

# Case Identification, Retention and Blood Pressure Control: Lessons From a Large-Scale Hypertension Programme in Kenya

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## Research article

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1 **CASE IDENTIFICATION, RETENTION AND BLOOD PRESSURE CONTROL: LESSONS**  
2 **FROM A LARGE-SCALE HYPERTENSION PROGRAMME IN KENYA.**

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30 **Abstract**

31 **Background:** The prevalence of hypertension in sub-Saharan Africa has been on the rise but remains  
32 underdiagnosed, undertreated and poorly controlled. In Kenya, 92% of patients are not on treatment and  
33 3% controlled. This study aimed to assess the performance of a hypertension screening and treatment  
34 program in five counties in Kenya with reference to identification of individuals at risk, retention on  
35 treatment and blood pressure (BP) control.

36 **Methods:** We conducted a retrospective cohort study using data routinely collected between March  
37 2015 and December 2018. All patients 18 years and older screened and/or treated for hypertension at  
38 any of the program supported sites were included in the study. We calculated prevalence of high BP  
39 (systolic BP equal or more than 140 mmHg, diastolic BP equal or more than 90 mmHg) and related risk  
40 in the screening episodes, retention on treatment, BP control and related factors among patients enrolled  
41 for treatment of hypertension.

42 **Results:** A total of 663,028 screening encounters were recorded of which 70.4% were female, median  
43 age was 34 years and majority (73.9%) were screened at the community level. Of the encounters, 19%  
44 had high BP, significantly higher among males and older individuals. A total of 66,981 patients were  
45 enrolled on treatment with majority being females (71.2%), median age 55 years, 40.4% aged 60+ years  
46 and 36.2% enrolled in Level 5 health facilities (county referral hospitals). Only 12% of patients were  
47 retained in care at 12 months with younger patients and individuals treated at higher level facilities  
48 (levels 4 and 5) having the lowest retention rates ( $p < 0.05$ ). By 12 months of treatment, BP was  
49 controlled in 48.6% of patients retained on treatment. Over a 36-month follow-up period, the mean  
50 systolic and diastolic BP gradually reduced by 8.9mmHg and 2.5mmHg, respectively.

51 **Conclusions:** The program screened primarily females and younger individuals at lower risk of  
52 developing hypertension. Retention in care was poor especially among younger patients and those  
53 enrolled at higher level facilities. Close to half of the patients retained, attained blood pressure control  
54 by one year. Hypertension programs should target high risk populations, decentralize care and include  
55 retention and follow-up strategies.

56 **Key words:** Hypertension, high blood pressure, Non-communicable diseases, screening, treatment,  
57 retention, blood pressure control, operational research, SORT IT

58 **BACKGROUND**

59 Non-communicable diseases (NCDs) are the leading cause of premature mortality, contributing to 71%  
60 of all deaths globally (1). Over 85% of the premature deaths occur in low-and middle-income countries  
61 (LMICs) and are mainly due to cardiovascular diseases (CVDs), cancers, chronic respiratory diseases  
62 and diabetes (1). In 2016, CVDs contributed to 31% of deaths worldwide with 75% of these deaths  
63 occurring in LMICs (2). Behavioral risk factors such as unhealthy diet, physical inactivity, tobacco use,  
64 and harmful use of alcohol are responsible for most CVDs (2). These behavioral risk factors result in  
65 physiological risk factors such as high blood glucose, raised blood pressure, raised blood lipids, obesity  
66 and overweight which increases risk of developing CVDs (2). High blood pressure (HBP) or  
67 hypertension is one of the strongest risk factors for development of CVDs (3) and is therefore a leading  
68 contributor of disease burden globally (4).

69 Over the last few decades, the prevalence of hypertension in sub-Saharan Africa (SSA) has been on the  
70 rise, which contributes to the rising burden of CVDs (4). A systematic review of data from SSA reported  
71 a pooled prevalence of hypertension of 30% with a high proportion unaware of their status. Of those  
72 with hypertension, only 18% were on treatment and only 7% had controlled blood pressure (BP) (5).  
73 In SSA, hypertension remains undiagnosed, untreated or inadequately treated due to weak health  
74 systems that have to deal with a double burden of communicable and NCDs (5).

75 In Kenya, CVD is the fourth leading cause of death after infectious, maternal and perinatal causes; (6)  
76 and is responsible for 25% of all hospital admissions (7). The STEPwise Survey for NCDs risk factors  
77 conducted in Kenya in 2015 found that 23.8% of individuals aged 18-69 years either had raised BP or  
78 were on treatment for hypertension. In addition, among those living with hypertension, 92% were not  
79 on treatment and only 3% were well controlled. The survey also revealed that 56% of Kenyans had  
80 never been screened for hypertension (7).

81 The high prevalence of hypertension coupled with low awareness, low treatment uptake and poor BP  
82 control requires effective strategies that will promote early detection and linkage to treatment (5).  
83 Studies have shown that hypertension screening programs can increase awareness and promote

84 prevention, early detection and prompt initiation of treatment (8,9). Hypertension screening programs  
85 can take various approaches. These include: mass screening which targets individuals at the community  
86 level; targeted screening which is directed at people who are at risk of hypertension; and opportunistic  
87 screening which targets individuals routinely engaging with the health system (10).

88 Several studies have described the challenges of hypertension awareness and treatment initiation in  
89 developing countries (11), however there is limited research on effective strategies to increase  
90 hypertension awareness as well as outcomes of hypertension screening programs in resource limited  
91 settings (9).

92 The Healthy Heart Africa program, implemented through Amref Health Africa between 2015 and 2018,  
93 is one of the largest hypertension screening and treatment programs in Kenya. The program was  
94 implemented in five counties in Kenya and employed both mass and opportunistic screening. The aim  
95 of this study is to assess the performance of a hypertension screening and treatment program in reference  
96 to; 1) identification of individuals at risk of hypertension 2) retention on treatment and 3) BP control.

## 97 **METHODS**

### 98 **Study design**

99 We conducted a retrospective cohort study using routinely collected data from a hypertension screening  
100 program implemented in five counties in Kenya between March 2015 and December 2018.

### 101 **General setting**

102 Kenya, a country in East Africa has an estimated population of 46 million. (KNBS, 2009) In 2010, a  
103 devolved system of government was introduced under a new constitution which provides for one  
104 national government and forty-seven county governments. The Kenya Health Sector has been devolved  
105 under this new governance arrangement where health service delivery is the responsibility of the  
106 counties while the national government is responsible for developing policies and guidelines (15). The  
107 Kenyan health care system is classified into six levels based on the range of expected services at each  
108 level. Level 1 is at community and household level, level 2 is dispensaries, level 3 at health centres,

109 level 4 comprises of primary (sub-county) hospitals, level 5 secondary (county) hospitals and level 6  
110 national referral hospitals (16).

### 111 **The hypertension screening programme**

112 The Healthy Heart Africa (HHA) project was implemented by Amref Health Africa in five counties in  
113 Kenya (Kiambu, Kirinyaga, Nairobi, Kajiado and Nakuru). These counties were selected purposively  
114 mainly due to relatively higher prevalence of high blood pressure and high population levels compared  
115 to other counties. In collaboration with the county health teams, a total of 86 health facilities ranging  
116 from level 1 to 5 were supported to improve hypertension screening and treatment. Community Health  
117 Volunteers (CHVs) and health workers were trained on hypertension management using the Ministry  
118 of Health (MOH) approved training curricula. The screening approaches employed were mass screening  
119 during medical camps and social gatherings at the community level and opportunistic screening  
120 targeting individuals routinely interacting with the health system. The CHVs were equipped with digital  
121 BP machines to screen for hypertension at community level and facility level supervised by a health  
122 provider. Those identified to have HBP were referred for diagnosis and treatment by a clinician at the  
123 nearest health facility. Patients initiated on treatment were scheduled for 1-3 monthly follow-up  
124 appointments at a convenient health facility.

### 125 **Study population**

126 All patients 18 years and older screened and/or treated for hypertension at any of the HHA project  
127 supported sites in the five counties between 1<sup>st</sup> of March 2015 and 31<sup>st</sup> December 2018

### 128 **Data collection procedure**

129 This study utilized data which had been entered monthly into a custom-built Microsoft Excel file, as  
130 part of routine project monitoring. Screening data were extracted from routine screening registers used  
131 at the hypertension screening service points and treatment data from patient records at facility level.

### 132 **Measures**

133 Demographic characteristics included age and sex. Age was categorized into 4 groups: 18-34, 35 – 44,  
134 45 – 59 and 60 years and above. Other variables included date of hypertension screening and treatment,

135 health system level where the service was offered ((Level 1, 2, 3, 4 and 5) and systolic and diastolic BP  
 136 readings of each hypertension screening and treatment encounter. BP measurements were taken after  
 137 the client had sat quietly for 3-5 minutes using validated automated BP machines (Omron M3). The BP  
 138 was measured while the client was seated upright on a chair with back support and legs outstretched.  
 139 With the arm relaxed and supported at the level of the heart, two measurements were taken at least 2-3  
 140 minutes apart. For the first visit, BP from both arms was taken and the highest recorded. Hypertension  
 141 screening outcomes of interest include prevalence of HBP among those screened, retention on treatment  
 142 and blood pressure control. Definitions of these outcomes are described in Table 1 below.

143 **Operational definitions**

144 Table 1: Operational definition of hypertension terms and treatment outcomes

<p><b>Hypertension screening encounter:</b> defined as blood pressure screening service offered to an individual at any of the program sites. It does not necessarily represent unique individuals screened by the program.</p> <p><b>Enrolled on treatment:</b> defined as patients diagnosed to have hypertension who are registered into the program and initiated or continued pharmacological and non-pharmacological therapy.</p> <p><b>Normal blood pressure<sup>†</sup>:</b> defined as systolic blood pressure (SBP) less than 130mmHg and diastolic blood pressure (DBP) less than 85mmHg (7).</p> <p><b>Pre-hypertension<sup>†</sup>:</b> defined as SBP between 130 - 139mmHg and/or DBP between 85 – 89mmHg (7).</p> <p><b>High blood pressure (HBP)<sup>†</sup>:</b> defined as SBP equal to or more than 140mmHg and/or DBP equal to or more than 90 mmHg (7) or more.</p> <p><b>Hypertension<sup>†</sup>:</b> An individual was considered hypertensive if they had 3 HBP readings at separate occasions within a 2-month period, if the initial SBP and/or DBP readings were equal or more than 160mmHg and 100mmHg respectively or if they had been previously on treatment for hypertension.</p> <p><b>Retention in care (RIC):</b> defined as proportion of patients on hypertensive treatment who were receiving treatment.</p> <p><b>12-month BP Control:</b> defined as proportion of patients who visited the facility between 10.5 – 13.5months after enrollment whose SBP less was than 140mmHg and/or DBP less than 90mmHg.</p> <p><b>Definition of Hypertension terms and treatment outcomes</b>        *Canadian Institute for Health Information        † Kenya National Guidelines for Cardiovascular Diseases Management</p>
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146 **Data analysis**

147 The data collected in the Microsoft Excel files were cleaned and exported to STATA v14.2 (*StataCorp,*  
148 *College Station, TX, USA*) for analysis. The data were described in terms of episodes/ encounters (for  
149 screening) and per-patient (for those on treatment). Summary statistics – frequencies and proportions  
150 for categorical variables and mean (standard deviations, SD) or median (interquartile range, IQR) for  
151 continuous variables – were used to describe the characteristics of the screening episodes and patients.  
152 The prevalence rate (PR) of high blood pressure, together with their 95% confidence interval (CI) and  
153 chi-square *P*-values were calculated for the screening episodes. Retention in care (RIC) over time for  
154 patients on treatment was calculated using Kaplan Meier survival curves, overall and adjusted by the  
155 available variables. Log-rank test was used to estimate the differences in the curves, as appropriate.  
156 Factors associated with RIC and blood pressure control at 12 months were calculated using binary  
157 regression models and presented as relative risks (RR) – unadjusted and adjusted (using the available  
158 variables), and 95% CI.  $P < 0.05$  were considered statistically significant.

159 **Ethical approval**

160 Ethical approval was granted by Amref Ethics and Scientific Review Committee (ESRC) and The  
161 Union Ethics Advisory Group. Waiver of consent was sought due to the retrospective nature of the  
162 study which does not affect the care provided to the patients, anonymized data and minimal risk of harm  
163 to the subjects.

164 **Results**

165 ***Demographic characteristics***

166 A summary of the demographic characteristics and blood pressure status of the screening encounters is  
167 described in **Table 2**. A total of 663,028 screening encounters were recorded of which 70.4% of those  
168 with documented sex were from females. Approximately one-third (31%) of the screening episodes had  
169 no documented sex. The median age was 34 years (IQR: 26-47) with 50.2% aged between 18 – 34 years.  
170 Majority of the screening encounters (73.9%) occurred at level 1 (community) of the health system  
171 while the least occurred at level 5 (county referral hospitals) (1.0%). Prevalence of pre-hypertension

172 and high blood pressure was 13.0% and 18.7% respectively. The average SBP and DBP was 123mmHg  
 173 (SD 18.2) and 75mmHg (SD 11.4) respectively.

174 **Table 2:** Characteristics of screening episodes in a hypertension screening and treatment program  
 175 implemented in five counties in Kenya between 2015 and 2018

Characteristics		N	(%)
Screening encounters		663,028	
Age in years	[median, IQR]	34.0	[26-47]
	18-34	285,289	(50.2)
	35-44	117,287	(20.6)
	45-59	99,169	(17.4)
	60+	66,888	(10.1)
	<i>Not recorded</i>	94,395	(14.2)
Sex	Male	135,361	(20.4)
	Female	322,753	(48.7)
	<i>Not recorded</i>	204,914	(30.9)
Facility level	1 (community)	489,973	(73.9)
	2 (dispensary)	12,460	(1.9)
	3 (health center)	103,103	(15.6)
	4 (sub-county hospital)	50,786	(7.7)
	5 (county referral hospital)	6,706	(1.0)
Blood pressure <sup>a</sup>	Normal	452,795	(68.3)
	Pre-hypertensive	86,113	(13.0)
	High	124,120	(18.7)
Systolic Blood Pressure (SBP)	[mean, SD]	123	[18.2]
Diastolic Blood Pressure (DBP)	[mean, SD]	75	[11.4]

176 <sup>a</sup>Normal = SBP ≤129mmHg and DBP ≤84mmHg, Pre-hypertensive = SBP 130mmHg – 139mmHg  
 177 or DBP 85mmHg – 89mmHg, High BP = SBP ≥140mmHg or DBP ≥ 90mmHg  
 178 IQR - Interquartile range; SD - Standard dev

179

### 180 **Factors associated with high blood pressure status among the screening encounters**

181 **Table 3** summarizes the factors associated with HBP at the screening encounters. The overall  
 182 prevalence of HBP was 18.7% (CI: 18.6 – 18.8). The prevalence of high blood pressure was higher  
 183 among males (22.2%) as compared to females (18.8%) – prevalence ratio of 1.18. High blood pressure  
 184 increased with age, with individuals 60 years and above having higher blood pressure levels at 40.2%  
 185 while those aged 18-34 years having the lowest at 10.5% (p<0.001). There was a general increase in  
 186 proportion of screening episodes with high blood pressure across the different health facility levels with  
 187 level 5 (county referral hospitals) recording the highest proportion at 30.4% compared to level 2  
 188 (dispensary) which had the lowest at 13.6%.

189 **Table 3: Proportion of screening encounters with high blood pressure and associated factors in a**  
 190 **hypertension screening and treatment program implemented in five counties in Kenya between**  
 191 **2015 and 2018.**

Characteristics		Total	High BP <sup>a</sup>		PR	(95% CI)	p-value
			N	(%)			
Total		663,028	124,120	(18.7)		(18.6 – 18.8)	
Sex	Male	135,361	30,047	(22.2)	1.18	(1.17-1.20)	<0.001
	Female	322,753	60,554	(18.8)	Ref		
Age (years)	18-34	285,289	30,049	(10.5)	Ref		
	35-44	117,287	23,208	(19.8)	1.88	(1.85-1.91)	<0.001
	45-59	99,169	30,614	(30.9)	2.93	(2.89-2.97)	<0.001
	60+	66,888	26,868	(40.2)	3.81	(3.76-3.87)	<0.001
Facility level	1	489,973	94,659	(19.3)	Ref		
	2	12,460	20,35	(16.3)	0.85	(0.81-0.88)	<0.001
	3	103,103	14,013	(13.6)	0.70	(0.69-0.72)	<0.001
	4	50,786	11,377	(22.4)	1.16	(1.14-1.18)	<0.001
	5	6,706	2,036	(30.4)	1.57	(1.51-1.63)	<0.001

192 PR – Prevalence Ratio; CI – Confidence Interval; BP – Blood Pressure

193 <sup>a</sup> High Blood Pressure (BP) = Systolic BP  $\geq$ 140 or Diastolic BP  $\geq$ 90

194

195 **Demographic characteristics of patients enrolled for treatment.**

196 **Table 4** summarizes the demographic characteristics of the patients enrolled for treatment in the  
 197 program. A total of 66,981 patients were enrolled for treatment with the majority being females (71.2%).

198 The median age of patients enrolled was 55 years (IQR: 44-67). Level 5 health facilities (county referral  
 199 hospitals) reported the highest number of patients (36.2%). The average SBP and DBP among patients  
 200 enrolled on screening and treatment was 148mmHg (SD: 20.4) and 89mmHg (SD: 12.4) respectively.

201 The majority of patients enrolled had only one clinic visit recorded (76.9%) with the total number of  
 202 visits ranging from 1 to 36. The median duration between clinic visits was 5.9 weeks (IQR: 3.9 – 12).

203 **Table 4:** Characteristics of patients enrolled on treatment in a hypertension and screening program  
 204 implemented in five counties in Kenya between 2015 and 2018

Characteristics		N	% <sup>a</sup>
Number of patients enrolled		66,981	
Age in years	(median, IQR)	55	[44-67]
	18-34	5,271	(10.0)
	35-44	8,484	(16.2)
	45-59	17,541	(33.4)
	60+	21,196	(40.4)
	<i>Not recorded</i>	14,489	
Sex	Female	47,689	(71.2)
	Male	19,292	(28.8)
Facility level	2 (dispensary)	3,521	(5.3)
	3 (health center)	17,122	(25.6)

	4 (sub-county hospital)	22,061	(32.9)
	5 (county referral hospital)	24,277	(36.2)
Blood pressure at enrolment	Systolic Blood Pressure [mean, SD]	148	[20.4]
	Diastolic blood pressure [mean, SD]	89	[12.4]
Patient visits	Only 1 visit recorded	51,536	(76.9)
	More than 1 visit recorded	15,445	(23.1)
	Median number of visits [Range]	1	[1-36]
Duration between visits (weeks)	[median, IQR]	5.9	[3.9-12]

205 <sup>a</sup> Only patients with more than one visit were considered for further analyses (considered meaningfully  
206 enrolled for treatment)

207 IQR - Interquartile range ; SD - Standard deviation

208

### 209 Retention rates of clients initiated on treatment and associated factors

210 Overall retention of patients enrolled for treatment dropped drastically within the first one year with 6-  
211 and 12-months retentions being 31% and 12%, respectively (**Figure 1**). With respect to gender, when  
212 adjusted for age and facility level, males had higher retention rates compared to females though the  
213 difference was not significant (log-rank p=0.29). Younger patients (aged 18-34 years) had the lowest  
214 retention rates, and the association became stronger when adjusted for sex and facility level (log-rank  
215 p<0.0001). Patients enrolled at the primary health care level (level 2 and 3) had significantly higher  
216 retention rates compared to patients enrolled at the hospital level (levels 4 and 5), and this association  
217 remained after adjustment for sex and age (log-rank p<0.0001).

218

### 219 Figure 1: Retention rates of clients initiated on treatment and associated factors

220

### 221 Evolution of BP over time and blood pressure control and associated factors

222 Over a 36 months follow-up period, the average SBP gradually reduced by 8.9mmHg from 147.6mmHg  
223 at enrollment while that of DBP reduced by 2.5mmHg from 88.5mmHg. By 12 months of treatment,  
224 BP was controlled in 48.6% of patients. Sex was the only factor that was significantly associated with  
225 blood pressure control with males being less likely to have controlled blood pressure (aRR = 0.84 [0.75  
226 – 0.91]). (**Table 5**).

227 **Table 5:** Factors associated with 12-month blood pressure control among patients enrolled for  
228 hypertension treatment in five counties in Kenya between 2015 and 2018

229

Characteristic		Total	BP controlled <sup>a</sup>		Unadjusted		Adjusted	
			N	(%)	RR	(95% CI)	RR	(95% CI)
Total		2,373	1,153	(48.6)				
Sex	Male	781	333	(42.6)	<b>0.83</b>	<b>(0.75-0.91)</b>	<b>0.84</b>	<b>(0.76-0.93)</b>
	Female	1,592	820	(51.5)	<i>Ref</i>		<i>Ref</i>	
Age (years)	18-34	121	59	(48.8)	<i>Ref</i>		<i>Ref</i>	
	35-44	483	247	(51.4)	1.05	(0.86-1.28)	1.06	(0.86-1.30)
	45-59	1,091	536	(49.1)	1.01	(0.83-1.22)	1.03	(0.85-1.26)

	60+	674	307	(45.6)	0.93	(0.76-1.14)	0.98	(0.80-1.20)
Facility level	2	257	137	(53.3)	<i>Ref</i>		<i>Ref</i>	
	3	1,790	841	(47.0)	0.88	(0.78-1.00)	0.89	(0.78-1.00)
	4	185	91	(49.2)	0.92	(0.77-1.11)	0.92	(0.76-1.11)
	5	141	84	(59.6)	1.12	(0.94-1.33)	1.10	(0.92-1.32)

230

231 RR – relative risk; CI – Confidence Interval; BP – Blood Pressure

232 <sup>a</sup> Blood pressure <140/90mmHg

### 233 **Discussion**

234 This study highlights the outcomes of a hypertension screening and treatment program implemented in  
235 five counties in Kenya. The largest proportion of the screening encounters were recorded at the  
236 community level and amongst females and younger individuals (18-34 years). One-in-five (19%) of the  
237 encounters had high blood pressure and this was more common among males and older individuals  
238 (aged 45 years and above). With respect to patients enrolled on treatment, a large proportion were  
239 females and individuals aged 45 years and above. Hospitals (level 4 and 5) enrolled the largest  
240 proportion of patients. Only 23% of patients enrolled on treatment had a return visit after the initial  
241 encounter and only 12% were retained in care at 12 months. Younger patients and individuals treated  
242 at the hospital level (level 4 and 5) had the lowest retention rates. Approximately half of patients on  
243 treatment had controlled blood pressure by 12 months.

244 The prevalence of HBP was lower than that reported in a national survey conducted in 2015 which  
245 found a prevalence of 23.8% amongst ages 18 – 69 years (12). Studies conducted in similar settings  
246 with primarily younger populations revealed variable prevalence rates of hypertension ranging between  
247 15% in Uganda to 23% in an urban slum in Kenya (13–16). Age of the participants across the various  
248 studies is partly responsible for this variation (5). In this program the lower prevalence can be attributed  
249 to relatively younger population screened (median age of 34 years).

250 Prevalence of HBP increased progressively with age. This trend is similar to that found in the national  
251 survey (12,17) as well as other studies conducted in other countries in SSA (5). In contrast, the screening  
252 services aimed at facilitating early detection of hypertension were accessed primarily by younger  
253 individuals who are at lower risk of developing hypertension. Several studies have found similar results  
254 and recommended development of strategies targeting older persons (13,18,19). Males had a  
255 significantly higher prevalence HBP which was also similar to what was found in the national survey  
256 (12). However, most of the patients enrolled on treatment were females. Other studies found that

257 females had higher hypertension awareness and treatment rates (20). The higher proportion of females  
258 screened and treated could be explained by the health facility visits related to reproductive issues which  
259 increase their interaction with the health system(21). These findings coupled with the fact that males  
260 have been found to have lower awareness of hypertension, calls for design of programs that will increase  
261 access to services for this population (17). This is in contrast with other studies conducted in SSA which  
262 found no significant difference in the prevalence of hypertension between different sexes (5,12)

263 It is important to note that most studies reported prevalence of hypertension confirmed by a series of  
264 blood pressure readings while in this study we report prevalence of HBP derived from one screening  
265 encounter.

266 Most of the patients were enrolled on treatment at the higher-level health facilities which can be  
267 explained by the higher likelihood of sicker patients seeking care at the hospital levels as well as the  
268 general tendency to refer care to higher level facilities. However, patients enrolled at the hospital level  
269 reported the lowest retention rates. This could be attributed to the fact that these patients may have  
270 complications that increase their mortality rate or could be explained by the increased distance from  
271 their home to the follow up location.

272 Overall retention on treatment was alarmingly low. Similar findings were reported in a study conducted  
273 in Tanzania where there was a decrease in patients taking antihypertension treatment after 12-month  
274 follow-up with only 5% attending the health facility for treatment (22). The national survey conducted  
275 in Kenya reported that only 22% of individuals previously diagnosed with hypertension were on  
276 treatment (12). Other studies in SSA have also reported a low proportion of hypertension patients  
277 receiving treatment ranging from 18 – 30% (5,23). Some of the reasons given for this include  
278 prescription of short-term medication by clinicians, belief that hypertension can be treated over only a  
279 few days and the cost of medication (17,22). Retention in care has been extensively studied among HIV  
280 patients and strategies such as delivery of HIV care at the community level, down-referral of stable  
281 patients, task-shifting of services, decentralization of care, differentiated care which have been shown  
282 to be effective should be incorporated within hypertension and other NCD programs (24).

283 Just under half of patients who could be followed up had controlled blood pressure 12 months after  
284 enrollment. This is similar to a national survey that reported blood pressure control rates of 51.7% (95%

285 CI: 33.5 – 69.9) among those on treatment (12). Other studies in SSA have reported lower BP control  
286 rates ranging from 7-20% (5,23). A multinational survey which included 17 countries from low-income,  
287 middle-income and high-income countries reported overall control rates of 33% with rates of 26.9% in  
288 low-and middle-income countries, 40.7% in high-income countries and 40.2 in low-income countries.  
289 Lowering blood pressure substantially reduces CVD morbidity and mortality (25). Therefore,  
290 hypertension treatment programs should not only ensure individuals with high blood pressure are  
291 initiated on treatment but should also monitor the BP control rates (26).  
292 This study found that males were less likely to have controlled blood pressure. This is similar to other  
293 studies in SSA which found that women had higher blood pressure control rates (20). Poor blood  
294 pressure control can be attributed to various health system and patient related factors. Health system  
295 related factors include lack of anti-hypertensive medication, high cost of medication, use of counterfeit  
296 medication, inadequate counseling, distance to clinics and ineffective treatment approach focusing on  
297 a single drug limited focus on lifestyle changes. Patient factors include poor adherence due to side  
298 effects, lower or no education, lack of time, competing priorities and poor health seeking behavior  
299 where patients refuse to accept their status due to lack of symptoms (20,27,28). Blood pressure control  
300 has been proposed as one of the indicators to measure achievements in universal health coverage  
301 (UHC), and therefore mechanisms to improve it should be prioritized (26,29,30).

### 302 *Implications of study findings*

303 This study has several programmatic implications. The steady rise in the burden of CVDs and other  
304 NCDs will necessitate implementation of programs to support early detection and management of these  
305 conditions similar to those targeting communicable diseases such as HIV. While the well-established  
306 and heavily funded communicable disease programs can provide valuable lessons to inform NCD  
307 programs, it is important to take into considerations unique challenges that NCDs presents. One of these  
308 challenges is the asymptomatic nature of conditions such as hypertension which contributes to low  
309 adherence and treatment rates among these patients. Secondly, resource allocation towards NCDs from  
310 both government and other external sources in low- and middle-income countries remains a challenge.  
311 This necessitates greater efficiency and effectiveness of NCD programs to ensure we optimize the  
312 outcomes within the available resources. This study provides valuable lessons to inform future

313 hypertension programs particularly as regards targeting of the interventions as well as program design.  
314 Hypertension programs should focus on reaching high risk populations such as older persons and males  
315 to optimize outcomes and impact. In addition, mechanisms must be put in place to improve retention  
316 especially among younger patients and those receiving care in higher level health facilities. More  
317 emphasis should be place towards monitoring and improving blood pressure control. Lastly, monitoring  
318 of retention and blood pressure control will not be possible without the use of utilization of data  
319 collection tools that allow longitudinal follow-up of patients including utilization of unique patient  
320 identifiers. Electronic medical records set up with robust longitudinal reporting and monitoring abilities,  
321 should be considered as one of the options of providing better longitudinal follow-up of patients.

### 322 *Strengths and limitations*

323 This study was conducted using data collected from a large cohort of patients, using data collected from  
324 a programme that ran across 5 of the 47 counties in Kenya, and was able to follow a number of patients  
325 over up to 36 months, which has not been done before in Kenya. The main limitation of this study was  
326 the retrospective nature of the study conducted within a program that did not have mechanisms in place  
327 to facilitate longitudinal analysis of patients screened and treated for hypertension. Due to this, patients  
328 were not systematically assigned a unique ID number, which meant it was always not possible to link  
329 records for patients returning for care or those who transferred clinics. Despite considerable efforts in  
330 data cleaning, patient outcomes are therefore likely to look worse than reality. Similarly, it was not  
331 possible to link screening episodes to subsequent enrolment in care. We thus report on rates of high  
332 blood pressure (not hypertension itself), and among screening episodes (not patients) though we believe  
333 that the pattern shown amongst screening episodes is likely to mirror that of patients themselves,  
334 especially given the large numbers.

### 335 *Conclusions*

336 This study found that the prevalence of elevated blood pressure was 18.7% amongst all screening  
337 episodes with males and older individuals being at higher risk. Despite this, majority of those enrolled  
338 on treatment were females and younger individuals. Retention on treatment at 12 months was low at  
339 12% with younger patients and patients enrolled in care in hospital reporting the lowest rates. Amongst  
340 those retained in care, blood pressure control at 12 months was higher than rates reported in studies

341 conducted in similar settings. Due to the limited resources, future hypertension screening and treatment  
342 programs should consider targeting their interventions to older individuals at higher risk of developing  
343 hypertension. In addition, there is need to develop strategies to address the low retention rates including  
344 strengthening longitudinal data collection systems and implementing patient follow up systems.

#### 345 **List of abbreviations**

346 BP: Blood Pressure

347 CHV: Community Health Volunteer

348 CVD: Cardiovascular diseases

349 DBP – Diastolic blood pressure

350 HBP: High Blood Pressure

351 MOH: Ministry of Health

352 NCD: Non-communicable diseases

353 RIC: Retention in Care

354 SBP: Systolic blood pressure

355 SSA: sub-Saharan Africa

#### 356 **Declarations**

##### 357 **Ethics approval and consent to participate**

358 Ethical approval was granted by Amref Ethics and Scientific Review Committee and The Union Ethical  
359 Advisory Group. Waiver of consent was sought due to the retrospective nature of the study which does  
360 not affect the care provided to the patients, anonymized data and minimal risk of harm to the subjects.

##### 361 **Consent for publication**

362 Not applicable

##### 363 **Availability of data and materials**

364 The datasets used and/or analysed during the current study are available from the corresponding author  
365 on reasonable request.

##### 366 **Competing interests**

367 The authors declare that they have no competing interests.

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377 **Authors' contributions**

378 LM was involved in conception of the idea, design of the study, analysis, interpretation of the data,  
379 drafting and revision of the manuscript. RH and PO both participated in design, analysis, interpretation  
380 of data, draft writing and review of the manuscript. CT contributed in the design and revision of the  
381 manuscript. TN was involved in acquisition and analysis of the data. WK participated in design of the  
382 study and revision of the manuscript. SM and LN contributed significantly in review and revision of the  
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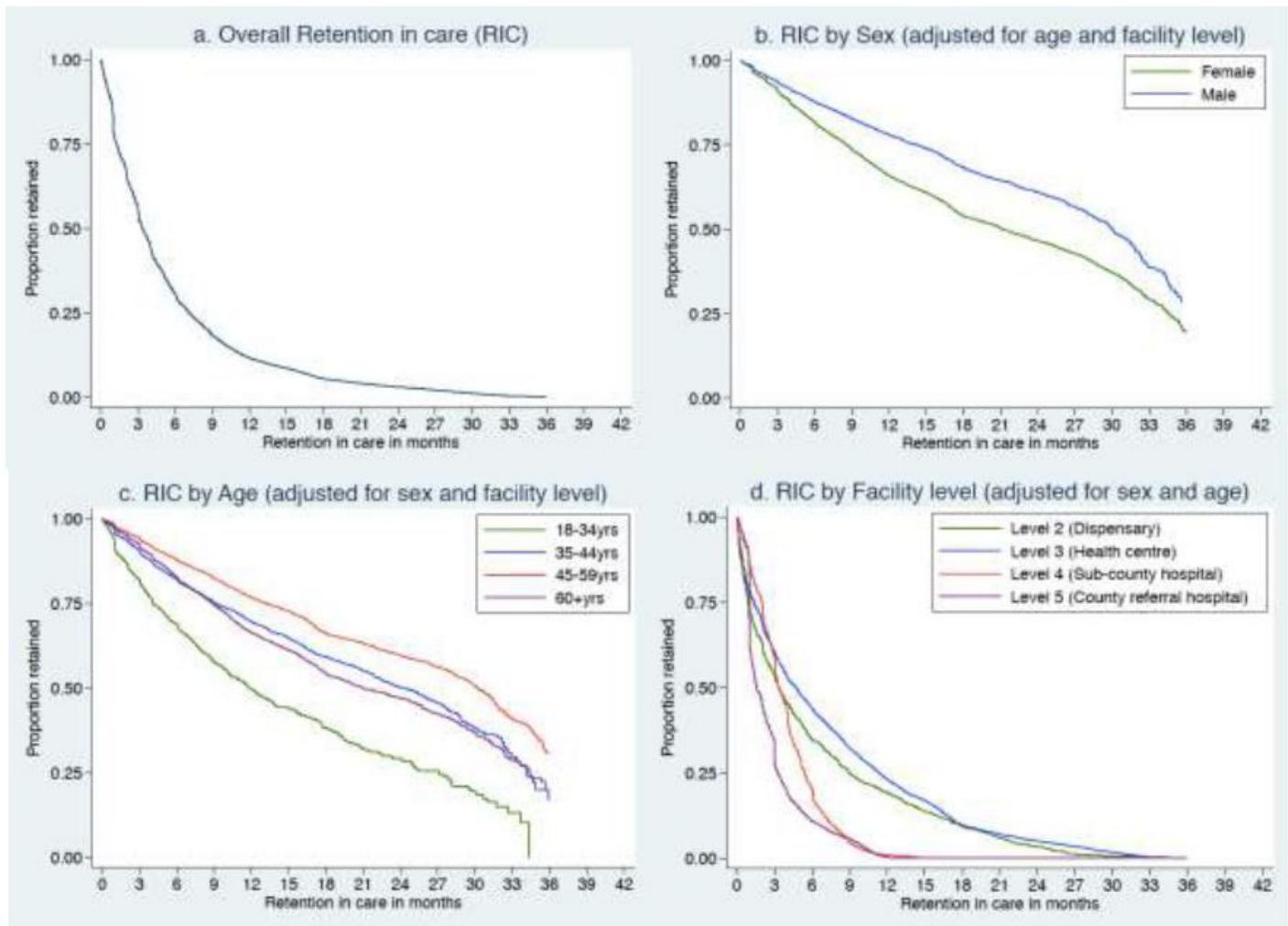
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# Figures



RIC – Retention in care

Figure 1

RIC – Retention in care. Retention rates of clients initiated on treatment and associated factors.