**African Journal of Health Economics, December 2022, Volume 11 (2): 1-11**

Print ISSN: 2006-4802; Online ISSN: 2504-86-86; Creative commons licenses/by/4.0/

# Economic analysis of hypertension management in public hospitals in Southwestern Nigeria: evidence from secondary data analysis

Theophilus Ehidiamen Oamen[1*], Kanayo Patrick Osemene[1], Maduabuchi Romanus Ihekoronye[1]

1. Department of Clinical Pharmacy and Pharmacy Administration, Faculty of Pharmacy, Obafemi Awolowo University, Ife, Osun State, Nigeria

*Corresponding author: *Theophilus Ehidiamen Oamen;* oamentheo@yahoo.com

## Abstract

**Background:** The rising out-of-pocket expenditure on anti-hypertension medications is a huge economic concern for low-income patients. In resource-limited settings, healthcare providers require empirical evidence to support cost reduction without compromising treatment effectiveness. The study aims to conduct a comparative economic analysis of hypertension management in public hospitals in Southwestern Nigeria.

**Methods:** A retrospective cross-sectional study of randomly selected two hundred and fifty-five (N=255) hypertensive patients from two purposively selected public hospitals (n=145 in secondary and n=110 in tertiary) in Abeokuta, Ogun state. Stratification into 3 treatment groups was based on Eighth Joint National Convention guidelines. The perspective of the economic analysis was healthcare provider based and focused only on direct medical costs. Costs were computed from the prices of generic drugs prescribed per clinic visit. The outcome measure was the attainment of blood pressure below < 140mmHg systolic and/or 90mmHg diastolic or <130 mmHg systolic and/or 80mmHg for diabetic hypertensive patients at the end of the 1-year study. Incremental cost-effectiveness ratios (ICERs) namely cost/mmHg and cost/controlled patient were computed by comparing treatment versus 'no therapy' groups.

**Results:** Total medication costs were higher in the tertiary hospital (US$29,218.3) compared to the secondary (US$19,357.4). Hypertension medication costs were higher in the tertiary hospital (US$12,388.2) compared to the secondary (US$9,583.7). The cost per mmHg was generally lower in the tertiary hospital due to better treatment outcomes. Costs per controlled patient were more favorable in the secondary hospital due to higher patient numbers.

**Conclusion:** Higher medication costs were associated with better blood pressure control. The study provided useful cost analysis information for subgroups of hypertensive patients in different healthcare settings. ICERs enable healthcare providers to execute evidence-based resource allocation.

**Keywords:** Hypertension, Cost-Effectiveness, Public Hospitals, Pharmacoeconomics, Economic Evaluation, Antihypertensive drugs

## Background

Hypertension or high blood pressure is a non-communicable severe disease with long-term debilitating negative effects on the vital organs of the patient. It is estimated to affect over one billion people worldwide, with most cases from low- and middle-income countries [1,2]. The chronic nature of hypertension is a serious public health concern due to its lifetime management [3]. In Nigeria, the total prevalence rate of hypertension stands at proximately 30%, and with a growing population of approximately 200 million people, portends grave implications [4,5]. According to World Health Organisation (WHO), hypertension and its associated complications account for a majority of premature death worldwide. Hence, WHO set a global target for non-communicable diseases including hypertension to reduce prevalence by over 30% between 2010-2030 [1, 2, 6].

The risk factors associated with hypertension are generally classified into modifiable and non-modifiable risk factors; modifiable factors include poor diet management (excessive salt and fat intake, and reduced fruit & vegetable intake), excessive weight, tobacco and alcohol consumption, stress, and a sedentary or inactive lifestyle. On the other hand, non-modifiable risk factors include- a family history of hypertension, age over 60 years, and co-morbidities such as diabetes and kidney diseases [1, 2, 6].

Hypertension is essentially managed using antihypertensive medications or drugs. According to the updated Joint National Convention 8, hypertension management involves the use of first-line and second-line treatment algorithm approaches [6]. The first-line treatment recommends the use of thiazide-type diuretics, calcium channel blockers, angiotensin-converting enzyme inhibitors, or angiotensin receptor blockers. Second-line treatment recommends the use of beta-blockers, aldosterone antagonists, alpha-blockers, and direct renin inhibitors. Therapy is managed by the use of combinations of these drug categories [6, 7].

In the management of chronic diseases like hypertension, the issue of cost to patients is a major consideration. Hence, the application of economic evaluation plays a major role in the effective and efficient management of medication costs and treatment outcomes [4, 8, 9]. Several economic analysis studies on hypertension management, have confirmed the high cost of accessing anti-hypertensive medications by patients [8, 10, 11]. In Nigeria, the risk of a greater negative impact on out-of-pocket expenditure is significant due to a large number of low-income earners who access medical care from public hospitals [12,13]. However, apart from the lifelong management of the disease, challenges faced by patients include high pill burden, poor blood pressure management, co-morbidities, and the burden of medication cost [11-14]. Therefore, this reinforces the need to explore cost-saving strategies for hypertensive patients with adequate consideration for clinical outcomes and compliance.

However, economic evaluations must not only focus on cost-savings on drug acquisition but also achieve primary outcomes, such as target blood pressure targets for patient groups [9-10,14-17]. Achieving this objective is daunting considering the limited resources available to healthcare managers and providers in low- and middle-income countries [8,17]. This suggests the need for an empirical basis for the prioritization of healthcare resources by healthcare providers and managers tailored to the specific needs of vulnerable patient groups. The economic analysis becomes a tool that should be routinely utilized by healthcare professionals to maximize treatment outcomes [18]. Cost-effective analysis matches treatment costs against desired

outcomes measured in natural units such as mmHg for hypertensive patients [9,16-17]. Incremental cost-effectiveness ratios such as the cost per patient achieving the blood pressure control target and the cost per mmHg reduction in the systolic or diastolic blood pressure should be evaluated [9-10,16,19]. The study attempts to evaluate the cost-effectiveness ratios (CER) of hypertensive patients based on their blood pressure groups based on the Eighth Joint National Convention (JNC 8) on hypertension management [6]. The study aims to conduct an economic analysis of hypertension management in two public hospitals in southwestern Nigeria.

## Methods

*Study setting*

The study was situated in two public hospitals in the Abeokuta metropolis in Ogun state in the southwestern geopolitical zone of Nigeria. Ogun State has a population of about 4 million residents and shares a common boundary with Lagos in the south and Oyo State in the west. Abeokuta is the capital of Ogun state with a population of approximately 500,000 residents [20]. The study was carried out in a secondary hospital (State Hospital) and a tertiary referral Hospital (Federal Medical Center). The state hospital is a state-owned healthcare institution with general care and specialist training in family medicine and gynecology. It has an approximately 300-bed capacity. The Federal Medical Centre is a federal-owned specialist tertiary hospital with residency programs in family medicine, surgery, gynecology, cardiology endocrinology, dermatology, and other specialist areas. The hospitals were purposively selected because they are the only two public referral hospitals owned by federal and state governments situated in a single town in Ogun state. Both hospitals have between 3 to 4 medical clinic days per week with a daily patient flow averaging between 350 to 400 per day.

*Study design and perspective*

The study was a cross-sectional retrospective study. Data were collected from patient's medical records for 1 year from November 2018 to November 2019.

The healthcare provider perspective that focuses on direct medical cost, was the basis for cost determination for anti-hypertensive medication. This study was focused on computed medication costs for analysis [19,21].

*Study population*

Known ambulatory hypertensive patients (with or without diabetes) with regular attendance and consecutive scheduled clinic appointments over one year were eligible for inclusion. In-patients, unconfirmed hypertensive patients, and patients with more than two consecutively missed clinic visits during the 1 year of evaluation were excluded. To simplify the computation of costs and classification according to disease severity, patients with chronic kidney disease, congestive heart failure, coronary artery disease, and stroke were excluded.

*Patients' classification based on JNC 8*

A patient is confirmed to be hypertensive when there is an elevation of blood pressure greater than or equal to 140mm mercury (Hg) for the systolic and/or diastolic blood pressure reading that is equal to or greater than 90mm mercury (Hg) [6]. The rationale for the stratification into stages of hypertension is based on JNC 8 hypertension algorithm to ensure that the cost of treatment is captured based on the level of severity [6, 16]. Patients were classified into three (3) treatment groups (stages one, two, and three): 1] Systolic blood pressure 140-159mmHg or diastolic pressure 90-99 were classified as Stage one; 2] Systolic pressure 160-179mmHg or diastolic 100-109mmHg were classified as Stage two, and 3] Systolic ≥ 180mmHg or diastolic ≥ 100mmHg were classified as Stage three **[6, 16].**

*Sample size and sampling technique*

The sample size was computed based on the estimated patient daily flow rate of 750 in both hospitals (350 in the State hospital, and 400 in the Federal Medical Center). The Krejcie and Morgan Table for finite populations gave a minimum sample size of 254 [22].

A total of 550 and 585 patients' files were purposively selected for assessment in the cardiology clinic in the secondary and tertiary hospitals respectively. Based on the selection criteria, 350 and 315 eligible case files were randomly obtained from the secondary and tertiary hospitals. Thereafter, a systematic random sampling technique was used to select 145 patients' case files in the state hospital and 110 in the Federal Medical Center. The total sample size obtained was 255 from both hospitals.

*Data collection*

The researchers developed a structured data collection instrument comprised of three sections to collect relevant data from patients' files. Section 1 was used to extract basic demographic information such as age, gender, and occupation. Section 2 was used to extract medications prescribed per clinic visit per patient. Section 3 was used to extract baseline blood pressure values at the start of the study and the blood pressure reading at the end of the one-year evaluation period. Blood pressure values of patients in the classified hypertension groups were recorded as baseline values at the start time and final blood pressure values at the end of the one-year evaluation period. The difference between baseline and final readings was computed. Data collection was conducted over a period of 1 year (Nov. 2018 to Nov. 2019).

*Costs determination*

Medication cost analyses were based on the number and value of prescriptions from the two hospitals. To obtain uniform cost measures, medication costs were standardized by fixing unit costs of each drug item at the average prices prevailing at both public hospitals at the time of data collection using the top-down method [23]. Costing of prescriptions was carried out per clinic visit of patients. The cost was calculated as a function of the dosage prescribed and the prices of generics dispensed in the hospitals. The cost of other medications utilized by the patients apart from antihypertensive drugs was also computed. The non-hypertensive drugs belong to other medication categories such as anticoagulants, analgesics, hematinic, antimalarial, and antiulcer medication. Examples are rosuvastatin, warfarin, paracetamol, ibuprofen, iron supplements, artesunate/amodiaquine, artemether, artemether/lumefantrine, and omeprazole among others. There was no discounting because the analysis is within 1 year. Hence, no discount rate was applied to cost computation in the study. Costing was computed as follows:

Cost of medication per patient per visit = Quantity of drug prescribed (Q) x Cost per Unit (C).
Where:
Quantity of drug prescribed (Q) = the number of units (tablets, capsules, caplets, or sachet).
Cost per Unit = the cost in naira (₦) for a tablet, capsule, caplet, or sachet.
Conversion to USD$ was based on ₦360 to 1 Dollar.

*Cost-effectiveness analysis*

The cost-effectiveness for each treatment group was calculated as the difference in costs divided by blood pressure before and after the period of evaluation. This is expressed as cost per 1 mm Hg systolic blood pressure (BP) reduction. Furthermore, the cost-effectiveness relationship is the ratio of the monthly mean cost to the proportion of patients with controlled blood pressure (measured by the average cost per

unit reduction in systolic blood pressure compared to a hypothetical 'no' therapy [10,15,16].

*Incremental cost-effectiveness ratio (ICER)*

ICER was expressed by two measures; 1] cost per mmHg and, 2] cost per patient with controlled BP. In this study, ICER is determined by dividing the difference in treatment cost of therapy compared to a hypothetical 'no' therapy by the number of patients achieving the target BP or by mmHg decrease in systolic blood pressure [10,15,16]. This is shown in the equation below:

$$ICER = \frac{Cost\ of\ Treatment - Cost\ of\ Hypothetical\ 'no' treatment}{number\ of\ patients\ and/or\ mmHg\ reduction\ in\ blood\ pressure}$$

No comparator treatment was used in the study. The outcomes from treatment groups of hypertensive patients were compared against hypothetical 'no' therapy groups. Incremental cost-effectiveness ratios were computed by comparing treatment groups versus 'no therapy' groups [19, 21].

*Outcome variable*

The outcome variable for the cost-effectiveness analysis was systolic blood pressure (denoting effectiveness). The outcome was determined by the patients achieving target blood pressure (BP) expressed as < 140mmHg systolic and/or 90mmHg diastolic or <130 mmHg systolic and/or 80mmHg for diabetic hypertensive patients respectively, at the end of the study period. Treatment effectiveness is derived from the difference between the final BP (at the end of the 1-year evaluation) and baseline BP [6, 14].

*Study assumptions*

Based on Joint National Convention non-pharmacological interventions or recommendations, it was assumed that patients were appropriately counselled on medication use, complied with appropriate lifestyle modifications such as weight reduction, exercise, and limits on salt intake, etc., and adhered to prescriptions [8,10].

*Data analysis*

Descriptive statistics such as the mean were calculated using the statistical package for the social sciences (SPSS). Also, Microsoft Excel was used for cost calculations and for estimating blood pressure values.

*Ethical Approval*

Ethical approval was obtained from the State Hospital, Abeokuta, and Federal Medical Center Abeokuta with approval details- OGHMB/22/2018 and FMCA/470/HERC/11/2018 respectively.

## Results

Demographic profile of patients

Cumulatively, out of 255 patients sampled, there is a higher number of females who are hypertensive 67.8% (173) compared to males 32.2% (82). About 5.9% of patients are between the age of 30 and 40 years, 12.9% between 41 to 50 years, and 56.9% were aged above fifty years. A predominant number of sampled patients are farmers (n=110, 43.1%) while 84 (33%) are retired and unemployed (Table 1).

Clinical Profile of Patients

In general, the number of patients diagnosed with stage 1 hypertension (*n*=190, 74.5%), stage 2 (*n*=37, 14.5%), and stage 3 was 28 (11%) respectively, as shown in Table 2. A majority of patients were non-diabetic (*n*=155, 60.8%) while 100 (39.2%) had diabetes as a co-morbidity.

Table 3 shows that anti-hypertensive medication costs were higher (US$12,388.2) in the tertiary compared to US$9,583.8 in the secondary hospital over one year. Total medication cost was US$29,218.3 and US$19,357.4 in both tertiary and secondary hospitals.

**Table 1.** Demographic profile of patients in secondary and tertiary hospitals

| Variables | Tertiary n (%) | Secondary n (%) | Total n (%) |
|---|---|---|---|
| **Gender** | | | |
| Male | 54 (37.2) | 28 (25.5) | 82 (32.2) |
| Female | 91 (62.8) | 82 (74.5) | 173 (67.8) |
| **Age (Yrs.)** | | | |
| < 30 | 4 (2.8) | 0 (0) | 4 (1.6) |
| 31-40 | 3 (2.1) | 8 (7,3) | 11 (4.3) |
| 41-50 | 15 (10.3) | 18 (16.4) | 33 (12.9) |
| 51-60 | 27 (18.6) | 35 (31.8) | 62 (24.3) |
| ≥ 60 | 96 (66.2) | 49 (44.5) | 145 (56.9) |
| **Occupation** | | | |
| Civil Servant | 13 (8.9) | 9 (8.2) | 22 (8.6) |
| Farming | 4 (2.8) | 3 (2.7) | 7 (2.75) |
| Trading | 57 (39.3) | 53 (48.2) | 110 (43.1) |
| Teacher | 10 (6.9) | 3 (2.7) | 13 (5.1) |
| Artisan | 11 (7.8) | 8 (6.4) | 19 (7.5) |
| Unemployed | 15 (9.7) | 12 (10.9) | 27 (10.6) |
| Retired | 35 (23.4) | 22 (19.1) | 57 (22.4) |
| **Total** | **145 (100)** | **110 (100)** | **255 (100)** |

**Table 2.** Clinical profile of patients at baseline in secondary and tertiary hospitals

| Baseline Values | Number [n (%)] | | |
|---|---|---|---|
| | **Secondary Hospital** | **Tertiary Hospital** | **Total** |
| **Stage 1**: $\frac{140\ to\ 159}{90\ to\ 99} mmHg$ | 111 (76.6) | 79 (71.8) | 190 (74.5) |
| **Stage 2**: $\frac{159\ to\ 179}{100\ to\ 109} mmHg$ | 20 (13.8) | 17 (15.5) | 37 (14.5) |
| **Stage 3**: > $\frac{180}{100} mmHg$ | 14 (9.7) | 14 (12.7) | 28 (11.0) |
| **Co-Morbidity (Diabetes)** | | | |
| Present | 64 (44.1) | 36 (30.9) | 100 (39.2) |
| Absent: | 81 (55.9) | 74 (69.1) | 155 (60.8) |
| **Total** | **145 (100)** | **110 (100)** | **255 (100)** |

*Note: mmHg=millimetre mercury, numerator=systolic blood pressure, denominator=diastolic blood pressure*
*Cost-Analysis of Medications used by patients for one year (2018-2019)*

Incremental Cost-Effectiveness Ratios (ICERs) of anti-hypertensive therapy

The cost per mmHg ratio was generally lower in the tertiary hospital compared to the secondary hospital (stage 1; US$4.36 vs. 5.34, stage 2: US$2.41 vs. 2.10, and stage 3: US$1.44 vs. 1.94) due to better treatment outcomes. The cost per controlled patient was more favorable in the secondary hospital compared to the tertiary hospital (stage 1; US$1.91 vs. 0.96, stage 2: US$35.57 vs. 9.02, and stage 3: US$22.30 vs. 14.83) due to more patient numbers as shown in Table 4.

## Discussion

In this study, we analyzed the economic costs using secondary data from known hypertensive patients from two public hospitals. The economic burden of hypertension management is evidenced by the higher costs of prescribed

**Table 3.** Estimated cost profile of medications utilized by patients in tertiary and secondary hospitals for 1 year (2018-2019)

| Drug | No of Prescriptions | | Cost (US$) | | Total cost (US$) |
|---|---|---|---|---|---|
| | Tertiary | Secondary | Tertiary | Secondary | |
| **Anti-hypertensive** | 442 | 295 | 12,388.2 | 9,583.8 | 21,972.0 |
| **Anti-diabetics** | 146 | 71 | 8,054.7 | 4,878.1 | 12,932.8 |
| **Anti-lipidemic** | 91 | 39 | 5,379.2 | 2,095.6 | 7,474.8 |
| **Other drugs†** | 481 | 337 | 3,396.2 | 2,799.9 | 6,196.1 |
| **Total** | **1,160** | **742** | **29,218.30** | **19,357.4** | **48,575.7** |

*†Other drugs = anticoagulants, analgesics, haematinics, antimalarial and antiulcer medication. Such as Rosuvastatin, paracetamol, iron supplements, artesunate/amodiaquine, and omeprazole. 1 US$ is equivalent to ₦360 as of 2019; ₦=NGN*

**Table 4.** Incremental cost-effectiveness ratios (ICERs) of treatment groups in hospitals

| Variable | No. of Patients | Patients (Controlled BP) | BP Decrease in mmHg (Systolic ± SD) | Mean Cost (US$) | Cost (US$)/mm Hg | Cost (US$)/controlled patient |
|---|---|---|---|---|---|---|
| **Secondary** | | | | | | |
| Stage 1 | 111 | 82 (72.6%) | 16.76 ± 15.91 | 78.85 | 5.34 | 0.96 |
| Stage 2 | 20 | 9 (45.0%) | 38.63 ± 16.30 | 81.21 | 2.10 | 9.02 |
| Stage 3 | 14 | 5 (35.7%) | 57.33 ± 14.61 | 111.49 | 1.94 | 22.30 |
| **Tertiary** | | | | | | |
| Stage 1 | 79 | 47(60.3%) | 20.62 ± 20.02 | 107.41 | 4.36 | 1.91 |
| Stage 2 | 17 | 2(11.8%) | 29.5 ± 10.50 | 95.06 | 2.41 | 35.57 |
| Stage 3 | 14 | 6(42.9%) | 61.83 ± 11.84 | 109.77 | 1.44 | 14.83 |

*Note: BP = blood pressure*

hypertensive drugs relative to antidiabetic, antilipidemic, antibiotics, antimalarial, etc., This reinforces the huge overall impact of medication costs on hypertensive patients because they also use other medications [8,10]. This gives a broader picture of the economic burden on patients compared to studies that focus only on the assumption that hypertensive patients are treated for hypertension only [11,12]. The out-of-pocket payment for these medications is not sustainable considering the demographic distribution of the patients who are essentially low-income earners [8]. This is against the backdrop that this study only addressed the medical costs of anti-hypertensive drugs utilized by the patients without adding other associated direct and indirect costs of assessing healthcare [19,21]. Therefore, there is a need for healthcare providers to take definitive steps and actions to minimize the impact of medication costs on patients with long-term medical conditions. The findings of the study assert the need for cost management to be aligned with the level of disease by applying incremental cost-effectiveness ratios.

The ICERs were expressed by two key parameters: cost per mmHg decrease in blood pressure (cost/mmHg) and cost per patient achieving controlled blood pressure (cost/patient with controlled blood pressure) [9-10,15-16] Overall lower values of cost per mmHg

decrease in blood pressure of patients in the tertiary compared to the secondary hospital suggests better outcomes were achieved because the higher the level of blood pressure control or reduction, the lower the cost for each unit of outcome achieved. However, increased medication costs negatively shift the balance to the detriment of the patients, especially for those who are high cardiovascular risk patients or those on multiple drug treatment or intensive treatments [10,16]. Furthermore, the cost per patient with controlled blood pressure had overall higher values in the tertiary compared to the secondary hospital. Generally, this aligns with the findings of a study that showed higher treatment costs for patients in tertiary hospitals compared to secondary hospitals [24] which are predominantly attributable to the level of care provided. Therefore, these ratios are of practical relevance because ICER provides informative and robust measures about the additional costs required to obtain an extra unit of health benefit. Thus, provides empirical evidence that accounts for the impact of the number of patients accessing treatment as well as desired clinical outcomes [8,19].

Therefore, both measures: cost per mmHg and cost per patient with controlled blood pressure, provided context and a holistic perspective to this evaluation study conducted [19,21]. This information supports extrapolating estimation of cost to deliver an extra unit of desired clinical outcome for 10, 100, 1,000, or more persons accessing healthcare [19]. In the context of the study, the ratios provide the healthcare provider with an informed idea of what it costs to get the desired outcome for patients in the treatment groups-stages 1, 2, and 3. Likewise, cost per controlled patient provides needed information to know the cost implication for delivering or achieving desired outcomes in an individual patient managing hypertension as well as other chronic diseases.

In low- and middle-income countries where inflationary trends negatively influence the cost of medicines and access to healthcare, economic analysis including ICER estimations should be done on a routine basis as costs and patient types may vary over time [21,25].

*Implications of the study for healthcare managers*

The findings of the study revealed that treatment costs are a major determinant of the cost-effectiveness of hypertension management [10,15-16,21]. Invariably, the level of blood pressure control and the number of patients accessing treatment are considerations when healthcare managers make decisions. This is because high treatment needs and demand for these treatments determine the distribution of resources. The added benefit of using ICERs in healthcare practice is that it provides scientific evidence to the healthcare provider or manager on the cost of medication/therapy required to give an extra unit of outcome which in this study refers to a decrease in systolic blood pressure.

Presenting cost-effectiveness ratios (CERs) of treatments carries less ambiguity for the health provider. In that, it is a ratio and does not change irrespective of the number of patients involved [15]. Therefore, these ratios can invariably be used by healthcare providers to optimally tailor costs, the allocation for drug procurement, subsidies, and budgeting. This serves the purpose of patients in treatment groups that most need affordable and effective treatment. Finally, hospital pharmacists are advised to get training in basic economic analysis considering the gap in knowledge and application of pharmacoeconomic evaluations in medication management [18].

Furthermore, the availability of pharmacoeconomic data such as ICERs would be of critical use to the Drug and Therapeutics Committee (DTC) to make informed allocative

and budgetary decisions. [25]. This assertion is strengthened by recommendations by Fadare *et al* (2018)) on the need to improve DTC functionality and efficiency with relevant information to support decisions and policies for cost-effective medicines for vulnerable patient groups in developing countries [26]. Hence, in the context of this study, it is recommended that the choice of hypertensive medications and pricing considerations are focal points of consideration for DTCs in public hospitals [25]. Therefore, hospital management requires adequate government support and monitoring to ensure the use of ICER information to improve quality outcomes for the patients and efficient resource utilization.

recommends the routine use of incremental cost-effectiveness ratios to provide evidence to support cost-reduction claims for hospital management for vulnerable patient groups.

*Study limitations*

The study involved ambulatory outpatients; therefore, the cost of hospitalization was not included. This implies that extrapolation of findings to inpatients should be done with caution. The costs of laboratory tests and consultation costs were not included; therefore, the total medical costs were not exhaustively captured. Samples sizes were relatively small and hence may affect the generalizability of findings. Assumptions of the cost analysis may not reflect the real case scenario. At the time of conducting the study, JNC 8 had not been updated to JNC 9.

## Conclusion

The cost management of hypertension was higher in the tertiary facility compared to the secondary facility. The use of cost-effectiveness ratios provided information to support the estimation of medication costs associated with the management of hypertension. The study

## Funding

None

## Conflicts of Interest

The authors, Oamen, Osemene, and Ihekoronye, declared that they have no conflict of interest.

## Authors' Contribution

TEO conceptualized research, literature development, data collection & analysis. KPO reviewed the literature, and data analysis & reviewed the manuscript. MRI reviewed data analysis and contributed to literature development.

## References

1. World Health Organisation. Raised blood pressure. WHO. 2015. Available from: http://www.who.int/gho/ncd/risk_factors/blood_pressure_prevalence_text/en/.
2. World Heart Federation: Hypertension. WHF 2015. Available from: http://www.world-heart-federation.org/cardiovascular-health/cardiovascular-disease-risk-factors/hypertensionHTN/.
3. Adeloye D, Basquill C, Aderemi AV, Thompson JY, Obi FA. An estimate of the prevalence of hypertension in Nigeria; a systematic review and meta-analysis. Journal of Hypertension. 2015; 23(2)230-242.
4. Ekwunife OI, Okafor CE, Ezenduka CC, Udeogaranya PO. Cost-utility analysis of antihypertensive medications in Nigeria: a decision analysis. Cost Effectiveness and

Resource Allocation. 2013. 11:2.
5. Ekwunife OI, Udeogaranya PO, Nwatu IL. Prevalence, awareness, treatment, and control of hypertension in a Nigerian population. Health. 2010. 2(7):731-735.
6. James P, Oparil S, Carter B. Evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8*).* Journal of American Medical Association. 2014.
7. Saseen J. Essential hypertension. In: Alldredge BK, Corelli RL, Ernst ME, Guglielmo BJ, Jacobson PA, Kradjan WA, Williams BR, editors. Koda-Kimble and Young's Applied Therapeutics: The Clinical Use of Drugs. 10th ed. Philadelphia: Lippincott Williams & Wilkins. 2013. Chapter 14
8. Oamen TE, Osemene KP. Drug utilization evaluation of medications used by hypertensive patients in hospitals in Nigeria. Hospital Topics. 2021. 100(1):1-10.
9. Almalki ZS, Iqbal MS., Alabian FM, Alenazi RK, Tasha AR, Daghar MF, et al. Long-term cost-effectiveness of a systolic blood pressure goal of < 120mmHg in hypertensive patients without Diabetes mellitus. Value in Health. 2020; 21; 157-163.
10. Ilesanmi S, Ige O, Adebiyi A. The managed hypertensive; the costs of blood pressure control in a Nigerian Town. Pan African Med J 2012; 12; 96
11. Osibogun A, Okwor T. Antihypertensive prescription and cost to patients in an outpatient department of teaching hospital in Lagos, Nigeria. Open J Preventive Med. 2014; (4)156-163
12. Abubakar I, Obansa S. Antihypertensive use, prescription patterns and cost of medication in a teaching hospital in Lagos, Nigeria. Inter J of Soc Sc and Econ Rev 2020; 2(2)
13. Akunne O, Adedapo A. Antihypertensive prescription among black patients without compelling indications: prescription, effectiveness, quality, and cost of medication. BMC Health Services Research. 2019; 19; 373
14. Costa F. Improving Adherence to Treatment and Reducing Economic Costs of Hypertension: the role of Olmesartan-based treatment. High Blood Press Cardiovascular Preview. 2017; 24 (3); 265-274.
15. Chanhyun P, Guijing W, Jefferey M, Jing F. Cost-effectiveness Analyses of Antihypertensive Medicines: A Systematic Review. American Journal of Preventive Medicine. 2017; 53(6s2): S131-S142.
16. Kostas A, Kyriakis S, and Yannis Y. Short-term cost-effectiveness analysis of Hypertension treatment in Greece. Hellenic Journal of Cardiology 2014; 66:197-203
17. Tolla MT, Norheim OF, Memirie ST, Abdisa SG, Ababulga A, Jerene D, et al. Prevention and treatment of cardiovascular disease in Ethiopia: a cost-effectiveness analysis. Cost Effectiveness Resource Allocation. 2016; 14:10
18. Oamen TE, Osemene KP, Ihekoronye RM. Assessing the application of pharmacoeconomic evaluations in medicines management by hospital pharmacists in Nigeria: a cross-sectional survey. Hospital Topics. 2021;1-10.
19. Elliot R, Payne K. Essentials of Economic Evaluation in Healthcare. Pharmaceutical Press. 2005.
20. National population commission [NPC]. Nigeria national census: Population distribution by sex, state, LGAs, and senatorial district. 2006. http://www.population.gov.ng/index.php/publication/140-popn-distri-by-sex-state-lgas-and-senatorial-distr-2006
21. Turner HC, Archer PA, Downey LE, Isaranuwatchai W, Chalkidou K, Jit M, Teerawattananon Y. An introduction to the main types of economic evaluations used for informing priority setting and resource allocation in healthcare: Key features, uses,

and limitations, Frontiers in Public Health. 2021. 9:722927.

22. Krejcie, RV., & Morgan, DW. Determining Sample Size for Research Activities. Educational and Psychological Measurement. 1970.
23. Oostenbrink JB., Koopmanschap MA, Rutten FFH. Standardizations of Costs. Pharmacoeconomics. 2002; 20:443-454.
24. Sangwan A, Prinja S, Aggarwal S, Aggarwal S, Jagnoor J, Bahuguna P, Ivers R. Cost of Trauma care in secondary- and Tertiary care public hospitals in North India. Appl Health Econ Health Policy. 2017;15(5):681-692.
25. Hughes D, Reynolds DJ. Pharmacoeconomic principles and relevance to the activities of drug and therapeutics committees. Clinical Medicine 2009;9(5):490-492.
**26.** Fadare JO, Ogunleye O, Obiako R, Orubu S, Enwere O, Ajemigbitse AA, Meyer JC, Enato E, Massele A, Godman B, Gustafsson LL. Drug and Therapeutics Committees in Nigeria: evaluation of scope and functionality. Expert review of clinical pharmacology. 2018;11(12):1255-1262.