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

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Abstract

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

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

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

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

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

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

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

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

The high prevalence of hypertension coupled with low awareness, low treatment uptake and poor BP control requires effective strategies that will promote early detection and linkage to treatment (5). Studies have shown that hypertension screening programs can increase awareness and promote
prevention, early detection and prompt initiation of treatment (8,9). Hypertension screening programs can take various approaches. These include: mass screening which targets individuals at the community level; targeted screening which is directed at people who are at risk of hypertension; and opportunistic screening which targets individuals routinely engaging with the health system (10).

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

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

METHODS

Study design

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

General setting

Kenya, a country in East Africa has an estimated population of 46 million. (KNBS, 2009) In 2010, a devolved system of government was introduced under a new constitution which provides for one national government and forty-seven county governments. The Kenya Health Sector has been devolved under this new governance arrangement where health service delivery is the responsibility of the counties while the national government is responsible for developing policies and guidelines (15). The Kenyan health care system is classified into six levels based on the range of expected services at each level. Level 1 is at community and household level, level 2 is dispensaries, level 3 at health centres,
level 4 comprises of primary (sub-county) hospitals, level 5 secondary (county) hospitals and level 6 national referral hospitals (16).

**The hypertension screening programme**

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

**Study population**

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

**Data collection procedure**

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

**Measures**

Demographic characteristics included age and sex. Age was categorized into 4 groups: 18-34, 35 – 44, 45 – 59 and 60 years and above. Other variables included date of hypertension screening and treatment,
health system level where the service was offered ((Level 1, 2, 3, 4 and 5) and systolic and diastolic BP readings of each hypertension screening and treatment encounter. BP measurements were taken after the client had sat quietly for 3-5 minutes using validated automated BP machines (Omron M3). The BP was measured while the client was seated upright on a chair with back support and legs outstretched. With the arm relaxed and supported at the level of the heart, two measurements were taken at least 2-3 minutes apart. For the first visit, BP from both arms was taken and the highest recorded. Hypertension screening outcomes of interest include prevalence of HBP among those screened, retention on treatment and blood pressure control. Definitions of these outcomes are described in Table 1 below.

Operational definitions

Table 1: Operational definition of hypertension terms and treatment outcomes

| Hypertension screening encounter: 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. |
| Enrolled on treatment: defined as patients diagnosed to have hypertension who are registered into the program and initiated or continued pharmacological and non-pharmacological therapy. |
| Normal blood pressure†: defined as systolic blood pressure (SBP) less than 130mmHg and diastolic blood pressure (DBP) less than 85mmHg (7). |
| Pre-hypertension†: defined as SBP between 130 - 139mmHg and/or DBP between 85 – 89mmHg (7). |
| High blood pressure (HBP) †: defined as SBP equal to or more than 140mmHg and/or DBP equal to or more than 90 mmHg (7) or more. |
| Hypertension†: 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. |
| Retention in care (RIC): defined as proportion of patients on hypertensive treatment who were receiving treatment. |
| 12-month BP Control: 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. |

Definition of Hypertension terms and treatment outcomes

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Data analysis

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

Ethical approval

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

Results

Demographic characteristics

A summary of the demographic characteristics and blood pressure status of the screening encounters is described in Table 2. A total of 663,028 screening encounters were recorded of which 70.4% of those with documented sex were from females. Approximately one-third (31%) of the screening episodes had no documented sex. The median age was 34 years (IQR: 26-47) with 50.2% aged between 18 – 34 years. Majority of the screening encounters (73.9%) occurred at level 1 (community) of the health system while the least occurred at level 5 (county referral hospitals) (1.0%). Prevalence of pre-hypertension
and high blood pressure was 13.0% and 18.7% respectively. The average SBP and DBP was 123mmHg (SD 18.2) and 75mmHg (SD 11.4) respectively.

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

| Characteristics                  | N       | (%)     |
|----------------------------------|---------|---------|
| Screening encounters             | 663,028 |         |
| Age in years [median, IQR]       |         |         |
| 18-34                            | 285,289 | (50.2)  |
| 35-44                            | 117,287 | (20.6)  |
| 45-59                            | 99,169  | (17.4)  |
| 60+                              | 66,888  | (10.1)  |
| Not recorded                     | 94,395  | (14.2)  |
| Sex                              |         |         |
| Male                             | 135,361 | (20.4)  |
| Female                           | 322,753 | (48.7)  |
| Not recorded                     | 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]  |

<sup>a</sup>Normal = SBP ≤129mmHg and DBP ≤84mmHg, Pre-hypertensive = SBP 130mmHg – 139mmHg or DBP 85mmHg – 89mmHg, High BP = SBP ≥140mmHg or DBP ≥ 90mmHg

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

Table 3 summarizes the factors associated with HBP at the screening encounters. The overall prevalence of HBP was 18.7% (CI: 18.6 – 18.8). The prevalence of high blood pressure was higher among males (22.2%) as compared to females (18.8%) – prevalence ratio of 1.18. High blood pressure increased with age, with individuals 60 years and above having higher blood pressure levels at 40.2% while those aged 18-34 years having the lowest at 10.5% (p<0.001). There was a general increase in proportion of screening episodes with high blood pressure across the different health facility levels with level 5 (county referral hospitals) recording the highest proportion at 30.4% compared to level 2 (dispensary) which had the lowest at 13.6%.
Table 3: Proportion of screening encounters with high blood pressure and associated factors in a hypertension screening and treatment program implemented in five counties in Kenya between 2015 and 2018.

| Characteristics | Total | High BP a | PR (95% CI) | p-value |
|-----------------|-------|-----------|-------------|---------|
| N (%)           |       |           |             |         |
| Total           | 663,028 | 124,120   | (18.7)      |         |
| 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 |

PR – Prevalence Ratio; CI – Confidence Interval; BP – Blood Pressure
High Blood Pressure (BP) = Systolic BP >=140 or Diastolic BP >=90

Demographic characteristics of patients enrolled for treatment.

Table 4 summarizes the demographic characteristics of the patients enrolled for treatment in the program. A total of 66,981 patients were enrolled for treatment with the majority being females (71.2%). The median age of patients enrolled was 55 years (IQR: 44-67). Level 5 health facilities (county referral hospitals) reported the highest number of patients (36.2%). The average SBP and DBP among patients enrolled on screening and treatment was 148mmHg (SD: 20.4) and 89mmHg (SD: 12.4) respectively. The majority of patients enrolled had only one clinic visit recorded (76.9%) with the total number of visits ranging from 1 to 36. The median duration between clinic visits was 5.9 weeks (IQR: 3.9 – 12).

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

| Characteristics | N | % a |
|-----------------|---|-----|
| 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) |
| Not recorded    | 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]

a Only patients with more than one visit were considered for further analyses (considered meaningfully enrolled for treatment)
IQR - Interquartile range ; SD - Standard deviation

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

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

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

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

| Characteristic  | Total  | BP controlled۷ | Unadjusted | Adjusted     |
|----------------|--------|---------------|------------|--------------|
|                | N      | (%)           | RR (95% CI)| RR (95% CI)  |
| Total          | 2,373  | 1,153 (48.6)  | Ref        | Ref          |
| Sex            |        |               |            |              |
| Male           | 781    | 333 (42.6)    | 0.83 (0.75-0.91) | 0.84 (0.76-0.93) |
| Female         | 1,592  | 820 (51.5)    | Ref        | Ref          |
| Age (years)    |        |               |            |              |
| 18-34          | 181    | 59 (48.8)     | Ref        | Ref          |
| 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) |
| Facility level | 60+ | 674 | 307 | (45.6) | 0.93 | (0.76-1.14) | 0.98 | (0.80-1.20) |
|---------------|-----|-----|-----|--------|------|-------------|------|-------------|
| 2             | 257 | 137 | (53.3) | Ref |      |             | Ref |             |
| 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) |

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

**Discussion**

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

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

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

*a Blood pressure <140/90mmHg*
females had higher hypertension awareness and treatment rates (20). The higher proportion of females screened and treated could be explained by the health facility visits related to reproductive issues which increase their interaction with the health system (21). These findings coupled with the fact that males have been found to have lower awareness of hypertension, calls for design of programs that will increase access to services for this population (17). This is in contrast with other studies conducted in SSA which found no significant difference in the prevalence of hypertension between different sexes (5,12).

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

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

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

Just under half of patients who could be followed up had controlled blood pressure 12 months after enrollment. This is similar to a national survey that reported blood pressure control rates of 51.7% (95%
CI: 33.5 – 69.9) among those on treatment (12). Other studies in SSA have reported lower BP control rates ranging from 7-20% (5,23). A multinational survey which included 17 countries from low-income, middle-income and high-income counties reported overall control rates of 33% with rates of 26.9% in low-and middle-income countries, 40.7% in high-income countries and 40.2 in low-income counties. Lowering blood pressure substantially reduces CVD morbidity and mortality (25). Therefore, hypertension treatment programs should not only ensure individuals with high blood pressure are initiated on treatment but should also monitor the BP control rates (26).

This study found that males were less likely to have controlled blood pressure. This is similar to other studies in SSA which found that women had higher blood pressure control rates (20). Poor blood pressure control can be attributed to various health system and patient related factors. Health system related factors include lack of anti-hypertensive medication, high cost of medication, use of counterfeit medication, inadequate counseling, distance to clinics and ineffective treatment approach focusing on a single drug limited focus on lifestyle changes. Patient factors include poor adherence due to side effects, lower or no education, lack of time, competing priorities and poor health seeking behavior where patients refuse to accept their status due to lack of symptoms (20,27,28). Blood pressure control has been proposed as one of the indicators to measure achievements in universal health coverage (UHC), and therefore mechanisms to improve it should be prioritized (26,29,30).

Implications of study findings

This study has several programmatic implications. The steady rise in the burden of CVDs and other NCDs will necessitate implementation of programs to support early detection and management of these conditions similar to those targeting communicable diseases such as HIV. While the well-established and heavily funded communicable disease programs can provide valuable lessons to inform NCD programs, it is important to take into considerations unique challenges that NCDs presents. One of these challenges is the asymptomatic nature of conditions such as hypertension which contributes to low adherence and treatment rates among these patients. Secondly, resource allocation towards NCDs from both government and other external sources in low- and middle-income countries remains a challenge. This necessitates greater efficiency and effectiveness of NCD programs to ensure we optimize the outcomes within the available resources. This study provides valuable lessons to inform future
Hypertension programs particularly as regards targeting of the interventions as well as program design. Hypertension programs should focus on reaching high risk populations such as older persons and males to optimize outcomes and impact. In addition, mechanisms must be put in place to improve retention especially among younger patients and those receiving care in higher level health facilities. More emphasis should be placed towards monitoring and improving blood pressure control. Lastly, monitoring of retention and blood pressure control will not be possible without the use of utilization of data collection tools that allow longitudinal follow-up of patients including utilization of unique patient identifiers. Electronic medical records set up with robust longitudinal reporting and monitoring abilities, should be considered as one of the options of providing better longitudinal follow-up of patients.

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

Conclusions
This study found that the prevalence of elevated blood pressure was 18.7% amongst all screening episodes with males and older individuals being at higher risk. Despite this, majority of those enrolled on treatment were females and younger individuals. Retention on treatment at 12 months was low at 12% with younger patients and patients enrolled in care in hospital reporting the lowest rates. Amongst those retained in care, blood pressure control at 12 months was higher than rates reported in studies
conducted in similar settings. Due to the limited resources, future hypertension screening and treatment programs should consider targeting their interventions to older individuals at higher risk of developing hypertension. In addition, there is need to develop strategies to address the low retention rates including strengthening longitudinal data collection systems and implementing patient follow up systems.

List of abbreviations

BP: Blood Pressure  
CHV: Community Health Volunteer  
CVD: Cardiovascular diseases  
DBP – Diastolic blood pressure  
HBP: High Blood Pressure  
MOH: Ministry of Health  
NCD: Non-communicable diseases  
RIC: Retention in Care  
SBP: Systolic blood pressure  
SSA: sub-Saharan Africa

Declarations

Ethics approval and consent to participate

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

Consent for publication

Not applicable

Availability of data and materials

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

Competing interests

The authors declare that they have no competing interests.
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Authors' contributions

LM was involved in conception of the idea, design of the study, analysis, interpretation of the data, drafting and revision of the manuscript. RH and PO both participated in design, analysis, interpretation of data, draft writing and review of the manuscript. CT contributed in the design and revision of the manuscript. TN was involved in acquisition and analysis of the data. WK participated in design of the study and revision of the manuscript. SM and LN contributed significantly in review and revision of the manuscript. All authors read and approved the final manuscript.

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