-
Glimeperide 4mg Tab/Cap	-	-	X	-	-	-
Metformin 1000mg Tab/Cap	-	-	X	-	-	-
Metformin 500mg Tab/Cap	X	X	X	X	4	4
<i>Medicines for asthma (n=1)</i>						
Salbutamol 100mcg/dos inhalation	X	X	X	X	4	2
<i>Other NCD medicines</i>						
Amitriptyline 25mg Tab/Cap	X	X	X	X	4	4
Omeprazole 20mg Tab/Cap	X	X	X	X	4	4
<i>Acute medicines (n=8)</i>						
Amoxicillin 250mg Dispersible tab	X	X	X	X	2	-

<sup>1</sup> As an alternative to atorvastatin.

Medicine	Level of care medicine was available				Lowest level of care assigned in the 2016 EML	Lowest level of care assigned in the 2010 EML
	<i>Level 2</i>	<i>Level 3</i>	<i>Level 4</i>	<i>Level 5</i>		
Amoxicillin 250mg Tab /Cap	X	X	X	X	2	2
Amoxicillin 500mg Tab/Cap	X	X	X	X	2	-
Ceftriaxone 1 g/vial Inj	X	X	X	X	2	4
Ciprofloxacin 500mg Tab/Cap	X	X	X	X	3	-
Co-trimoxazole (8+40mg/ml susp.	X	X	X	X	2	2
Diazepam 5mg Tab/Cap	X	X	X	X	4	5
Paracetamol 24mg/ml Susp	X	X	X	X	1	1

X = medicine available in at least one facility

- = medicine not available or not in the EML

All of the NCD medicines are included in the current Kenyan standard treatment guidelines.

Appendix 2: Overview of types of study facilities by county

<i>County</i>	<i>Public health facility</i>	<i>Private non-profit health facility</i>	<i>Private for-profit drug outlet</i>	<i>Total</i>
Embu	6	18	24	48
Kakamega	6	10	16	32
Kwale	5	4	12	21
Makueni	8	17	26	51
Narok	7	9	15	31
Nyeri	16	14	30	60
Samburu	3	4	5	12
West Pokot	8	2	7	17
<b>Total</b>	<b>59</b>	<b>78</b>	<b>135</b>	<b>272</b>

Appendix 3: Availability of medicines (proportion of facilities having medicine available on day of visit) by type of facility

Medicine (Tablets/capsules otherwise noted)	Public (N=59)		Private non-profit (N=78)		Private for-profit drug outlets (N=135)		Overall availability N=(272)	
	Generic	Originator	Generic	Originator	Generic	Originator	Generic	Originator
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
<i>Medicines for CVD</i>								
Amlodipine 10mg	3.4 (2)	-	14.1 (11)	1.3 (1)	46.7 (63)	1.5 (2)	27.9 (76)	1.1 (3)
<b>Amlodipine 5mg</b>	<b>28.8 (17)</b>	-	<b>20.5 (16)</b>	-	<b>39.3 (53)</b>	<b>1.5 (2)</b>	<b>31.6 (86)</b>	<b>0.7 (2)</b>
Atenolol 50mg	52.5 (31)	-	48.7 (38)	-	70.4 (59)	0.7 (1)	60.3 (164)	0.4 (1)
Bisoprolol 10mg	-	-	1.3 (1)	-	-	-	0.4 (1)	-
Bisoprolol 5mg	1.7 (1)	-	-	-	0.7 (1)	-	0.7 (2)	-
Captopril 25mg	-	-	3.9 (3)	-	16.3 (22)	-	9.2 (25)	-
<b>Furosemide 40mg</b>	<b>69.5 (41)</b>	-	<b>70.5 (55)</b>	<b>2.6 (2)</b>	<b>73.3 (99)</b>	<b>5.9 (8)</b>	<b>71.7 (195)</b>	<b>3.6 (10)</b>
Hydrochlorothiazide	20.3 (12)	-	20.5 (16)	-	29.6 (40)	-	24.7 (68)	-
Ramipril 10mg	-	-	-	1.3 (1)	0.7 (1)	-	0.4 (1)	0.4 (1)
Ramipril 5mg	-	-	1.3 (1)	-	1.5 (2)	0.7 (1)	1.1 (3)	0.4 (1)
<b>Simvastatin 20mg</b>	-	-	<b>1.3 (1)</b>	-	<b>1.5 (2)</b>	-	<b>1.1 (3)</b>	-
Valsartan 80mg	-	-	1.3 (1)	-	0.7 (1)	-	0.7 (2)	-
Mean availability CVD medicines								
<i>Medicines for diabetes</i>								
<b>Glibenclamide 5mg</b>	<b>57.6 (34)</b>	-	<b>56.4 (44)</b>	<b>1.3 (1)</b>	<b>75.6 (102)</b>	<b>4.4 (6)</b>	<b>66.1 (180)</b>	<b>2.6 (7)</b>
Glimeperide 1mg	-	-	-	1.3 (1)	3 (4)	4.4 (6)	1.5 (4)	2.6 (7)
Glimeperide 2mg	-	-	1.3 (1)	2.6 (2)	10.4 (14)	5.2 (7)	5.5 (15)	3.3 (9)
Glimeperide 4mg	-	-	-	3.9 (3)	5.2 (7)	3.0 (4)	2.6 (7)	2.6 (7)
Metformin 1000mg	-	-	1.3 (1)	1.3 (1)	15.5 (21)	8.9 (12)	8.1 (22)	5.1 (14)

Medicine (Tablets/capsules otherwise noted)	Public (N=59)		Private non-profit (N=78)		Private for-profit drug outlets (N=135)		Overall availability N=(272)	
	Generic	Originator	Generic	Originator	Generic	Originator	Generic	Originator
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Metformin 500mg	66.1 (39)	-	60.3 (47)	1.3 (1)	73.3 (99)	10.4 (14)	68.4 (188)	5.5 (15)
<i>Medicines for asthma</i>								
Salbutamol 100mcg/dos inhalation	39 (23)	1.2 (1)	23.1 (18)	21.8 (17)	34.8 (47)	35.6 (48)	32.4 (88)	24.3 (66)
<i>Other NCD medicines</i>								
Amitriptyline 25mg	67.8 (40)	-	64.1 (50)	-	63.7 (86)	-	64 (176)	-
Omeprazole 20 mg	76.3 (45)	-	83.3 (65)	-	96.3 (130)	0.7 (1)	88.2 (242)	0.4 (1)
<i>Acute medicines</i>								
Amoxicillin 250mg Dispersible tab	35.6 (21)	-	33.3 (26)	1.3 (1)	29.6 (40)	1.5 (2)	32.0 (87)	1.1 (3)
Amoxicillin 250mg	69.5 (41)	-	66.7 (52)	2.6 (2)	68.9 (93)	3.7 (5)	68 (187)	5.6 (7)
Amoxicillin 500mg	11.9 (7)	-	46.2 (36)	2.6 (2)	82.2 (111)	11.1 (15)	56.6 (154)	6.3 (17)
Ceftriaxone 1g/vial Inj	67.8 (40)	3.4 (2)	73.1 (57)	5.1 (4)	69.6 (94)	4.4 (6)	70.2 (191)	4.4 (12)
Ciprofloxacin 500mg	25.4 (15)	-	55.1 (43)	2.6 (2)	83.7 (113)	3.7 (5)	62.9 (171)	2.6 (7)
Co-trimoxazole 8+40mg/ml susp	52.5 (31)	-	62.8 (49)	2.6 (2)	68.9 (93)	6.7 (9)	63.6 (173)	4.0 (11)
Diazepam 5mg	57.6 (34)	-	65.4 (51)	1.3 (1)	47.4 (64)	-	54.8 (150)	0.4 (1)
Paracetamol 24mg/ml Susp	74.6 (44)	-	73.1 (57)	2.6 (2)	73.3 (99)	15.6 (21)	73.5 (200)	8.5 (23)

Note: Bisoprolol 2.5mg Tab/Cap, Simvastatin 40mg Tab/Cap, and Valsartan 160mg Tab/Cap were not available in any facility. Medicines either on the 2010 or 2016 edition of the EML in bold



### Appendix 4: Proportion of availability of study medicines (proportion of facilities having medicine available on day of visit) by county

Medicine	Embu		Kakamega		Kwale		Makueni		Narok		Nyeri		Samburu		West Pokot	
	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB
Amitriptyline 25mg	66.7 (32)		40.6 (13)		57.1 (12)		76.5 (39)		51.6 (16)		85 (51)		83.3 (10)		17.7 (3)	
Amlodipine 10mg	33.3 (16)	0 (0)	15.6 (5)	0 (0)	28.6 (6)	0 (0)	25.5 (13)	2 (1)	12.9 (4)	3.2 (1)	48.3 (29)	7 (1)	25 (3)	0 (0)	0 (0)	0 (0)
Amlodipine 5mg	39.6 (19)	0 (0)	25 (8)	0 (0)	33.3 (7)	4.8 (1)	25.5 (13)	2 (1)	19.4 (6)	0 (0)	51.7 (31)	0 (0)	8.3 (1)	0 (0)	5.9 (1)	0 (0)
Amoxicillin dispersible tabs 250mg	14.6 (7)	0 (0)	43.8 (14)	0 (0)	19.1 (4)	0 (0)	21.6 (11)	0 (0)	12.9 (4)	0 (0)	53.3 (32)	3 (3)	58.3 (7)	0 (0)	47.1 (8)	0 (0)
Amoxicillin 500mg	58.3 (28)	0 (0)	62.5 (20)	3.1 (1)	52.4 (11)	14.3 (3)	58.8 (30)	9.8 (5)	61.3 (19)	9.7 (3)	60 (36)	3 (5)	41.7 (5)	0 (0)	29.4 (5)	0 (0)
Amoxicillin 250mg	68.8 (33)	0 (0)	56.3 (18)	0 (0)	57.1 (12)	4.8 (1)	82.4 (42)	2 (1)	77.4 (24)	3.2 (1)	65 (39)	7 (4)	16.7 (2)	0 (0)	94.1 (16)	0 (0)
Atenolol 50mg	58.3 (28)	0 (0)	46.9 (15)	0 (0)	71.4 (15)	0 (0)	72.6 (37)	0 (0)	22.6 (7)	3.2 (1)	91.7 (55)	0 (0)	41.7 (5)	0 (0)	11.8 (2)	0 (0)
Bisoprolol 10mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8.3 (1)	0 (0)	0 (0)	0 (0)
Bisoprolol 2.5mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Bisoprolol 5mg	2.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.7 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Captopril 25mg	16.7 (8)	0 (0)	3.1 (1)	0 (0)	4.8 (1)	0 (0)	5.9 (3)	0 (0)	9.7 (3)	0 (0)	13.3 (8)	0 (0)	8.3 (1)	0 (0)	0 (0)	0 (0)
Ceftriaxone 1g/vial Inj	58.3 (28)	2.1 (1)	75 (24)	3.1 (1)	71.4 (15)	0 (0)	78.4 (40)	5.9 (3)	67.7 (21)	3.2 (1)	68.3 (41)	7 (4)	66.7 (8)	16.7 (2)	82.4 (14)	0 (0)
Ciprofloxacin 500mg	70.8 (34)	2.1 (1)	59.4 (19)	0 (0)	57.1 (12)	4.8 (1)	66.7 (34)	2 (1)	61.3 (19)	6.5 (2)	66.7 (40)	3 (2)	66.7 (8)	0 (0)	29.4 (5)	0 (0)
Cotrimoxazole 8+40mg/ml susp	72.9 (35)	0 (0)	50 (16)	0 (0)	57.1 (12)	4.8 (1)	54.9 (28)	11.8 (6)	54.8 (17)	6.5 (2)	75 (45)	3 (2)	66.7 (8)	0 (0)	70.6 (12)	0 (0)
Diazepam 5g	47.9 (23)	0 (0)	31.3 (10)	0 (0)	42.9 (9)	0 (0)	76.5 (39)	0 (0)	38.7 (12)	0 (0)	73.3 (44)	7 (1)	58.3 (7)	0 (0)	29.4 (5)	0 (0)
Furosemide 40mg	62.5 (30)	2.1 (1)	56.3 (18)	3.1 (1)	71.4 (15)	4.8 (1)	84.3 (43)	2 (1)	61.3 (19)	3.2 (1)	91.7 (55)	3 (5)	66.7 (8)	0 (0)	41.2 (7)	0 (0)
Glibenclamide 5mg	56.3 (27)	0 (0)	62.5 (20)	0 (0)	66.7 (14)	4.8 (1)	78.4 (40)	5.9 (3)	51.6 (16)	3.2 (1)	86.7 (52)	3 (2)	58.3 (7)	0 (0)	23.5 (4)	0 (0)
Glimepiride 1mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4.8 (1)	2 (1)	3.9 (2)	3.2 (1)	3.2 (1)	3.3 (2)	3 (3)	0 (0)	0 (0)	0 (0)	0 (0)
Glimepiride 2mg	6.3 (3)	2.1 (1)	0 (0)	3.1 (1)	0 (0)	0 (0)	9.8 (5)	3.9 (2)	9.7 (3)	3.2 (1)	6.7 (4)	7 (4)	0 (0)	0 (0)	0 (0)	0 (0)

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Medicine	Embu		Kakamega		Kwale		Makueni		Narok		Nyeri		Samburu		West Pokot	
	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB
Glimepiride 4mg	2.1 (1)	2.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	3.9 (2)	3.2 (1)	3.2 (1)	6.7 (4)	3.2 (3)	0 (0)	0 (0)	0 (0)	0 (0)
Metformin 1000mg	10.4 (5)	0 (0)	0 (0)	3.1 (1)	4.8 (1)	0 (0)	3.9 (2)	7.8 (4)	12.9 (4)	6.5 (2)	16.7 (10)	15.0 (6)	0 (0)	0 (0)	0 (0)	0 (0)
Metformin 500mg	68.8 (33)	0 (0)	53.1 (17)	6.3 (2)	76.2 (16)	0 (0)	78.4 (40)	13.7 (7)	35.5 (11)	9.7 (3)	91.7 (55)	15.3 (3)	83.3 (10)	0 (0)	17.7 (3)	0 (0)
Omeprazole 20mg	91.7 (44)	0 (0)	93.8 (30)	0 (0)	85.7 (18)	0 (0)	88.2 (45)	2 (1)	74.2 (23)	0 (0)	95 (57)	18.0 (0)	75 (9)	0 (0)	82.4 (14)	0 (0)
Paracetamol 24mg/ml susp	75 (36)	0 (0)	56.3 (18)	0 (0)	71.4 (15)	14.3 (3)	68.6 (35)	15.7 (8)	71 (22)	3.2 (1)	91.7 (55)	18.3 (1)	58.3 (7)	0 (0)	70.6 (12)	0 (0)
Ramipril 10mg	0 (0)	0 (0)	3.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	17.7 (1)	0 (0)	0 (0)	0 (0)	0 (0)
Ramipril 5mg	2.1 (1)	0 (0)	3.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	0 (0)	0 (0)	0 (0)	18.0 (0)	8.3 (1)	0 (0)	0 (0)	0 (0)
Salbutamol Inhaler	47.9 (23)	12.5 (6)	46.9 (15)	9.4 (3)	19.1 (4)	19.1 (4)	19.6 (10)	51 (26)	16.1 (5)	19.4 (6)	23.3 (14)	18.3 (0)	58.3 (7)	8.3 (1)	58.8 (10)	0 (0)
Simvastatin 20mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3.9 (2)	0 (0)	0 (0)	0 (0)	1.7 (1)	18.0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Simvastatin 40mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18.0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Valsartan 80mg	0 (0)	0 (0)	3.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18.0 (0)	8.3 (1)	0 (0)	0 (0)	0 (0)
Valsartan 180mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18.0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
<b>Mean % availability</b>	<b>34.4</b>	<b>0.7</b>	<b>29.8</b>	<b>1.0</b>	<b>31.8</b>	<b>2.7</b>	<b>36.8</b>	<b>4.7</b>	<b>27.6</b>	<b>2.9</b>	<b>42.0</b>	<b>18.4</b>	<b>32.0</b>	<b>0.8</b>	<b>23.9</b>	<b>0</b>

*Gen=Generic; OB=Originator Brand*

**Appendix 5 – Proportion of facilities dispensing medicines free of charge and median price ratios by level of care (using MSH supplier prices as a reference)**

Medicines	Proportion of facilities giving medicines for free								Median price ratios			
	Level 2		Level 3		Level 4		Level 5		Level 2	Level 3	Level 4	Level 5
	N	% (n)	N	% (n)	N	% (n)	N	% (n)				
<i>Medicines for CVD</i>												
Amlodipine 10mg Tab/Cap	4	25(1)	1	0(0)	7	0(0)	1	100(1)	0.94	2.07	2.67	0.00
<b>Amlodipine 5mg Tab/Cap</b>	<b>10</b>	<b>10(1)</b>	<b>3</b>	<b>33.3(1)</b>	<b>15</b>	<b>0(0)</b>	<b>4</b>	<b>25(1)</b>	<b>4.72</b>	<b>4.08</b>	<b>3.14</b>	<b>3.14</b>
Atenolol 50mg Tab/Cap	30	30(9)	11	54.5(6)	21	0(0)	5	20(1)	3.70	6.08	2.78	2.78
Bisoprolol 10mg Tab/Cap	0	-	0	-	1	0(0)	0	-	-	-	-	-
Bisoprolol 5mg Tab/Cap	0	-	1	100(1)	0	-	0	-	-	-	-	-
Captopril 25mg Tab/Cap	2	0(0)	0	-	1	0(0)	0	-	3.23	0.00	7.26	0.00
<b>Furosemide 40mg Tab/Cap</b>	<b>45</b>	<b>26.7(12)</b>	<b>18</b>	<b>66.7(12)</b>	<b>24</b>	<b>0(0)</b>	<b>4</b>	<b>25(1)</b>	<b>2.26</b>	<b>11.18</b>	<b>2.70</b>	<b>4.92</b>
Hydrochlorothiazide 50mg Tab/Cap	12	16.7(2)	7	57.1(4)	5	0(0)	3	33.3(1)	3.49	23.6	6.98	3.49
Ramipril 10mg Tab/Cap	0	-	0	-	1	0(0)	0	-	-	-	-	-
Ramipril 5mg Tab/Cap	0	-	0	-	1	0(0)	0	-	-	-	-	-
<b>Simvastatin 20mg Tab/Cap</b>	<b>0</b>	<b>-</b>	<b>0</b>	<b>-</b>	<b>1</b>	<b>0(0)</b>	<b>0</b>	<b>-</b>	<b>0.00</b>	<b>0.00</b>	<b>8.32</b>	<b>0.00</b>
Valsartan 80mg Tab/Cap	0	-	0	-	1	0(0)	0	-	-	-	-	-
<i>Medicines for diabetes</i>												
<b>Glibenclamide 5mg Tab/Cap</b>	<b>32</b>	<b>21.9(7)</b>	<b>16</b>	<b>50(8)</b>	<b>23</b>	<b>4.3(1)</b>	<b>5</b>	<b>20(1)</b>	<b>3.51</b>	<b>12.08</b>	<b>4.39</b>	<b>6.14</b>
Glimeperide 1mg Tab/Cap	0	-	0	-	1	0(0)	0	-	-	-	-	-
Glimeperide 2mg Tab/Cap	0	-	0	-	3	0(0)	0	-	-	-	-	-
Glimeperide 4mg Tab/Cap	0	-	0	-	3	0(0)	0	-	-	-	-	-
Metformin 1000mg Tab/Cap	0	-	0	-	1	0(0)	0	-	0.00	0.00	2.59	0.00
<b>Metformin 500mg Tab/Cap</b>	<b>39</b>	<b>28.2(11)</b>	<b>18</b>	<b>55.6(10)</b>	<b>21</b>	<b>0(0)</b>	<b>5</b>	<b>20(1)</b>	<b>3.31</b>	<b>4.07</b>	<b>1.99</b>	<b>2.65</b>
<i>Medicines for asthma</i>												
<b>Salbutamol 100mcg/dos inhaler</b>	<b>21</b>	<b>33.3(7)</b>	<b>12</b>	<b>50.0(6)</b>	<b>19</b>	<b>5.3(1)</b>	<b>4</b>	<b>25.0(1)</b>	<b>1.16</b>	<b>0.75</b>	<b>1.08</b>	<b>1.08</b>
<i>Other NCD medicines</i>												

Medicines	Proportion of facilities giving medicines for free								Median price ratios			
	Level 2		Level 3		Level 4		Level 5		Level 2	Level 3	Level 4	Level 5
	N	% (n)	N	% (n)	N	% (n)	N	% (n)				
Amitriptyline 25mg Tab/Cap	42	<b>33.3(14)</b>	15	<b>66.7(10)</b>	24	0(0)	4	50(2)	3.5	0.9	2.4	3.5
Omeprazole 20 mg Tab/Cap	62	<b>29(18)</b>	19	<b>42.1(8)</b>	22	0(0)	3	0(0)	3.52	7.04	3.52	3.52
Mean at each level		<b>23.1</b>		<b>52.4</b>		<b>1.0</b>		<b>31.8</b>	<b>3.03</b>	<b>7.18</b>	<b>4.52</b>	<b>2.84</b>
<i>Acute medicines</i>												
Amoxicillin 250mg Dispersible tab	28	<b>39.3(11)</b>	8	<b>75(6)</b>	7	0(0)	2	0(0)	0.95	0.95	0.95	9.78
Amoxicillin 500mg Tab/Cap	23	<b>26.1(6)</b>	67	<b>4.5(3)</b>	10	0(0)	2	50(1)	1.66	4.97	1.82	1.99
Amoxicillin 250mg Tab /Cap	49	<b>34.7(17)</b>	17	<b>58.8(10)</b>	20	0(0)	5	20(1)	1.86	3.11	1.66	1.86
Ceftriaxone 1 g/vial Inj	47	<b>23.4(11)</b>	212	<b>4.7(10)</b>	19	10.5(2)	5	20(1)	3.74	2.99	4.99	2.49
Ciprofloxacin 500mg Tab/Cap	33	<b>21.2(7)</b>	7	<b>28.6(2)</b>	14	0(0)	2	50(1)	2.66	2.66	2.66	2.66
Co-trimoxazole 8+40mg/ml susp.	43	<b>37.2(16)</b>	15	<b>53.3(8)</b>	18	38.9(7)	4	75(3)	1.25	2.68	1.67	1.04
Diazepam 5mg Tab/Cap	41	<b>36.6(15)</b>	145	<b>6.2(9)</b>	23	0(0)	4	50(2)	2.06	5.15	3.09	1.55
Paracetamol 24mg/ml Susp	54	<b>42.6(23)</b>	178	<b>6.7(12)</b>	22	40.9(9)	4	75(3)	0.96	0.96	0.96	0.96
Mean at each level		<b>32.6</b>		<b>29.7</b>		<b>11.2</b>		<b>42.5</b>	<b>1.89</b>	<b>2.90</b>	<b>2.22</b>	<b>2.79</b>

"N" refers to the number of facilities that have the medicine in stock and which reported a price for it.

Medicine formulations on the EML (2010 or 2016 editions) are highlighted in bold

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7-8
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	8-9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	8, 9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9
Bias	9	Describe any efforts to address potential sources of bias	9, 10
Study size	10	Explain how the study size was arrived at	8, 9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10, 11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10-11
		(b) Describe any methods used to examine subgroups and interactions	10-11
	(c) Explain how missing data were addressed	10	
	(d) If applicable, describe analytical methods taking account of sampling strategy	NA	
	(e) Describe any sensitivity analyses	10	
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8, 9, 10
		(b) Give reasons for non-participation at each stage	11
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8, 12
		(b) Indicate number of participants with missing data for each variable of interest	11, 12, 16
Outcome data	15*	Report numbers of outcome events or summary measures	11 - 17

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2	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
3			NA
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6			(b) Report category boundaries when continuous variables were categorized
7			NA
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9			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
10			NA
11	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
12			12-17
13			
14	<b>Discussion</b>		
15	Key results	18	Summarise key results with reference to study objectives
16			18-19
17	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
18			20
19			
20	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
21			21
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24	Generalisability	21	Discuss the generalisability (external validity) of the study results
25			21
26	<b>Other information</b>		
27	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
28			22
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30			

NA = Not applicable

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Availability and prices of medicines for non-communicable diseases at health facilities and retail drug outlets in Kenya – A cross sectional survey in eight counties

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3 **Availability and prices of medicines for non-communicable diseases at health facilities and**  
4 **retail drug outlets in Kenya – A cross sectional survey in eight counties**  
5

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## ABSTRACT

**Objectives:** The objective of this study was to determine the availability and prices of medicines for non-communicable diseases (NCDs) in health facilities and private for-profit drug outlets in Kenya.

**Design:** Cross sectional study

**Methods:** All public and non-profit health facilities in eight counties (Embu, Kakamega, Kwale, Makeni, Narok, Nyeri, Samburu and West Pokot) that purchased medicines from the Mission for Essential Drugs and Supplies, a major wholesaler, were surveyed in September 2016. For each health facility, one nearby private for-profit drug outlet was also surveyed. Data on availability and price were analyzed for 24 NCD and eight acute medicine formulations. Availability was analyzed separately for medicines in the national Essential Medicines List (EML) and those in the Standard Treatment Guidelines (STGs). Median price ratios were estimated using the International Medical Products Price Guide as a reference.

**Results:** 59 public and 78 non-profit facilities and 135 drug outlets were surveyed. Availability of NCD medicines was highest in private for-profit drug outlets (61.7% and 29.3% for medicines on the EML and STGs respectively). Availability of STG medicines increased with increasing level of care of facilities - 16.1% at dispensaries to 31.7% at secondary referral facilities. The mean proportion of availability for NCD medicines listed in the STGs (0.25) was significantly lower than for acute medicines (0.61),  $p < 0.0001$ . The proportion of public facilities giving medicines for free (0.47) was significantly higher than the proportion of private non-profit facilities giving medicines for free (0.09), ( $p < 0.0001$ ). The mean price ratio of NCD medicines

22 was significantly higher than for acute medicines in non-profit facilities (4.1 vs 2.0 respectively;  
23  $p=0.0076$ ), and in private for-profit drug outlets (3.5 vs. 1.7;  $p=0.0013$ ).

24 **Conclusion:** Patients with NCDs in Kenya appear to have limited access to medicines.

25 Increasing access should be a focus of efforts to achieve universal health coverage.

26 **Keywords:** Kenya, non-communicable diseases, medicines, access, price

## 27 STRENGTHS AND LIMITATIONS

### 28 *Strengths*

- 29 • To the best of our knowledge this is the first study to evaluate availability of medicines  
30 based on the level of care medicines are assigned in the National Essential Medicines  
31 List.
- 32 • This study also evaluated availability separately for medicines for non-communicable  
33 diseases included in the Essential Medicines List and those included in the Standard  
34 Treatment Guidelines, highlighting the crucial differences between the two service  
35 delivery documents.

### 36 *Limitations*

- 37 • The cross sectional study design did not allow us to assess trends in availability and price  
38 of medicines over time and precludes making strong causal inferences.
- 39 • Availability of medicines was evaluated as binary variable (yes/no) and did not count the  
40 quantity in stock.
- 41 • The sample of participating private for-profit drug outlets was restricted to those nearest  
42 to public and non-profit facilities. While this may not be representative of all private for-

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43 profit sector facilities, it gave us the opportunity to study the availability and prices  
44 consumers would encounter when referred from public and non-profit facilities.

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## 45 INTRODUCTION

46 The burden of non-communicable diseases (NCDs) has been on the rise, especially in low- and  
47 middle-income countries (LMICs)(1,2). Globally, an estimated 40·5 million deaths in 2016 were  
48 due to NCDs(2). Eighty percent of these deaths were caused by diseases including cancers,  
49 cardiovascular diseases, chronic respiratory diseases, and diabetes. Nearly 80% of NCD deaths  
50 occur in LMICs, and people living in sub-Saharan Africa face the highest risk of death(2,3). In  
51 Kenya, one-half of total hospital admissions and over 55% of hospital deaths are due to  
52 NCDs(4). Cardiovascular diseases are the leading cause of NCD related deaths followed by  
53 cancer, which accounts for 7% of overall mortality in the country(5). According to the Kenya  
54 Stepwise Survey for Non-communicable Diseases Risk Factors 2015 Report, the prevalence of  
55 hypertension stands at 24%(4). With a national prevalence of about 4%, diabetes accounts for  
56 more than 8,000 deaths annually in Kenya(6,7).

57 In 2011, the United Nations General Assembly adopted a resolution for the prevention and  
58 control of NCDs (8). This commitment was renewed in 2015 with the adoption of the  
59 Sustainable Development Goals (SDGs), Target 3.4 of which aims to “By 2030, reduce by one  
60 third premature mortality from non-communicable diseases through prevention and treatment  
61 and promote mental health and well-being”(9). In 2014, Kenya launched its National Health  
62 Policy (NHP) with the goal of attaining the “highest possible standard of health in a responsive  
63 manner”(10). Among the six key objectives of this policy, one directly targets non-  
64 communicable diseases: “halt and reverse the rising burden of non-communicable conditions”.

65 Two critical indicators listed in the global monitoring framework (GMF) for the prevention and  
66 control of NCDs adopted by the 66<sup>th</sup> World Health Assembly in 2013 include affordability and  
67 availability of NCD medicines in health facilities (11,12).

68 Several studies have demonstrated limited availability and affordability of NCD medicines in  
69 LMICs(13–15). Despite the high burden of NCDs in Kenya, there are many challenges regarding  
70 access to NCD medicines(4,16,17). The government owned Kenya Medical Supplies Agency  
71 (KEMSA) and the Mission for Essential Drugs and Supplies (MEDS), are the leading suppliers  
72 (wholesalers) of medicines to public and non-profit hospitals and clinics. MEDS, a faith-based  
73 organization, supply about 40% of the volume of medicines consumed at public and non-profit  
74 facilities and operates in about 33 of the 47 counties in the country(18), Stockouts at these two  
75 wholesalers have reportedly been minimal(19). However, the availability of medicines in health  
76 facilities that serve patients (including dispensaries, health centers and hospitals) is generally  
77 poor, which may be a reflection of the supplier – retailer supply chain weaknesses and public  
78 financing of medicines among other factors(20). Medicines for NCDs were found to be much  
79 less available at health facilities compared with medicines for communicable diseases (46% vs.  
80 70%)(20). The Kenya Service Delivery and Readiness Assessment Report, published in 2014,  
81 reported an even lower mean availability of NCD medicines at primary care facilities and  
82 hospitals: 25% and 32% respectively(21).

83 There is no pricing policy or the regulation of mark-ups on medicines in Kenya. The country  
84 implemented a reduced user fee policy in 2004 which among other things, includes providing  
85 medicines for free at levels 2 and 3 facilities(19,22). However, studies have shown poor  
86 adherence to this policy(22,23). Only 19% of the population has insurance coverage, hence most  
87 patients pay for medicines out-of-pocket(24). Based on data collected in 2009, the prices of

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3 88 medicines are lower in public facilities compared to faith based facilities, though stock-outs are  
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5 89 about three times more common in public facilities (46% vs. 14%)(19).  
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9 90 Previous studies on availability and price of medicines in Kenya have had two major limitations.  
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11 91 First, these did not take into account the level of care of health facilities surveyed. With the goal  
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13 92 of ensuring appropriate use of medicines at various levels of care, the National Essential  
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15 93 Medicines List (EML), which guides public procurement in Kenya restricts most NCD  
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17 94 medicines to levels 4 facilities (primary (county) referral hospitals) and above(25,26). However,  
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19 95 it is not clear if providers or suppliers follow this restriction. Based on this restriction, the free  
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21 96 medicines policy at lower levels of care and possibly other factors, availability and prices of  
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23 97 medicines might differ by level of care. Secondly, previous studies did not evaluate availability  
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25 98 of medicines in the EML separately from medicines in the National Standard Treatment  
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27 99 Guidelines (STGs). Even though the EML and STGs are meant to complement each other in  
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29 100 standardizing the provision of quality health services in Kenya, there are more medicines listed  
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31 101 in the STGs than in the EML which can make the standardization of care challenging(25–30).  
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37 102 The objective of this study was to determine the availability and price of medicines for NCDs in  
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39 103 health facilities and private for-profit drug outlets in Kenya. The study compared the availability  
40  
41 104 and prices of NCD medicines to acute medicines in order to highlight potential gaps in the  
42  
43 105 delivery of NCD services. By taking into account the EML restrictions discussed above, and the  
44  
45 106 level of care of health facilities surveyed, this study highlights the disparities in access to  
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47 107 medicines by level of care. Because of the inconsistency between the EML and STGs, the study  
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49 108 also evaluates separately, the availability of medicines included in the EML and availability of  
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51 109 medicines included in the STGs. Findings from this study complement existing evidence on the  
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3 110 availability and price of NCD medicines in low- and middle-income countries, which is  
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5 111 necessary to inform the design of policies to enhance access to medicines(13,20,21,31–34).  
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## 8 9 112 **METHODS**

### 10 11 113 **Study setting**

12  
13 114 The data presented in this paper were collected during the baseline study on the evaluation of  
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15 115 *Novartis Access*, a low-cost NCD medicines program implemented by Novartis  
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17  
18 116 Pharmaceuticals(18,35). *Novartis Access* targets medicines for four non-communicable diseases  
19  
20 117 – cardiovascular disease (dyslipidemia, heart failure and hypertension), diabetes, asthma and  
21  
22 118 breast cancer. Data were collected from eight study counties - Embu, Kakamega, Kwale,  
23  
24 119 Makeni, Narok, Nyeri, Samburu and West Pokot. These counties were a mix of semi-urban and  
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26  
27 120 rural areas with a total population of seven million inhabitants, representing 15% of the national  
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29 121 population(36). These counties were selected based on their patronage of medicines from MEDS,  
30  
31 122 and safety for field data collection. The selection of these counties had been described in more  
32  
33 123 detail by Rockers et al.(18).  
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37 124 Health facilities (public and private-non-profit facilities) in Kenya are hierarchically classified  
38  
39 125 into dispensaries (level 2), health centers (level 3), primary (county) referral hospitals (level 4),  
40  
41 126 secondary referral hospitals (level 5) and tertiary hospitals (level 6)(10). Dispensaries are the  
42  
43 127 lowest level of care and offer treatment for simple ailments to outpatients, antenatal care, etc.,  
44  
45 128 while tertiary hospitals are the highest level of care and offer more specialized services(37,38).  
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### 50 129 **Data collection**

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53 130 Data were collected in September 2016 by trained data collectors in English language, using  
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55 131 study instrument programmed in the software application, Survey CTO(39). The study  
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3 132 instrument was pilot tested twice by the trained data collectors and revised based on the feedback  
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5 133 received from each pilot test.  
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9 134 All of the public and private non-profit health facilities (level 2 to level 5) in eight counties that  
10  
11 135 purchase medicines through MEDS were surveyed. No level 6 facility was included in the study.  
12

13 136 After data collection at each health facility, data collectors asked respondents to identify the  
14  
15 137 nearest private for-profit drug outlet where patients are referred when prescribed medicines are  
16  
17 138 not available at the facility. These private for-profit drug outlets were then visited and  
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19 139 administered the same survey instrument used at the facilities.  
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23 140 Data were collected on availability (having or not having the medicine in stock on the day of  
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25 141 data collection, based on physical observation by data collectors) and price (in Kenyan Shillings  
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27 142 – KES) of 27 NCD medicine formulations and nine medicine formulations for acute diseases.  
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30 143 Price data (how much patients pay if they have to pay for the medicine out of pocket) were  
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32 144 collected from the staff in charge of medicines at each facility. For each medicine, data were  
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34 145 collected on the originator brand and the lowest-priced generic. The selection of the 27 NCD  
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36 146 medicines for this study was based on two criteria: (1) inclusion of the medicines in the *Novartis*  
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38 147 *Access* portfolio as this study was part of a larger study of the *Novartis Access* program; (2) the  
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40 148 inclusion of the medicines in the standard treatment guidelines (STGs) of the Ministry of Health.  
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44 149 The acute disease medicine formulations included in this study are all on the EML of Kenya and  
45  
46 150 have been used as reference medicines in evaluating the availability and price of medicines in  
47  
48 151 health systems(34). These medicines were selected by a group of researchers from Boston  
49  
50 152 University based on their frequency of use in primary care and their use in other research  
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52 153 studies(13,14,20). All the study medicines were listed in the most recent STGs of the Ministry of  
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54 154 Health. The list of medicines on which data were collected are shown in Appendix 1.  
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### 155 **Patient and public involvement**

156 Patients were not involved in the design or conduct of the study. Patients may be engaged after  
157 endline data collection to disseminate final study results at the county level and to the wider  
158 NCD patient community.

### 159 **Data analysis**

160 Data were analyzed using SAS version 9.4 (The SAS Institute Inc.) (40). Three of the NCD  
161 medicines which were for cancer (anastrozole, letrozole and tamoxifen) were excluded from this  
162 analysis because cancer management in Kenya mainly occurs in tertiary health facilities which  
163 were not the focus of this study. Additionally, diclofenac 50mg tablets was excluded from the  
164 analysis because it was the only acute disease medicine that was in the STG but not listed on the  
165 national EML. Inclusion of medicines in the EML was determined by their enlistment in either  
166 the 2010 or 2016 editions of the EML(25,41). Based on this definition, nine of the NCD  
167 medicines were included in the EML. The analysis focused on the number of observations and  
168 excluded missing data.

169 The following outcome measures were estimated: 1) the proportion of availability (defined as the  
170 proportion of healthcare providers having a branded or generic version of each medicine  
171 available in stock), and 2) the median price (and minimum and maximum prices) of each generic  
172 or originator medicine across healthcare providers. Availability for NCD medicines was assessed  
173 using two approaches. The first analysis focused only on NCD medicine formulations listed in  
174 the EML. In the second analysis, availability was analyzed for 24 NCD medicine formulations  
175 which were listed in the most recent editions of STGs(30,42–45). The availability of study  
176 medicine formulations was evaluated by provider type and also by level of care. Differences in  
177 mean availability between acute and NCD medicines were estimated using the two-sample t-test.

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3 178 Median, minimum and maximum prices of study medicines were estimated for observations for  
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5 179 which medicines were not given for free (i.e. price was not equal to zero). All price analyses  
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8 180 were conducted in September 2016 Kenyan Shillings. Using the supplier prices from the 2015  
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10 181 edition of the International Medical Products Price Guide (IMPPG) which is published by  
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12 182 Management Sciences for Health (MSH) as a reference, the median price ratio for each medicine  
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14 183 formulation was estimated(46). Due to the limited availability of originator brands, median price  
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16 184 ratios were estimated for only generics. Only 23 of the study medicines had supplier prices  
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18 185 reported in the IMPPG which was used for the median price ratio computation. First the prices  
19  
20 186 from the IMPPG (in 2015 United States Dollars) were inflated to 2016 rates, using the average of  
21  
22 187 2015 and 2016 annual inflation rates (0.7) obtained from the US Inflation Calculator(47). The  
23  
24 188 September 2016 price data were converted from Kenyan Shillings to United States Dollars using  
25  
26 189 September 15, 2016 exchange rate of obtained from *xe.com*. Median price ratios were compared  
27  
28 190 among public, private non-profit, and private for-profit drug stores, and across levels of care  
29  
30 191 (levels 2, 3, 4 and 5) using analysis-of-variance (ANOVA) with the Tukey-Kramer adjustment  
31  
32 192 procedure to compare pairs of means. Differences in mean price ratios between acute and NCD  
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34 193 medicines were estimated using the two-sample t-test. The proportion of facilities giving each  
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36 194 medicine for free was also estimated, stratified by provider type and level of care.  
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## 43 RESULTS

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46 196 A total of 272 healthcare providers were surveyed – 59 public facilities, 78 private non-profit  
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48 197 facilities and 135 private for-profit drug outlets. There was one hundred percent response rate  
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50 198 from health facilities, while two of the private for-profit drug outlets declined to participate in the  
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52 199 study. The total number of participating healthcare providers varied across study counties, from a  
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54 200 minimum of 12 in Samburu to a maximum of 48 in Embu county (Appendix 2). More than half  
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201 (n=77; 61%) of study facilities were level 2 (dispensaries), 18% (n=23) were level 3 (health  
202 centers), while 20.6% (n=26) were level 4 (primary referral facilities). There were few (n=5; 4%)  
203 level 5 (secondary referral) facilities.

### 204 **Medicines availability**

205 We first present results on the availability of STG and EML medicines by provider type. This is  
206 followed by results on availability stratified by level of care. Finally, we focus on how  
207 availability patterns indicate non-compliance with the EML.

#### 208 *Availability by provider type*

209 Figure 1 compares the availability of NCD medicines listed in the EML, NCD medicines listed  
210 in the STGs, and medicines for acute conditions listed in the EML, by provider type. For each of  
211 the three categories of medicines, availability was highest in private for-profit drug outlets (61.7,  
212 29.3 and 66.9% for NCD medicines on the EML, NCD medicines on the STG and acute disease  
213 medicines) compared to public and non-profit providers. Across all provide types, availability of  
214 medicines listed in the EML was higher than availability of medicines listed in the STGs.

215 Comparing medicines on the EML, the mean proportion of NCD medicine availability (0.55)  
216 was not significantly different from the mean proportion of acute medicine availability (0.61)  
217 ( $p=0.55$ ). Considering medicines in the STGs, the overall mean proportion of NCD medicine  
218 availability (0.25) was significantly lower than the overall mean proportion of acute medicine  
219 availability (0.61);  $p<0.0001$ . Appendix 3 presents the overall availability of each study medicine  
220 disaggregated by provider type and branded versus generic formulations. Generally, generics  
221 were more common than originator brands across all providers. Only two originator brands of  
222 study medicines were available in public facilities compared with 19 in private non-profit, and

223 21 in private for-profit drug outlets. Several medicines included in the EML had a proportion of  
224 availability of over 50%. However, salbutamol, an important medicine for asthma relief had an  
225 availability of less than 40% across the different types of providers. Thirteen medicines had very  
226 low availability including CVD medicines such as bisoprolol, ramipril, simvastatin, valsartan and  
227 diabetes medicines such as glimepiride.

[Figure 1: Facility level mean proportion of availability by provider type for NCD medicines included in the EML, NCD medicines listed in STGs and acute medicines included in the EML]

### 229 *Availability by level of care*

230 Figure 2 presents the proportion of availability of NCD medicines listed in the STGs and acute  
231 disease medicines (listed in the EML) by level of care. For NCD medicines in the STGs  
232 availability increases with increasing level of care, from 16.1% at level 2 facilities to 31.7% at  
233 level 5 facilities. A similar trend was observed for acute disease medicines. At each level of care,  
234 the availability of acute disease medicines was more than two times the availability of NCD  
235 medicines listed in the STGs. The findings at level 5 facilities should be interpreted with caution  
236 because of the small sample size – only five facilities were surveyed at this level of care.

237

[Figure 2: Facility level mean proportion of availability by level of care for medicines listed in the standard treatment guidelines and acute disease medicines]

238 Appendix 4 presents the availability of study medicines by county. The mean proportion of  
239 availability of study medicines ranges from 0.24 in West Pokot to 0.42 in Makueni.

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3 241 *Non-compliance of public and non-profit facilities with the EML*  
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6 242 Twelve of the NCD medicines in this study were not on the EML. However, each of these  
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8 243 medicines was found at all levels of care. The proportion of health facilities stocking these  
9  
10 244 medicines ranged from 0.01 to 0.2. As mentioned earlier, all of the study NCD medicines  
11  
12 245 included in the EML were assigned level 4 and above except salbutamol inhaler which was  
13  
14 246 assigned level 2 and above. However, more than half of levels 2 and 3 facilities were stocking  
15  
16 247 four of these medicines (amitriptyline 25mg, furosemide 40mg, metformin 500mg, and  
17  
18 248 omeprazole 20mg) (Appendix 3). Among acute medicines, diazepam 5mg was restricted to level  
19  
20 249 4 and above, however, the proportion of level 2 and level 3 facilities stocking this medicine were  
21  
22 250 0.5 and 0.6 respectively.  
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27 251 **Medicine prices**  
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29 252 In this section, we first present results on medicine prices by provider type, followed by results  
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31 253 on prices stratified by level of care.  
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34

35 254 *Medicine prices by provider type*  
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38 255 There were wide variations in medicine prices across and within provider types. The within  
39  
40 256 provider type variations appeared to be more pronounced in private drug outlets compared to  
41  
42 257 public sector facilities. For example, the price of 1g vial of generic ceftriaxone ranged from 30 to  
43  
44 258 800 KES in private drug outlets, 10 to 550 in private not-for-profit facilities and 50 to 400 in  
45  
46 259 public facilities.  
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50  
51 260 The mean proportion of public facilities giving medicines for free (0.47) was significantly higher  
52  
53 261 than the mean proportion of private non-profit facilities giving medicines for free (0.09), ( $p <$   
54  
55 262 0.0001). For example, generic metformin 500mg Tab/Cap was provided for free at 38.5%  
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263 (n=15/39) of public facilities and 14.9% (n=7/47) of private-non-profit facilities. Drug outlets  
 264 did not offer any medicines for free. There was large variability in the free provision of  
 265 medicines among public health facilities which was unrelated to county (data not shown). The  
 266 mean proportion of non-profit facilities giving NCD medicines for free (0.05) was significantly  
 267 less than the mean proportion giving acute medicines for free (0.18),  $p < 0.0001$ . However, this  
 268 difference was not significantly different in public facilities (0.45 for NCD medicines and 0.54  
 269 for acute medicines),  $p = 0.3119$ .

270 The median price ratio ranged from 0.6 for paracetamol syrup in private for-profit drug outlets to  
 271 8.3 for simvastatin 20mg tablets/caps in private non-profit health facilities. There was more  
 272 variability in median price ratios for NCD medicines (Figure 3). The mean price ratio was 2.29  
 273 in the public sector, 3.61 in the private non-profit sector, and 2.95 in drug outlets (Table 1 and  
 274 Figure 3). The mean price ratio of NCD medicines (2.1) was not significantly different from the  
 275 mean price ratio of acute medicines (2.0) in public facilities  $p = 0.3517$ . However, the mean price  
 276 ratio of NCD medicines was significantly higher than the mean price ratio of acute medicines in  
 277 non-profit facilities (4.1 vs 2.0 respectively),  $p = 0.0094$ ; and in drug outlets (3.5 vs. 1.7)  
 278  $p = 0.0014$ .

[Figure 3: Mean price ratios of NCD medicines and acute disease medicines by provider type]

*Table 1 – Percentage of healthcare providers dispensing medicines free of charge and median price ratios by provider type (using MSH supplier prices as a reference)*

Medicine tablets or capsules except otherwise noted	Public facilities		Private non-profit facilities		Median price ratios		
	Number surveyed*	Percentage dispensed for free % (number)	Number surveyed*	Percentage dispensed for free % (number)	Public	Non profit	Drug Stores
<i>Medicines for CVD</i>							
Amlodipine 10mg	2	50 (1)	12	8.3 (1)	1.3	2.7	2.7
<b>Amlodipine 5mg</b>	<b>17</b>	<b>17.6</b>	<b>16</b>	<b>0</b>	<b>2.3</b>	<b>6.3</b>	<b>5.0</b>

Medicine tablets or capsules except otherwise noted	Public facilities		Private non-profit facilities		Median price ratios		
	Number surveyed*	Percentage dispensed for free % (number)	Number surveyed*	Percentage dispensed for free % (number)	Public	Non profit	Drug Stores
		<b>(3)</b>					
Atenolol 50mg	31	32.3 (10)	38	15.8 (6)	.	3.7	4.6
Bisoprolol 10mg	0	-	1	0	.	3.4	-
Bisoprolol 5mg	1	0 0	0	-	-	-	-
Captopril 25mg	0	-	3	0	.	4.4	2.0
<b>Furosemide 40mg</b>	<b>41</b>	<b>43.9 (18)</b>	<b>57</b>	<b>12.3 (7)</b>	<b>1.6</b>	<b>3.3</b>	<b>3.3</b>
Hydrochlorothiazide 50mg	12	58.3 (7)	16	0	2.3	6.4	4.7
Ramipril 10mg	0	-	1	0	-	-	-
Ramipril 5mg	0	-	1	0	-	-	-
<b>Simvastatin 20mg</b>	<b>0</b>	<b>-</b>	<b>1</b>	<b>0</b>	<b>.</b>	<b>8.3</b>	<b>5.7</b>
Valsartan 80mg	0	-	1	0	-	-	-
<i>Medicines for diabetes</i>							
<b>Glibenclamide 5mg</b>	<b>34</b>	<b>35.3 (12)</b>	<b>44</b>	<b>11.4 (5)</b>	<b>3.5</b>	<b>5.3</b>	<b>5.3</b>
Glimeperide 1mg	0	-	1	0	-	-	-
Glimeperide 2mg	0	-	3	0	-	-	-
Glimeperide 4mg	0	-	3	0	-	-	-
Metformin 1000mg	0	-	1	0	.	2.6	1.3
<b>Metformin 500mg</b>	<b>39</b>	<b>38.5 (15)</b>	<b>47</b>	<b>14.9 (7)</b>	<b>2.0</b>	<b>3.3</b>	<b>3.3</b>
<i>Medicines for asthma</i>							
<b>Salbutamol 100MCG/DOS inhaler</b>	<b>24</b>	<b>41.7 (10)</b>	<b>35</b>	<b>14.3 (5)</b>	<b>1.1</b>	<b>1.0</b>	<b>1.4</b>
<i>Other NCD medicines</i>							
<b>Amitriptyline 25mg</b>	<b>40</b>	<b>45 (18)</b>	<b>50</b>	<b>16 (8)</b>	<b>1.3</b>	<b>3.5</b>	<b>2.3</b>
<b>Omeprazole 20 mg</b>	<b>45</b>	<b>35.6 (16)</b>	<b>65</b>	<b>15.4 (10)</b>	<b>3.5</b>	<b>3.5</b>	<b>3.5</b>
<i>Acute medicines</i>							
<b>Amoxicillin 250mg Dispersible tab</b>	<b>21</b>	<b>52.4 (11)</b>	<b>27</b>	<b>22.2 (6)</b>	<b>1.4</b>	<b>0.9</b>	<b>0.9</b>
<b>Amoxicillin 250mg</b>	<b>41</b>	<b>43.9 (18)</b>	<b>53</b>	<b>18.9 (10)</b>	<b>1.9</b>	<b>1.9</b>	<b>1.9</b>



Medicine tablets or capsules except otherwise noted	Public facilities		Private non-profit facilities		Median price ratios		
	Number surveyed*	Percentage dispensed for free % (number)	Number surveyed*	Percentage dispensed for free % (number)	Public	Non profit	Drug Stores
<b>Amoxicillin 500mg</b>	<b>7</b>	<b>71.4 (5)</b>	<b>37</b>	<b>13.5 (5)</b>	<b>1.5</b>	<b>1.7</b>	<b>1.7</b>
<b>Ceftriaxone 1 g/vial Inj</b>	<b>40</b>	<b>40.0 (16)</b>	<b>57</b>	<b>12.3 (7)</b>	<b>2.9</b>	<b>3.7</b>	<b>1.7</b>
<b>Ciprofloxacin 500mg</b>	<b>15</b>	<b>40.0 (6)</b>	<b>45</b>	<b>8.9 (4)</b>	<b>2.7</b>	<b>2.7</b>	<b>2.7</b>
<b>Co-trimoxazole 8+40mg/ml Susp.</b>	<b>31</b>	<b>67.7 (21)</b>	<b>51</b>	<b>27.5 (14)</b>	<b>1.1</b>	<b>2.1</b>	<b>1.7</b>
<b>Diazepam 5mg</b>	<b>34</b>	<b>44.1 (15)</b>	<b>51</b>	<b>21.6 (11)</b>	<b>3.7</b>	<b>2.1</b>	<b>2.1</b>
<b>Paracetamol 24mg/ml Susp.</b>	<b>44</b>	<b>75.0 (33)</b>	<b>57</b>	<b>24.6 (14)</b>	<b>1.0</b>	<b>1.0</b>	<b>0.6</b>
<b>Mean</b>		<b>43.8%</b>		<b>8.7%</b>	<b>2.1</b>	<b>3.4</b>	<b>2.9</b>

\* Refers to the number of facilities that have the medicine in stock and which reported a price for it. Medicines on the EML (2010 or 2016) are highlighted in bold

## 279 Medicine prices by level of care

280 Appendix 5 presents the proportion of facilities dispensing medicines for free and the median  
 281 prices of medicines by level of care. There were wide price variations across the different levels  
 282 of care and within each level of care. Even though level 2 and 3 facilities were expected to be  
 283 providing medicines for free, the proportion of level 2 facilities which gave specific medicines  
 284 for free ranged from none to 42%. The proportion of level 3 facilities that provided medicines for  
 285 free ranged from none to 67%. More levels 2 and 3 facilities provided medicines for free  
 286 compared to level 4 facilities. There were no clear trends in price ratios by level of care.

## 287 DISCUSSION

288 This study has revealed important findings on the availability and price of NCD medicines in  
 289 Kenya. It is the first study to report on disparities in availability of medicines by level of care  
 290 within public and non-profit facilities and take into account the EML restriction on medicines  
 291 with respect to level of care.

## 292 **Medicines availability for NCD and acute conditions**

293 While the availability for many EML medicines was higher than 50%, availability was far below  
294 the international target of 80% availability(15,48). This is concerning in particular for NCD  
295 medicines. We found significantly lower availability of NCD medicines listed in the STGs  
296 compared to medicines for acute conditions. This is despite the fact that one-half of total hospital  
297 admissions and over 55% of hospital deaths in Kenya are due to NCDs (4). The mean  
298 availability of NCD medicines included in the STGs was two to three times lower than those  
299 found in other studies in Kenya(13,20,21). The low availability of some of these NCD medicines  
300 may indicate low demand, or the preference of prescribers and patients for other therapeutic  
301 options within the same classes of medicines which were not assessed in our study. Considering  
302 the high burden of NCDs globally, and the rapidly increasing burden in low- and middle-income  
303 countries, efforts are needed to ensure the reliable supply of NCD medicines in health facilities at  
304 all levels in Kenya.

305 Our study assessed the availability of medicines specifically at levels 2, 3, 4 and 5 facilities with  
306 availability higher at higher levels of care (though the differences were not statistically  
307 significant). Among the programmatic objectives of the EML is the promotion of appropriate use  
308 of medicines. For this reason, several NCD medicines are limited to certain levels of care.  
309 Despite the limitation of NCD medicines to level 4 facilities and above, we found many of these  
310 medicines in several level 2 and 3 facilities suggesting there is demand for NCD medicines at  
311 these lower level facilities. If the barrier to availability is the limitation of NCD medicines to  
312 level 4 facilities and above, then additional measures such as building the capacity of lower level  
313 care facilities to provide these medicines may be needed to ensure access. It is also important to  
314 note that 12 NCD medicine formulations that were not listed in the EML were available across

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3 315 all levels of care. Though the availability of these medicines were lower than those on the EML,  
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5 316 it still raises the question of whether the EML is being implemented to its optimal potential in the  
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8 317 country.

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10 318 The generally low availability of originator brands, especially in the public sector is in line with  
11  
12 319 international recommendations to promote the use of generic medicines to increase efficiency in  
13  
14 320 medicines expenditure(32,49,50). Nonetheless, the limited availability of originator medicines in  
15  
16 321 the public sector does not necessarily translate into higher rates of prescribing of generics. The  
17  
18 322 2012 Pharmaceutical Country Profile of Kenya indicates that prescribing by International Non-  
19  
20 323 proprietary Names (INN) is neither obligatory in the public sector nor in the private sector(51).  
21  
22 324 Only 32% of medicines are prescribed by INN. Thus, it is important to promote prescribing by  
23  
24 325 INN to further promote the use of generic medicines.  
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### 30 326 **Prices of medicines**

31  
32 327 Though it is government policy to provide medicines for free at levels 2 and 3 facilities in  
33  
34 328 Kenya, our findings suggest that there is a large variation in policy adherence and each facility  
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36 329 decided whether to charge for the medicines dispensed. Free dispensing varied across and within  
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38 330 provider type (except for private drug outlets where no medicine was given for free), across level  
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40 331 of care and by county. Patient knowledge of which facilities charge for medicines and which do  
41  
42 332 not increases the complexity of efforts to find affordable medicines. There was no hospital at  
43  
44 333 which paracetamol syrup and co-trimoxazole suspension, medicines frequently prescribed for  
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46 334 children, were given for free.  
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51 335 There were large price variations across and within provider type, level of care and county. Drug  
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53 336 outlets and private non-profit facilities exhibited similar patterns in relation to pricing. Both  
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3 337 types of providers charged higher prices than public facilities. Private non-profit providers were  
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5 338 significantly less likely to offer medicines for free compared to public facilities. Additionally, the  
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8 339 mean price ratios of NCD medicines were significantly higher than the mean price ratio of acute  
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10 340 medicines in both private non-profit facilities and private drug outlets, though no significant  
11  
12 341 differences were observed in the public sector. This may indicate relatively higher mark-ups on  
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14 342 NCD medicines in non-profit and private drug outlets. Other studies have reported higher prices  
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16 343 at private for-profit drug outlets(19,20,52). A study by Health Action International also  
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18 344 demonstrated higher mark-ups on medicines in private non-profit providers(53). The government  
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20 345 of Kenya also charges import declaration fees on medicines which may contribute to higher  
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22 346 prices(51). Considering the low availability of NCD medicines in public facilities, patients' best  
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24 347 option may have been to access their medicines at private non-profit facilities and private drug  
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26 348 outlets at higher prices. The high cost of NCD medicines has been shown to be a financial  
27  
28 349 burden on households in Kenya(54,55).

### 34 350 **Strengths and limitations**

35  
36 351 As mentioned earlier, this study is the first study that evaluates availability taking into  
37  
38 352 consideration the level of care medicines are assigned in the EML. In addition, this study also  
39  
40 353 evaluates availability separately NCD for medicines included in the EML and those included in  
41  
42 354 the STGs, highlighting the differences between the two documents. The cross sectional nature of  
43  
44 355 the study does not allow us to assess trends in availability and price over time and precludes  
45  
46 356 strong causal inference. While this study adds to the evidence base on the availability and prices  
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48 357 of NCD medicines in Kenya, the findings may not be generalizable to the whole country because  
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50 358 the study counties were not randomly selected from across the country. In addition we evaluated  
51  
52 359 availability as binary variable (yes/no) and did not count the quantity available. Furthermore, the  
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360 sample of the private for-profit drug outlets was restricted to the nearest ones from public and  
361 non-profit facilities. Even though this sample is not representative of all private for-profit sector  
362 providers in each county, it allows studying the availability and prices consumers would  
363 encounter when referred from public and non-profit facilities.

## 364 **CONCLUSION**

365 We found evidence that the availability of NCD medicines in Kenya is significantly lower than  
366 the target level of 80%. Availability is poorest in the public sector, and generally highest in the  
367 private for-profit sector. Availability increased with increasing level of care. Our findings  
368 suggest that NCD patients in Kenya do not have reliable access to NCD medicines, particularly  
369 at public health facilities. Increasing access at public facilities, particularly level 2 and 3  
370 facilities, should be a focus of the Kenyan government's efforts to achieve universal health  
371 coverage. Pricing policies or guidelines may be useful to streamline medicine prices in the  
372 country.

## 373 **STATEMENT OF AUTHORSHIP**

374 PA, PR, RL, MO, JB and VW participated in the conception and design of the study. These  
375 authors also participated in the development and piloting of study instruments and the  
376 supervision of data collection. PA, PR, RL, MO, JB, HC and VW contributed significantly to  
377 data analysis and writing of the manuscript and have approved of the final version submitted for  
378 publication.

## 379 **DATA SHARING**

380 Deidentified data are publicly available and can be requested at:  
381 <http://sites.bu.edu/evaluatingaccess-novartisaccess/kenya/data/>. The terms of use of the data are

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3 382 also available at this website. If you have any questions about the data please contact the  
4  
5 383 Department of Global Health, Boston University School of Public Health at: sphgh@bu.edu  
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### 8 9 384 **COMPETING INTERESTS**

10  
11 385 The authors have no conflicts of interest to declare.  
12  
13

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17  
18 388 design, data collection, data analysis or the writing of the manuscript. The data generated from  
19  
20 389 this study is owned by Boston and the publications of the results are not subject to control by the  
21  
22 390 funding organization (see also agreement  
23  
24 391 <http://sites.bu.edu/novartisaccessevaluation/agreements/>)  
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### 28 392 29 30 393 **ETHICAL STATEMENT**

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32 394 This research study was reviewed and approved by the Institutional Review Boards of the Boston  
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34 395 University Medical Campus and Strathmore University in Kenya.  
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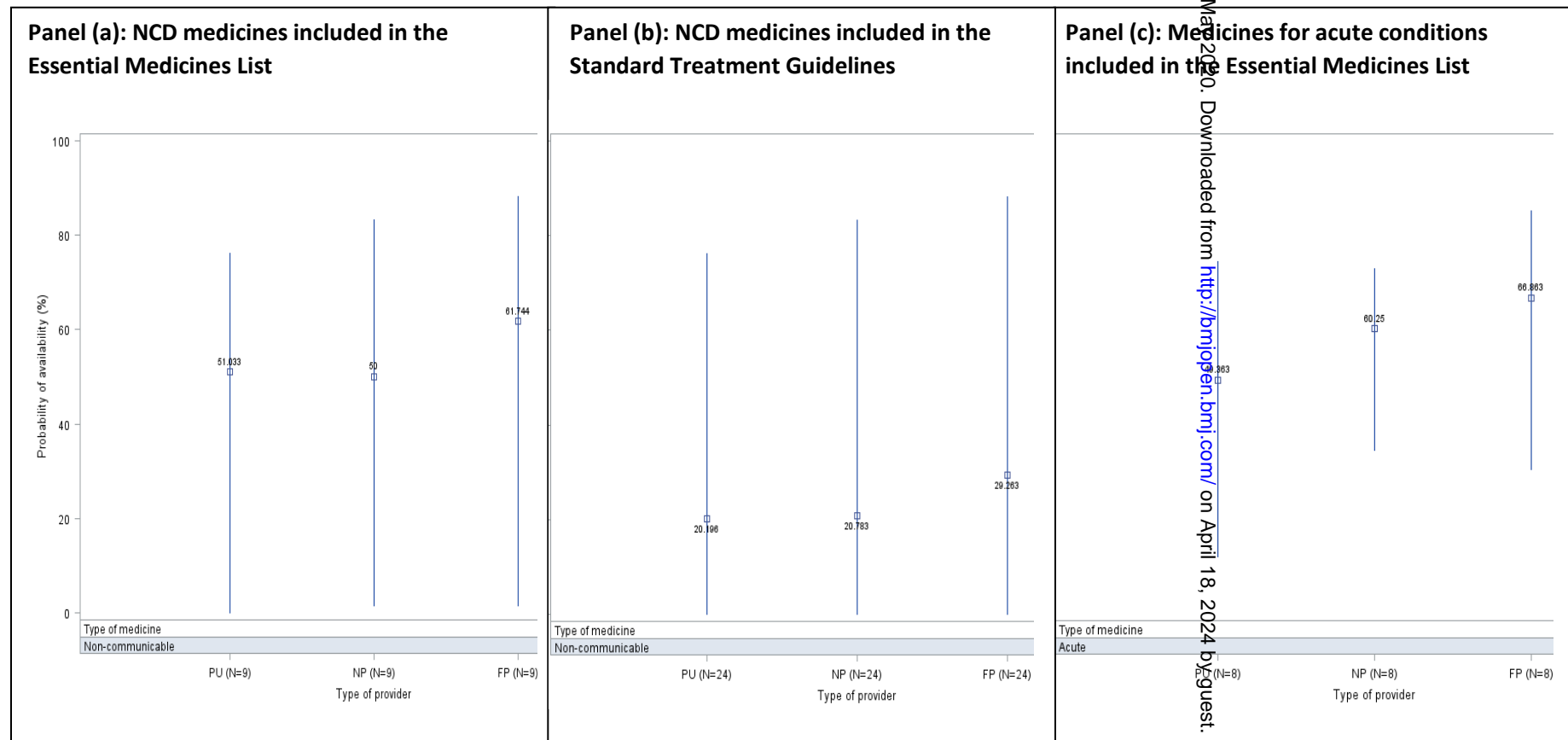
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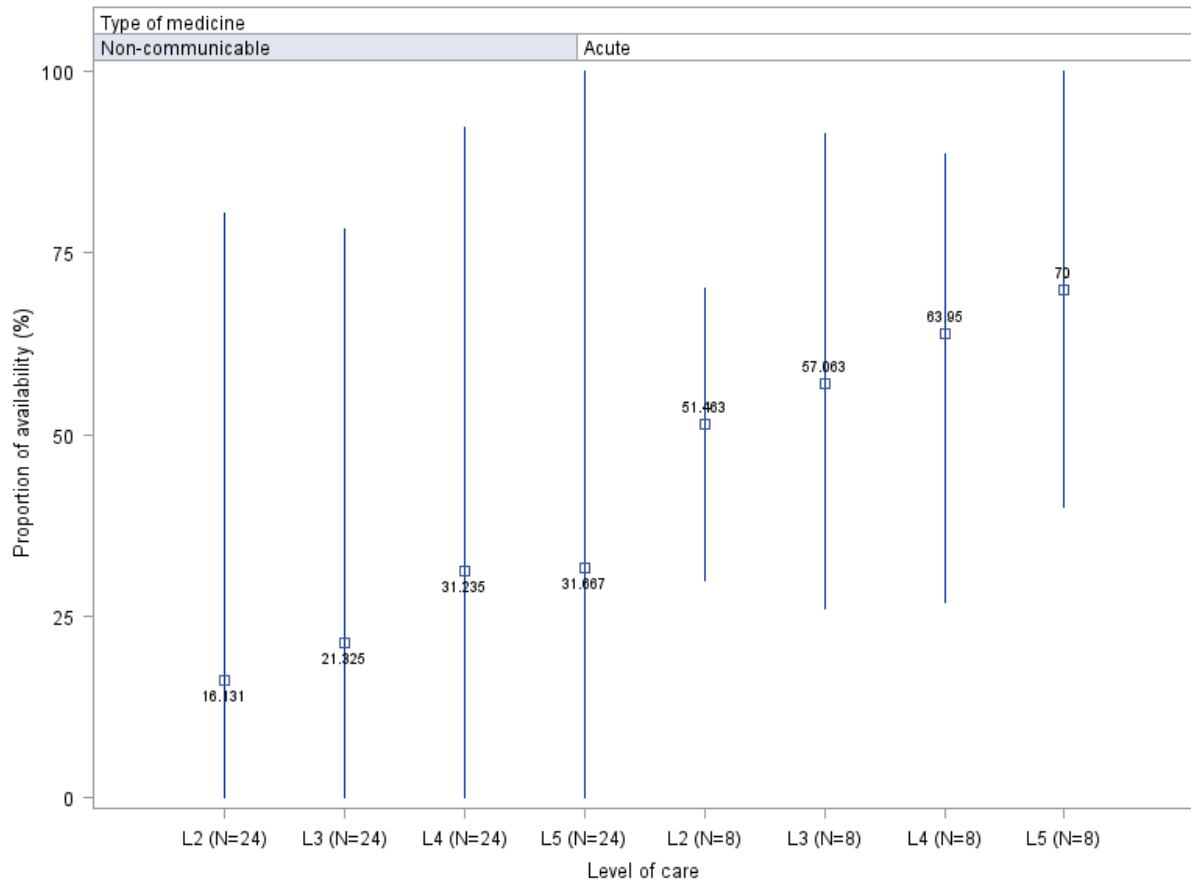
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Figure 1: Facility level mean proportion of availability by provider type for NCD medicines included in the EML, NCD medicines listed in STGs and acute medicines included in the EML



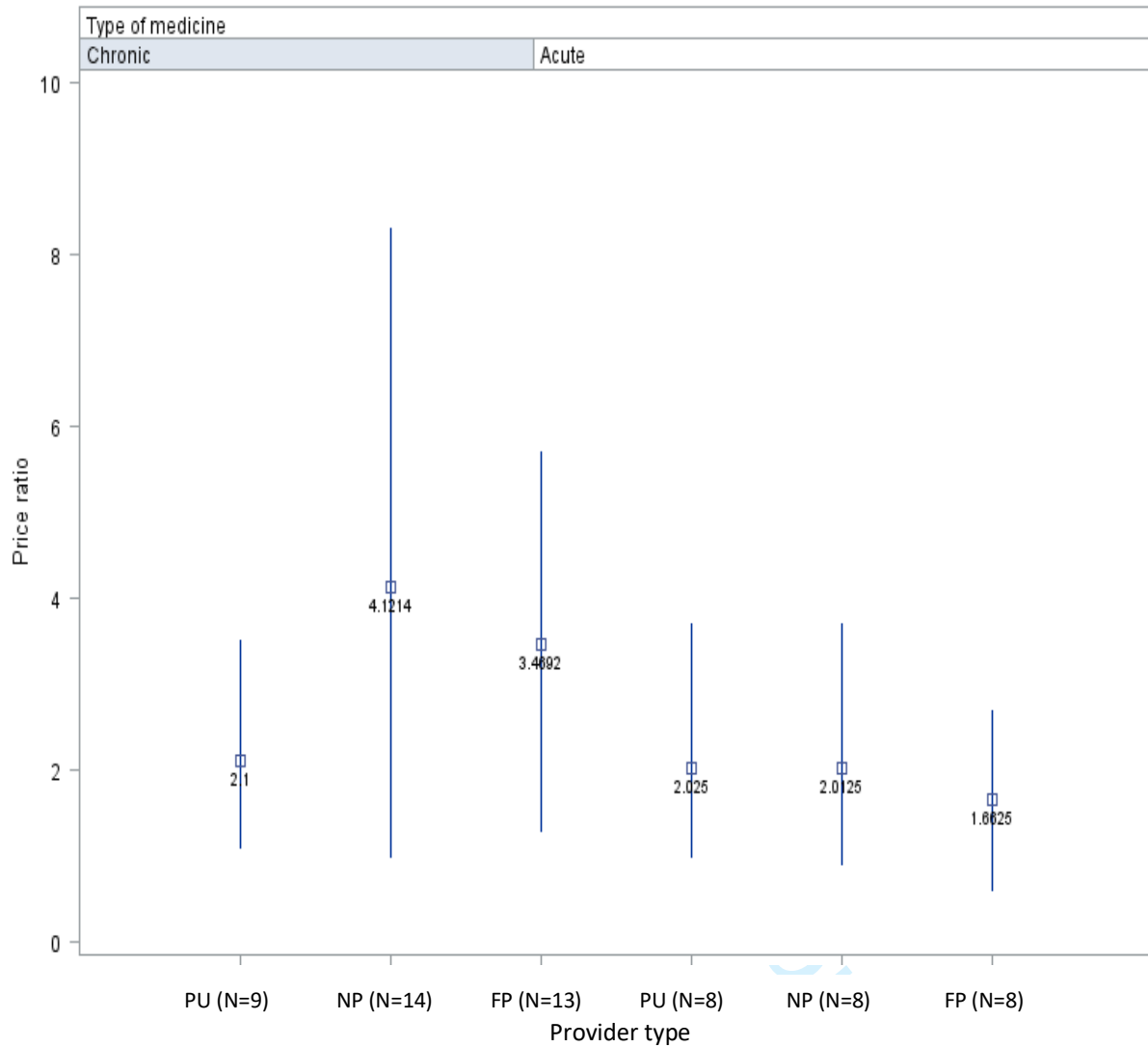
PU = Public facility; NP=Private non-profit facility; FP=Private for-profit drug outlet; NCD=Non-communicable disease; STG=Standard Treatment Guidelines; EML=Essential Medicines List (The box indicates the mean and the bars indicate the minimum and maximum)

Figure 2: Facility level mean proportion of availability by level of care for medicines listed in the standard treatment guidelines and acute disease medicines



L2 = Level 2 facilities; L3 = Level 3 facilities; L4 = Level 4 facilities; L5 = Level 5 facilities; N=number of medicines surveyed (The box indicates the mean and the bars indicate the minimum and maximum)

Figure 3: Mean price ratios of NCD medicines and acute disease medicines by provider type



PU= Public facility; NP=Private-non-profit facility; FP=Private-of-profit drug outlet N=Number of medicines surveyed (The box indicates the mean and the bars indicate the minimum and maximum)

## APPENDIX

Appendix 1: List of study medicines, level of care found and level of care assigned in the 2010 and 2016 essential medicines list (EML)

Medicine	Level of care medicine was available				Lowest level of care assigned in the 2016 EML	Lowest level of care assigned in the 2010 EML
	Level 2	Level 3	Level 4	Level 5		
<i>Medicines for CVD (n=15)</i>						
Amlodipine 10mg Tab/Cap	X	X	X	X	-	-
Amlodipine 5mg Tab/Cap	X	X	X	X	4	4
Atenolol 50mg Tab/Cap	X	X	X	X	-	4
Bisoprolol 10mg Tab/Cap	-	-	X	-	-	-
Bisoprolol 5mg Tab/Cap	-	X	-	-	-	-
Bisoprolol 2.5mg Tab/Cap	-	-	-	-	-	-
Captopril 25mg Tab/Cap	X	-	X	-	-	-
Furosemide 40mg Tab/Cap	X	X	X	X	4	4
Hydrochlorothiazide 50mg Tab/Cap	X	X	X	X	-	-
Ramipril 10mg Tab/Cap	-	-	X	-	-	-
Ramipril 5mg Tab/Cap	-	-	X	-	-	-
Simvastatin 20mg Tab/Cap <sup>1</sup>	-	-	X	-	4	-
Simvastatin 40mg Tab/Cap	-	-	-	-	-	-
Valsartan 80mg Tab/Cap	-	-	X	-	-	-
Valsartan 160mg Tab/Cap	-	-	-	-	-	-
<i>Medicines for diabetes (n=6)</i>						
Glibenclamide 5mg Tab/Cap	X	X	X	X	4	4
Glimeperide 1mg Tab/Cap	-	-	X	-	-	-
Glimeperide 2mg Tab/Cap	-	-	X	-	-	-
Glimeperide 4mg Tab/Cap	-	-	X	-	-	-
Metformin 1000mg Tab/Cap	-	-	X	-	-	-
Metformin 500mg Tab/Cap	X	X	X	X	4	4
<i>Medicines for asthma (n=1)</i>						
Salbutamol 100mcg/dos inhalation	X	X	X	X	4	2
<i>Other NCD medicines</i>						
Amitriptyline 25mg Tab/Cap	X	X	X	X	4	4
Omeprazole 20mg Tab/Cap	X	X	X	X	4	4
<i>Acute medicines (n=8)</i>						
Amoxicillin 250mg Dispersible tab	X	X	X	X	2	-

<sup>1</sup> As an alternative to atorvastatin.

Medicine	Level of care medicine was available				Lowest level of care assigned in the 2016 EML	Lowest level of care assigned in the 2010 EML
	<i>Level 2</i>	<i>Level 3</i>	<i>Level 4</i>	<i>Level 5</i>		
Amoxicillin 250mg Tab /Cap	X	X	X	X	2	2
Amoxicillin 500mg Tab/Cap	X	X	X	X	2	-
Ceftriaxone 1 g/vial Inj	X	X	X	X	2	4
Ciprofloxacin 500mg Tab/Cap	X	X	X	X	3	-
Co-trimoxazole (8+40mg/ml susp.	X	X	X	X	2	2
Diazepam 5mg Tab/Cap	X	X	X	X	4	5
Paracetamol 24mg/ml Susp	X	X	X	X	1	1

X = medicine available in at least one facility

- = medicine not available or not in the EML

All of the NCD medicines are included in the current Kenyan standard treatment guidelines.



Appendix 2: Overview of types of study facilities by county

<i>County</i>	<i>Public health facility</i>	<i>Private non-profit health facility</i>	<i>Private for-profit drug outlet</i>	<i>Total</i>
Embu	6	18	24	48
Kakamega	6	10	16	32
Kwale	5	4	12	21
Makueni	8	17	26	51
Narok	7	9	15	31
Nyeri	16	14	30	60
Samburu	3	4	5	12
West Pokot	8	2	7	17
<b>Total</b>	<b>59</b>	<b>78</b>	<b>135</b>	<b>272</b>

Appendix 3: Availability of medicines (proportion of facilities having medicine available on day of visit) by type of facility

Medicine (Tablets/capsules otherwise noted)	Public (N=59)		Private non-profit (N=78)		Private for-profit drug outlets (N=135)		Overall availability N=(272)	
	Generic	Originator	Generic	Originator	Generic	Originator	Generic	Originator
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
<i>Medicines for CVD</i>								
Amlodipine 10mg	3.4 (2)	-	14.1 (11)	1.3 (1)	46.7 (63)	1.5 (2)	27.9 (76)	1.1 (3)
<b>Amlodipine 5mg</b>	<b>28.8 (17)</b>	-	<b>20.5 (16)</b>	-	<b>39.3 (53)</b>	<b>1.5 (2)</b>	<b>31.6 (86)</b>	<b>0.7 (2)</b>
Atenolol 50mg	52.5 (31)	-	48.7 (38)	-	70.4 (59)	0.7 (1)	60.3 (164)	0.4 (1)
Bisoprolol 10mg	-	-	1.3 (1)	-	-	-	0.4 (1)	-
Bisoprolol 5mg	1.7 (1)	-	-	-	0.7 (1)	-	0.7 (2)	-
Captopril 25mg	-	-	3.9 (3)	-	16.3 (22)	-	9.2 (25)	-
<b>Furosemide 40mg</b>	<b>69.5 (41)</b>	-	<b>70.5 (55)</b>	<b>2.6 (2)</b>	<b>73.3 (99)</b>	<b>5.9 (8)</b>	<b>71.7 (195)</b>	<b>3.6 (10)</b>
Hydrochlorothiazide	20.3 (12)	-	20.5 (16)	-	29.6 (40)	-	24.7 (68)	-
Ramipril 10mg	-	-	-	1.3 (1)	0.7 (1)	-	0.4 (1)	0.4 (1)
Ramipril 5mg	-	-	1.3 (1)	-	1.5 (2)	0.7 (1)	1.1 (3)	0.4 (1)
<b>Simvastatin 20mg</b>	-	-	<b>1.3 (1)</b>	-	<b>1.5 (2)</b>	-	<b>1.1 (3)</b>	-
Valsartan 80mg	-	-	1.3 (1)	-	0.7 (1)	-	0.7 (2)	-
Mean availability CVD medicines								
<i>Medicines for diabetes</i>								
<b>Glibenclamide 5mg</b>	<b>57.6 (34)</b>	-	<b>56.4 (44)</b>	<b>1.3 (1)</b>	<b>75.6 (102)</b>	<b>4.4 (6)</b>	<b>66.1 (180)</b>	<b>2.6 (7)</b>
Glimeperide 1mg	-	-	-	1.3 (1)	3 (4)	4.4 (6)	1.5 (4)	2.6 (7)
Glimeperide 2mg	-	-	1.3 (1)	2.6 (2)	10.4 (14)	5.2 (7)	5.5 (15)	3.3 (9)
Glimeperide 4mg	-	-	-	3.9 (3)	5.2 (7)	3.0 (4)	2.6 (7)	2.6 (7)
Metformin 1000mg	-	-	1.3 (1)	1.3 (1)	15.5 (21)	8.9 (12)	8.1 (22)	5.1 (14)

Medicine (Tablets/capsules otherwise noted)	Public (N=59)		Private non-profit (N=78)		Private for-profit drug outlets (N=135)		Overall availability N=(272)	
	Generic	Originator	Generic	Originator	Generic	Originator	Generic	Originator
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Metformin 500mg	66.1 (39)	-	60.3 (47)	1.3 (1)	73.3 (99)	10.4 (14)	68.4 (188)	5.5 (15)
<i>Medicines for asthma</i>								
Salbutamol 100mcg/dos inhalation	39 (23)	1.2 (1)	23.1 (18)	21.8 (17)	34.8 (47)	35.6 (48)	32.4 (88)	24.3 (66)
<i>Other NCD medicines</i>								
Amitriptyline 25mg	67.8 (40)	-	64.1 (50)	-	63.7 (86)	-	64 (176)	-
Omeprazole 20 mg	76.3 (45)	-	83.3 (65)	-	96.3 (130)	0.7 (1)	88.2 (242)	0.4 (1)
<i>Acute medicines</i>								
Amoxicillin 250mg Dispersible tab	35.6 (21)	-	33.3 (26)	1.3 (1)	29.6 (40)	1.5 (2)	32.0 (87)	1.1 (3)
Amoxicillin 250mg	69.5 (41)	-	66.7 (52)	2.6 (2)	68.9 (93)	3.7 (5)	68 (187)	5.6 (7)
Amoxicillin 500mg	11.9 (7)	-	46.2 (36)	2.6 (2)	82.2 (111)	11.1 (15)	56.6 (154)	6.3 (17)
Ceftriaxone 1g/vial Inj	67.8 (40)	3.4 (2)	73.1 (57)	5.1 (4)	69.6 (94)	4.4 (6)	70.2 (191)	4.4 (12)
Ciprofloxacin 500mg	25.4 (15)	-	55.1 (43)	2.6 (2)	83.7 (113)	3.7 (5)	62.9 (171)	2.6 (7)
Co-trimoxazole 8+40mg/ml susp	52.5 (31)	-	62.8 (49)	2.6 (2)	68.9 (93)	6.7 (9)	63.6 (173)	4.0 (11)
Diazepam 5mg	57.6 (34)	-	65.4 (51)	1.3 (1)	47.4 (64)	-	54.8 (150)	0.4 (1)
Paracetamol 24mg/ml Susp	74.6 (44)	-	73.1 (57)	2.6 (2)	73.3 (99)	15.6 (21)	73.5 (200)	8.5 (23)

Note: Bisoprolol 2.5mg Tab/Cap, Simvastatin 40mg Tab/Cap, and Valsartan 160mg Tab/Cap were not available in any facility. Medicines either on the 2010 or 2016 edition of the EML in bold

### Appendix 4: Proportion of availability of study medicines (proportion of facilities having medicine available on day of visit) by county

Medicine	Embu		Kakamega		Kwale		Makueni		Narok		Nyeri		Samburu		West Pokot	
	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB
Amitriptyline 25mg	66.7 (32)		40.6 (13)		57.1 (12)		76.5 (39)		51.6 (16)		85 (51)		83.3 (10)		17.7 (3)	
Amlodipine 10mg	33.3 (16)	0 (0)	15.6 (5)	0 (0)	28.6 (6)	0 (0)	25.5 (13)	2 (1)	12.9 (4)	3.2 (1)	48.3 (29)	7 (1)	25 (3)	0 (0)	0 (0)	0 (0)
Amlodipine 5mg	39.6 (19)	0 (0)	25 (8)	0 (0)	33.3 (7)	4.8 (1)	25.5 (13)	2 (1)	19.4 (6)	0 (0)	51.7 (31)	0 (0)	8.3 (1)	0 (0)	5.9 (1)	0 (0)
Amoxicillin dispersible tabs 250mg	14.6 (7)	0 (0)	43.8 (14)	0 (0)	19.1 (4)	0 (0)	21.6 (11)	0 (0)	12.9 (4)	0 (0)	53.3 (32)	3 (3)	58.3 (7)	0 (0)	47.1 (8)	0 (0)
Amoxicillin 500mg	58.3 (28)	0 (0)	62.5 (20)	3.1 (1)	52.4 (11)	14.3 (3)	58.8 (30)	9.8 (5)	61.3 (19)	9.7 (3)	60 (36)	3 (5)	41.7 (5)	0 (0)	29.4 (5)	0 (0)
Amoxicillin 250mg	68.8 (33)	0 (0)	56.3 (18)	0 (0)	57.1 (12)	4.8 (1)	82.4 (42)	2 (1)	77.4 (24)	3.2 (1)	65 (39)	7 (4)	16.7 (2)	0 (0)	94.1 (16)	0 (0)
Atenolol 50mg	58.3 (28)	0 (0)	46.9 (15)	0 (0)	71.4 (15)	0 (0)	72.6 (37)	0 (0)	22.6 (7)	3.2 (1)	91.7 (55)	0 (0)	41.7 (5)	0 (0)	11.8 (2)	0 (0)
Bisoprolol 10mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8.3 (1)	0 (0)	0 (0)	0 (0)
Bisoprolol 2.5mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Bisoprolol 5mg	2.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.7 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Captopril 25mg	16.7 (8)	0 (0)	3.1 (1)	0 (0)	4.8 (1)	0 (0)	5.9 (3)	0 (0)	9.7 (3)	0 (0)	13.3 (8)	0 (0)	8.3 (1)	0 (0)	0 (0)	0 (0)
Ceftriaxone 1g/vial Inj	58.3 (28)	2.1 (1)	75 (24)	3.1 (1)	71.4 (15)	0 (0)	78.4 (40)	5.9 (3)	67.7 (21)	3.2 (1)	68.3 (41)	7 (4)	66.7 (8)	16.7 (2)	82.4 (14)	0 (0)
Ciprofloxacin 500mg	70.8 (34)	2.1 (1)	59.4 (19)	0 (0)	57.1 (12)	4.8 (1)	66.7 (34)	2 (1)	61.3 (19)	6.5 (2)	66.7 (40)	3 (2)	66.7 (8)	0 (0)	29.4 (5)	0 (0)
Cotrimoxazole 8+40mg/ml susp	72.9 (35)	0 (0)	50 (16)	0 (0)	57.1 (12)	4.8 (1)	54.9 (28)	11.8 (6)	54.8 (17)	6.5 (2)	75 (45)	3 (2)	66.7 (8)	0 (0)	70.6 (12)	0 (0)
Diazepam 5g	47.9 (23)	0 (0)	31.3 (10)	0 (0)	42.9 (9)	0 (0)	76.5 (39)	0 (0)	38.7 (12)	0 (0)	73.3 (44)	7 (1)	58.3 (7)	0 (0)	29.4 (5)	0 (0)
Furosemide 40mg	62.5 (30)	2.1 (1)	56.3 (18)	3.1 (1)	71.4 (15)	4.8 (1)	84.3 (43)	2 (1)	61.3 (19)	3.2 (1)	91.7 (55)	3 (5)	66.7 (8)	0 (0)	41.2 (7)	0 (0)
Glibenclamide 5mg	56.3 (27)	0 (0)	62.5 (20)	0 (0)	66.7 (14)	4.8 (1)	78.4 (40)	5.9 (3)	51.6 (16)	3.2 (1)	86.7 (52)	3 (2)	58.3 (7)	0 (0)	23.5 (4)	0 (0)
Glimepiride 1mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4.8 (1)	2 (1)	3.9 (2)	3.2 (1)	3.2 (1)	3.3 (2)	3 (3)	0 (0)	0 (0)	0 (0)	0 (0)
Glimepiride 2mg	6.3 (3)	2.1 (1)	0 (0)	3.1 (1)	0 (0)	0 (0)	9.8 (5)	3.9 (2)	9.7 (3)	3.2 (1)	6.7 (4)	7 (4)	0 (0)	0 (0)	0 (0)	0 (0)

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Medicine	Embu		Kakamega		Kwale		Makueni		Narok		Nyeri		Samburu		West Pokot	
	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB	Gen	OB
Glimepiride 4mg	2.1 (1)	2.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	3.9 (2)	3.2 (1)	3.2 (1)	6.7 (4)	3.2 (3)	0 (0)	0 (0)	0 (0)	0 (0)
Metformin 1000mg	10.4 (5)	0 (0)	0 (0)	3.1 (1)	4.8 (1)	0 (0)	3.9 (2)	7.8 (4)	12.9 (4)	6.5 (2)	16.7 (10)	15.0 (6)	0 (0)	0 (0)	0 (0)	0 (0)
Metformin 500mg	68.8 (33)	0 (0)	53.1 (17)	6.3 (2)	76.2 (16)	0 (0)	78.4 (40)	13.7 (7)	35.5 (11)	9.7 (3)	91.7 (55)	83.3 (3)	83.3 (10)	0 (0)	17.7 (3)	0 (0)
Omeprazole 20mg	91.7 (44)	0 (0)	93.8 (30)	0 (0)	85.7 (18)	0 (0)	88.2 (45)	2 (1)	74.2 (23)	0 (0)	95 (57)	88.3 (0)	75 (9)	0 (0)	82.4 (14)	0 (0)
Paracetamol 24mg/ml susp	75 (36)	0 (0)	56.3 (18)	0 (0)	71.4 (15)	14.3 (3)	68.6 (35)	15.7 (8)	71 (22)	3.2 (1)	91.7 (55)	88.3 (11)	58.3 (7)	0 (0)	70.6 (12)	0 (0)
Ramipril 10mg	0 (0)	0 (0)	3.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	19.7 (1)	0 (0)	0 (0)	0 (0)	0 (0)
Ramipril 5mg	2.1 (1)	0 (0)	3.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	0 (0)	0 (0)	0 (0)	19.7 (1)	8.3 (1)	0 (0)	0 (0)	0 (0)
Salbutamol Inhaler	47.9 (23)	12.5 (6)	46.9 (15)	9.4 (3)	19.1 (4)	19.1 (4)	19.6 (10)	51 (26)	16.1 (5)	19.4 (6)	23.3 (14)	19.7 (20)	58.3 (7)	8.3 (1)	58.8 (10)	0 (0)
Simvastatin 20mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3.9 (2)	0 (0)	0 (0)	0 (0)	1.7 (1)	19.7 (1)	0 (0)	0 (0)	0 (0)	0 (0)
Simvastatin 40mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	19.7 (1)	0 (0)	0 (0)	0 (0)	0 (0)
Valsartan 80mg	0 (0)	0 (0)	3.1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	19.7 (1)	8.3 (1)	0 (0)	0 (0)	0 (0)
Valsartan 180mg	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	19.7 (1)	0 (0)	0 (0)	0 (0)	0 (0)
<b>Mean % availability</b>	<b>34.4</b>	<b>0.7</b>	<b>29.8</b>	<b>1.0</b>	<b>31.8</b>	<b>2.7</b>	<b>36.8</b>	<b>4.7</b>	<b>27.6</b>	<b>2.9</b>	<b>42.0</b>	<b>31.4</b>	<b>32.0</b>	<b>0.8</b>	<b>23.9</b>	<b>0</b>

*Gen=Generic; OB=Originator Brand*

**Appendix 5 – Proportion of facilities dispensing medicines free of charge and median price ratios by level of care (using MSH supplier prices as a reference)**

Medicines	Proportion of facilities giving medicines for free								Median price ratios			
	Level 2		Level 3		Level 4		Level 5		Level 2	Level 3	Level 4	Level 5
	N	% (n)	N	% (n)	N	% (n)	N	% (n)				
<i>Medicines for CVD</i>												
Amlodipine 10mg Tab/Cap	4	25(1)	1	0(0)	7	0(0)	1	100(1)	0.94	2.07	2.67	0.00
<b>Amlodipine 5mg Tab/Cap</b>	<b>10</b>	<b>10(1)</b>	<b>3</b>	<b>33.3(1)</b>	<b>15</b>	<b>0(0)</b>	<b>4</b>	<b>25(1)</b>	<b>4.72</b>	<b>4.08</b>	<b>3.14</b>	<b>3.14</b>
Atenolol 50mg Tab/Cap	30	30(9)	11	54.5(6)	21	0(0)	5	20(1)	3.70	6.08	2.78	2.78
Bisoprolol 10mg Tab/Cap	0	-	0	-	1	0(0)	0	-	-	-	-	-
Bisoprolol 5mg Tab/Cap	0	-	1	100(1)	0	-	0	-	-	-	-	-
Captopril 25mg Tab/Cap	2	0(0)	0	-	1	0(0)	0	-	3.23	0.00	7.26	0.00
<b>Furosemide 40mg Tab/Cap</b>	<b>45</b>	<b>26.7(12)</b>	<b>18</b>	<b>66.7(12)</b>	<b>24</b>	<b>0(0)</b>	<b>4</b>	<b>25(1)</b>	<b>2.26</b>	<b>11.18</b>	<b>2.70</b>	<b>4.92</b>
Hydrochlorothiazide 50mg Tab/Cap	12	16.7(2)	7	57.1(4)	5	0(0)	3	33.3(1)	3.49	23.6	6.98	3.49
Ramipril 10mg Tab/Cap	0	-	0	-	1	0(0)	0	-	-	-	-	-
Ramipril 5mg Tab/Cap	0	-	0	-	1	0(0)	0	-	-	-	-	-
<b>Simvastatin 20mg Tab/Cap</b>	<b>0</b>	<b>-</b>	<b>0</b>	<b>-</b>	<b>1</b>	<b>0(0)</b>	<b>0</b>	<b>-</b>	<b>0.00</b>	<b>0.00</b>	<b>8.32</b>	<b>0.00</b>
Valsartan 80mg Tab/Cap	0	-	0	-	1	0(0)	0	-	-	-	-	-
<i>Medicines for diabetes</i>												
<b>Glibenclamide 5mg Tab/Cap</b>	<b>32</b>	<b>21.9(7)</b>	<b>16</b>	<b>50(8)</b>	<b>23</b>	<b>4.3(1)</b>	<b>5</b>	<b>20(1)</b>	<b>3.51</b>	<b>12.08</b>	<b>4.39</b>	<b>6.14</b>
Glimeperide 1mg Tab/Cap	0	-	0	-	1	0(0)	0	-	-	-	-	-
Glimeperide 2mg Tab/Cap	0	-	0	-	3	0(0)	0	-	-	-	-	-
Glimeperide 4mg Tab/Cap	0	-	0	-	3	0(0)	0	-	-	-	-	-
Metformin 1000mg Tab/Cap	0	-	0	-	1	0(0)	0	-	0.00	0.00	2.59	0.00
<b>Metformin 500mg Tab/Cap</b>	<b>39</b>	<b>28.2(11)</b>	<b>18</b>	<b>55.6(10)</b>	<b>21</b>	<b>0(0)</b>	<b>5</b>	<b>20(1)</b>	<b>3.31</b>	<b>4.07</b>	<b>1.99</b>	<b>2.65</b>
<i>Medicines for asthma</i>												
<b>Salbutamol 100mcg/dos inhaler</b>	<b>21</b>	<b>33.3(7)</b>	<b>12</b>	<b>50.0(6)</b>	<b>19</b>	<b>5.3(1)</b>	<b>4</b>	<b>25.0(1)</b>	<b>1.16</b>	<b>0.75</b>	<b>1.08</b>	<b>1.08</b>
<i>Other NCD medicines</i>												

Medicines	Proportion of facilities giving medicines for free								Median price ratios			
	Level 2		Level 3		Level 4		Level 5		Level 2	Level 3	Level 4	Level 5
	N	% (n)	N	% (n)	N	% (n)	N	% (n)				
Amitriptyline 25mg Tab/Cap	42	<b>33.3(14)</b>	15	<b>66.7(10)</b>	24	0(0)	4	50(2)	3.5	0.9	2.4	3.5
Omeprazole 20 mg Tab/Cap	62	<b>29(18)</b>	19	<b>42.1(8)</b>	22	0(0)	3	0(0)	3.52	7.04	3.52	3.52
Mean at each level		<b>23.1</b>		<b>52.4</b>		<b>1.0</b>		<b>31.8</b>	<b>3.03</b>	<b>7.18</b>	<b>4.52</b>	<b>2.84</b>
<i>Acute medicines</i>												
Amoxicillin 250mg Dispersible tab	28	<b>39.3(11)</b>	8	<b>75(6)</b>	7	0(0)	2	0(0)	0.95	0.95	0.95	9.78
Amoxicillin 500mg Tab/Cap	23	<b>26.1(6)</b>	67	<b>4.5(3)</b>	10	0(0)	2	50(1)	1.66	4.97	1.82	1.99
Amoxicillin 250mg Tab /Cap	49	<b>34.7(17)</b>	17	<b>58.8(10)</b>	20	0(0)	5	20(1)	1.86	3.11	1.66	1.86
Ceftriaxone 1 g/vial Inj	47	<b>23.4(11)</b>	212	<b>4.7(10)</b>	19	10.5(2)	5	20(1)	3.74	2.99	4.99	2.49
Ciprofloxacin 500mg Tab/Cap	33	<b>21.2(7)</b>	7	<b>28.6(2)</b>	14	0(0)	2	50(1)	2.66	2.66	2.66	2.66
Co-trimoxazole 8+40mg/ml susp.	43	<b>37.2(16)</b>	15	<b>53.3(8)</b>	18	38.9(7)	4	75(3)	1.25	2.68	1.67	1.04
Diazepam 5mg Tab/Cap	41	<b>36.6(15)</b>	145	<b>6.2(9)</b>	23	0(0)	4	50(2)	2.06	5.15	3.09	1.55
Paracetamol 24mg/ml Susp	54	<b>42.6(23)</b>	178	<b>6.7(12)</b>	22	40.9(9)	4	75(3)	0.96	0.96	0.96	0.96
Mean at each level		<b>32.6</b>		<b>29.7</b>		<b>11.2</b>		<b>42.5</b>	<b>1.89</b>	<b>2.90</b>	<b>2.22</b>	<b>2.79</b>

"N" refers to the number of facilities that have the medicine in stock and which reported a price for it.

Medicine formulations on the EML (2010 or 2016 editions) are highlighted in bold

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7-8
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	8-9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	8, 9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9
Bias	9	Describe any efforts to address potential sources of bias	9, 10
Study size	10	Explain how the study size was arrived at	8, 9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10, 11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10-11
		(b) Describe any methods used to examine subgroups and interactions	10-11
	(c) Explain how missing data were addressed	10	
	(d) If applicable, describe analytical methods taking account of sampling strategy	NA	
	(e) Describe any sensitivity analyses	10	
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8, 9, 10
		(b) Give reasons for non-participation at each stage	11
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8, 12
		(b) Indicate number of participants with missing data for each variable of interest	11, 12, 16
Outcome data	15*	Report numbers of outcome events or summary measures	11 - 17



1			
2	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
3			NA
4			
5			
6			(b) Report category boundaries when continuous variables were categorized
7			NA
8			
9			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
10			NA
11	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
12			12-17
13			
14	<b>Discussion</b>		
15	Key results	18	Summarise key results with reference to study objectives
16			18-19
17	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
18			20
19			
20	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
21			21
22			
23			
24	Generalisability	21	Discuss the generalisability (external validity) of the study results
25			21
26	<b>Other information</b>		
27	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
28			22
29			
30			

NA = Not applicable

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).