East African Journal of Health and Science
eajhs.eanso.org
Volume 6 Issue 1, 2023
Print ISSN: 2707-3912 | Online ISSN: 2707-3920
Title DOI: https://doi.org/10.37284/2707-3920

EAST AFRICAN NATURE & SCIENCE ORGANIZATION

Original Article

Capacity of Clinical Officers to Care for Patients with Hypertension and Type 2 Diabetes Mellitus in Rural Healthcare Facilities in Kisumu County, Kenya

David Ikura Shivachi[1*]

[1] Maseno University, P. O. Box 7799-40100 Kisumu, Kenya
*Author for correspondence Email: ikurars@gmail.com

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

Date Published:

08 August 2023

Keywords:

Clinical Officers, Hypertension, Type 2 Diabetes Mellitus, Non-Communicable Diseases.

ABSTRACT

This study aimed to investigate the ability of clinical staff in a rural Kenyan health facility to manage patients with hypertension and type 2 diabetes mellitus. The study involved 146 clinicians from 56 medical facilities who were interviewed using semi-structured questionnaires, simulations, and observational instruments. Descriptive analysis was performed using SPSS version 24. Results showed that lack of knowledge of risk factors for HTN& T2DMHTN & T2DM, inability to perform a complete physical examination, inability to identify first-line medications for either hypertension or type 2 diabetes mellitus, unavailability of assigned patient follow-up clinic day/staff/room, and lack of treatment guidelines for hypertension and diabetes were associated with an inability to manage such patients. However, concurrent prescription of anti-hypertension medication along with advice on lifestyle modification strategies was associated with an ability to do so (OR 0.079; 95% CI0.016-0.934; P=P = 0.002). The study recommends that clinical staff receive education on the risk factors, physical examination, and first-line medications for managing hypertension and type 2 diabetes mellitus. Additionally, the study highlights the importance of having scheduled clinic days, assigned staff, dedicated rooms, and protocols and guidelines to improve the management of these conditions.

APA CITATION

Shivachi, D. I. (2023). Capacity of Clinical Officers to Care for Patients with Hypertension and Type 2 Diabetes Mellitus in Rural Healthcare Facilities in Kisumu County, Kenya *East African Journal of Health and Science*, *6*(1), 301-317. https://doi.org/10.37284/eajhs.6.1.1357.

CHICAGO CITATION

Shivachi, David Ikura. 2023. "Capacity of Clinical Officers to Care for Patients with Hypertension and Type 2 Diabetes Mellitus in Rural Healthcare Facilities in Kisumu County, Kenya". *East African Journal of Health and Science* 6 (1), 301-317. https://doi.org/10.37284/eajhs.6.1.1357.

HARVARD CITATION

Shivachi, D. I. (2023) "Capacity of Clinical Officers to Care for Patients with Hypertension and Type 2 Diabetes Mellitus in Rural Healthcare Facilities in Kisumu County, Kenya", *East African Journal of Health and Science*, 6(1), pp. 301-317. doi: 10.37284/eajhs.6.1.1357.

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

IEEE CITATION

D. I., Shivachi, "Capacity of Clinical Officers to Care for Patients with Hypertension and Type 2 Diabetes Mellitus in Rural Healthcare Facilities in Kisumu County, Kenya", *EAJHS*, vol. 6, no. 1, pp. 301-317, Aug. 2023.

MLA CITATION

Shivachi, David Ikura. "Capacity of Clinical Officers to Care for Patients with Hypertension and Type 2 Diabetes Mellitus in Rural Healthcare Facilities in Kisumu County, Kenya". *East African Journal of Health and Science*, Vol. 6, no. 1, Aug. 2023, pp. 301-317, doi:10.37284/eajhs.6.1.1357.

INTRODUCTION

Noncommunicable diseases (NCDs) are long-term chronic conditions caused by a range of influences, such as genetic, environmental, physiological, and behavioural factors (Baldwin & Amato 2012). They are responsible for approximately 41 million (or 71%) of all global deaths, with four categories - cardiovascular disease, cancer, diabetes, and chronic respiratory disease - accounting for 80% of all premature fatalities in people aged 30-69. Fifteen million young people die each year due to NCDs. WHO reports that more than 85% of these "premature deaths" take place in low- and middle-income nations. Cardiovascular disease accounts for the most fatalities from NCDs – 17.9 million annually – followed by cancer (9 million), respiratory disease (3.9 million) and diabetes (1.6 million). All these diseases share common risk factors such as smoking, poor diet, lack of exercise, and excessive alcohol consumption - which can lead to obesity, hypertension, high cholesterol and finally illness (WHO, 2017). This remains an immense public health issue globally.

According to research from Laslett et al. (2015), by 2030, cardiovascular disease will account for 23.6 million deaths annually - making it the leading cause of death worldwide, associated with a high prevalence of hypertension, diabetes mellitus, dyslipidaemia and obesity (Mendis et al., 2015). Risk factors for cardiovascular disease are present in both men and women with diabetes (Benjamin et al., 2018); 61% of those with diabetes die from CVD or stroke. In Kenya specifically, World Health (2017) states that CVD is the second leading cause of death, resulting in 25% of hospital admissions and 13% of autopsies – posing a significant economic burden due to expensive diagnosis and treatment fees.

Furthermore, evidence suggests that almost half of the people with diabetes also have hypertension (HTN); increasing their risk of both microvascular complications, such as blindness or kidney failure; as well as macrovascular complications like coronary artery disease or heart attack, As per Garcia-Touza and Sowers' (2012) study on BP management; controlling blood pressure in people with diabetes can prevent both microvascular and macrovascular complications – therefore it is essential to slow down the progression via early intervention American Diabetes (2011) since this could significantly reduce instances of disability or death (England & Wales Predictive Diabetes Study Group 1998).

Type 2 diabetes mellitus is also a multi-system illness, taking various forms while impacting the pancreas muscle, liver, adipocytes, kidney and brain Brunton (2016). Originally thought to be mainly insulin deficiency relating back to Banting et al.'s (1922) work (Polonsky, 2012), doctors now recognise T2DM as inflammation linked to systemic inflammatory factors plus hormonal environmental, genetic and systemic issues.

This study evaluated the ability to manage hypertension and type 2 diabetes among clinical staff in rural health facilities in Kisumu County, Kenya. He found that lack of knowledge, inadequate physical examination and no treatment guidelines hindered effective management. The study highlights the need for ongoing training, better access to equipment, and the importance of

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

treatment guidelines for improving patient care and outcomes in rural healthcare settings.

MATERIALS AND METHODS

In this cross-sectional study, the ability of Clinical Officers (COs) working in rural healthcare settings in Kisumu County, a region in western Kenya, to treat high blood pressure and type 2 diabetes was examined. Data on the capacity of the Clinical Officers were collected using a structured questionnaire. A list of all Clinical Officers in Kisumu County was obtained from the County staff master list with a total population of 311 COs serving 226,719 households with a population of 952,654 (KNBS, 2013). The target population of 204 COs working in rural setting government facilities. The sample size was determined using the Yamane formula for the known target population to recruit participants were divided among four strata— dispensaries, hospitals, sub-counties, and counties—according to the level of service. Semi-structured questionnaires were given to every participant, which included their education level and participation in seminars related to HTN & T2DM diagnosis and management. The participants were observed while they interacted with simulated patients using different clinical tools such as stethoscopes, tuning forks and more. Furthermore, they had to demonstrate their knowledge by providing protocols, guidelines and treatment flowcharts for hypertension, diabetes mellitus and other related diseases.

RESULTS

In this study, 146 clinicians (COs) from 56 public health facilities in Kisumu County were analysed using SPSS version 24. The objective was to evaluate the association between the likelihood of diagnosing hypertension (HTN) and type 2 diabetes (type 2 diabetes) and different factors, such as training, diagnosis, treatment, follow-up and availability of resources. Binary logistic regression with 95% confidence intervals was used to determine the odds ratio (OR). Important variables were included in the model. The results showed significantly different rates between COs who could manage HTN and T2D and those who couldn't. The study found significant associations with specific demographic and occupational factors.

Table 1: Respondent's characteristics grouped into clinical officers' ability or inability to manage hypertension and diabetes

Category	Characteristics	Total (*n* = 146)	Unable to Manage (*n* = 105)	Able to Manage (*n* = 41)	*P*-value
		n (%)	n (%)	n (%)	
Gender	Female	63 (43.2)	47 (44.2)	16 (39.0)	0.580
	Male	83 (56.8)	58 (55.2)	25 (61.0)	
Duration of Service	<10 years	110 (75.3)	79 (75.2)	31 (75.6)	0.572
	>10 years	36 (24.7)	26 (24.8)	10 (24.4)	
Healthcare facility Level	Dispensary	33 (22.6)	21 (20.0)	12(29.3)	0.494
	Health centre	38 (26.0)	29 (27.6)	9(22.0)	
	Sub-county	54 (37.0)	28 (36.2)	16(39.0)	
	County	21 (14.4)	17 (16.2)	4(9.8)	
Department	General OPD	81 (55.5)	54(66.7)	27(33.3)	0.572
	MCH	4 (2.7)	2(1.9)	2(4.9)	
	HIV	61 (41.8)	49 (46.7)	12(29.3)	
Employer	County Government	83 (56.8)	59 (56.2)	24 (58.5)	0.473
	Support partner	63(43.2)	46 (43.8)	17 (41.5)	

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

Clinical Officers' Demographic Characteristics and Ability to Manage HTN & T2DM

A binary logistic regression model was used to assess the relationship between COs' capability to manage HTN & T2DM and demographic characteristics (*Table 2*). There was not any correlation between the length of service and the management of HTN & T2DM (OR=1.025, 95% CI; 0.442-2.376, P =0.954). Similarly, there was no association between the interviewees' level of hospital service and those employed at a dispensary (OR=2.531, 95% CI; *P* = 0.164) or a health centre (OR=1.386, 95% CI; OR=1.893, 95% CI; 0.366-5.210, *P* = 0.634) or a sub-county facility (0.544-6.586, *P* = 0.316) compared to those employed in a county hospital. Further analysis revealed that there was no connection between HTN & T2DM management and MCH COs working in departments (OR=2.195, 95% CI; 0.287-16.823, *P* = 0.449), and only marginal ability for COs working in HIV departments to manage HTN & T2DM (OR=0.493, 95% CI; 0.544-1.080, *P* = 0).

Table 2: Association between clinical officers' demographic characteristics and ability to manage hypertension and type 2 diabetes mellitus

Category	Independent variable	Odds Ratio	95%CI	*P*-value
Duration of service post internship	>10 years	Ref.	-	-
	<10 years	1.025	0.442-2.376	0.954
Healthcare facility Level	County	Ref.	-	-
	Dispensary	2.531	0.685-9.351	0.164
	Health centre	1.386	0.366-5.210	0.634
	Sub-county	1.893	0.544-6.586	0.316
Department	General OPD	Ref.	-	-
	MCH	2.195	0.287-16.823	0.449
	HIV	0.493	0.544-1.080	0.077
Employer	County	Ref.	-	-
	Support partner	1.125	0.539-2.347	0.753

Post-Diploma Training Trends of Participating Clinical Officers

Clinical officers (COs) are certified to provide typical general health services at the local level. They usually receive their instruction at a middle-level college. As a result, COs are educated to carry out standard surgery methods as well as normal medical methods such as diagnosing and treating illnesses. Due to the fact that COs are a classification of healthcare practitioners who come in contact with patients at primary healthcare centres, it is essential for them to know numerous common disorders, including Noncommunicable Diseases (NCDs). After the primary three years of college education, 146 research participants were assessed for the COs' additional training in general Hypertension & Type 2 Diabetes management.

Qualification COs at Post-Diploma Training and Ability to Manage HTN & T2DM

A regression analysis was done to evaluate the link between managing hypertension and type 2 diabetes and post-diploma qualification type, and results found no correlation (OR=1.470; 95% CI: 0.129-16.799; P = 0.756) or certification (OR = 2.190; 95% CI:0.59-8.086; P 0.239) when compared to participants who had a bachelor's or master's degree (*Table 3*).

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

Table 3: Association between types of qualification attained by cos at post-diploma training levels and ability to manage HTN & T2DM

Category	Independent variable	Odds Ratio	95% CI	P-value
Level of qualification at training post diploma	Degree	Ref.	-	-
	Diploma	1.470	0.129-16.799	0.756
	Certificate	2.190	0.593-8.086	0.239

After analysing the distribution of COs having received post-diploma training, 43.2% (*n* = 63) reported having received it. When asked about the quality of HTN & T2DM training at the diploma level, 42.5% (*n* = 62) said it was good, 47.9% (*n* = 70) said it was fair, and 9.6% (*n* = 14) said it was bad. 33.6% (*n* = 49) mentioned receiving specific training in HTN post-diploma level, 24.7% (*n* = 36) for DM; however, only 16.4% of those surveyed reported having received training in both HTN & T2DM whereas 58.2% had not received any additional training at all. The comparability of additional training after diploma acquisition and quality of HTN & T2DM training at the diploma level had no correlation to the capability to manage HTN & T2DM effectively, with P values of 0.666, 0.159, 0.333, 0.403 and 0.373, respectively for each variable set studied between those who could or could not manage HTN & T2DM successfully.

Table 4: Clinical officers' training post diploma level and ability to manage hypertension and type 2 diabetes mellitus

Category	Characteristics	Total n (%)	Unable to manage n (%)	Able to manage n (%)	P-value
Training post diploma	Yes	63 (43.2)	49 (44.1)	14(40.0)	0.666
	No	83 (56.3)	62 (55.9)	21(60.0)	
Training Rating	Poor	14 (9.6)	7(6.7)	7(17.1)	0.159
	Fair	70 (47.9)	52(49.5)	18(43.9)	
	Good	62 (42.5)	46(43.8)	16 (39.0)	
Trained in HTN	No	97 (66.4)	67 (63.8)	30 (73.2)	0.333
	Yes	49 (33.6)	38 (36.2)	11 (26.8)	
Trained in DM	No	110 (75.3)	78 (74.3)	32 (78)	0.403
	Yes	36 (24.7)	27 (25.7)	9(22)	
Training in HTN and DM	Not trained	85 (58.2)	60 (57.1)	25 (61.0)	0.373
	Trained in either	37 (25.3)	25 (23.8)	12 (29.3)	
	Trained in both	24 (16.4)	20 (19.0)	4 (9.8)	

Clinical Officers' Knowledge of Diagnosis of Patients with HTN and T2DM

Understanding how to identify risk factors and conduct physical examinations whilst also being able to interpret laboratory and/or radiological results are all vital components of making a proper diagnosis when dealing with patients who present with HTN and T2DM (National Academies of Sciences, Engineering, and Medicine, 2016). To assess this ability, the clinical officers were tested by being asked to recognise the risk factors associated with HTN and T2DM, demonstrate an appropriate physical examination procedure and explain any laboratory or radiological results given by the patient.

Knowledge of Risk Factors for Developing Hypertension and Type 2 Diabetes Mellitus

When reviewing a patient's medical history, the clinician should consider ten risk factors for hypertension and/or diabetes mellitus, including age (>40), alcohol abuse, ethnicity, dyslipidaemia, first-

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

degree relatives, impaired glucose tolerance, obesity, inactivity, tobacco use, and unhealthy diets (MOH, 2018). As seen in *Table 5*, 17.8% (*n* = 26) of COs surveyed did not ask about any of the risk factors at all; 11.6% (*n* = 17) asked about two; 26.7% (*n* = 39) asked about three; 13.7% (*n* = 20) asked about four; and only 1.4% (*n* = 2) asked about five or more. 78.0% (*n* = 32) of those who identified three or more risk factors were deemed capable of managing HTN & T2DM (P<0.001). However, 58.2% (*n* = 85) of the participants identified two or fewer risk factors.

Table 5: Clinical officers' ability to take the history of risk factors in patients with hypertension and type 2 diabetes mellitus

Category	Characteristics	Total n (%)	Unable to manage *n* = 105	Able to manage *n* = 41	p-value
History of risk factors	0risk factor	26 (17.8)	23 (21.9)	3 (7.3)	<0.001
	1risk factor	17 (11.6)	15 (14.3)	2 (4.9)	
	2risk factors	42 (28.8)	38 (36.2)	4 (9.8)	
	3risk factors	39 (26.7)	22 (21.0)	17 (41.5)	
	4risk factors	20 (13.7)	7 (6.7)	13 (31.7)	
	5risk factors	2 (1.4)	0 (0.0)	2 (4.9)	
Enquiry >3 risk factors	< 3 risk factors	85 (58.2)	76 (72.4)	9 (22.0)	<0.001
	≥ 3 risk factors	61 (41.8)	29 (27.6)	32 (78.0)	

Clinical Officers' Ability to take Patient History and Manage HTN and T2DM

Clinical officers querying fewer than three risk factors in patients with hypertension and type 2 diabetes mellitus were nine times less likely to effectively manage them, based on a binary regression analysis (OR=9.256; 95% CI: 3.936-21.768; P = 0.001). This indicates the importance of comprehending the predisposing risk factors of HTN & T2DM to its successful management, as seen in *Table 6*.

Table 6: Association between COs' ability to take history and manage hypertension and type 2 diabetes mellitus

Category	Independent Variable	O. R	95% CI	p-value
History Taking on Risk Factors	≥3Risk factors	Ref.	-	-
	<3 Risk factors	9.256	3.936-21.768	<0.001

Physical Examination of Patients with Hypertension and Type 2 Diabetes Mellitus

The study participants were asked to demonstrate the steps of a physical examination for HTN & T2DM patients. 62.3% (*n* = 91) of them recorded their blood pressure, 61.6% (*n* = 90) weighed themselves, 16.4% (*n* = 24) checked their waist circumference, and 30.8% (*n* = 45) examined their feet, but only 4.8% (*n* = 7) achieved success in this examination (*Table 7*). Blood pressure (*P* = 0.190), weight (*P* = 0.629), and feet examination (*P* = 0.885) had no difference between COs who were able to manage HTN & T2DM and those who could not; however, the measurement of waist circumference revealed a gap between the two groups, with 26.8% (*n* = 11) of successful COs having done so correctly (*P* = 0.034), indicating the importance of physical examination knowledge in managing HTN & T2DM. Furthermore, a complete physical examination showed that 14.6% (*n* = 6) of COs were competent in managing patients with this condition effectively (*P* = 0.001; *Table 7*).

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

Table 7: Physical examination by clinical officers of patients with hypertension and type 2 diabetes mellitus

Category	Characteristics	Total n (%)	Unable to Manage	Able to manage	*P*-value
Blood Pressure	Done	91 (62.3)	62 (59.0)	29 (70.7)	0.190
	Not done	55 (37.7)	43 (41.0)	12 (29.3)	
Weight	Taken	90 (61.6)	66 (62.9)	24 (58.5)	0.629
	Not taken	56 (38.4)	32 (37.1)	17 (41.5)	
Waist circumference	Measured	24 (16.4)	13 (12.4)	11 (26.8)	0.034
	Not measured	122 (83.6)	92 (87.6)	30 (73.2)	
Feet examination	Examined	45 (30.8)	32 (30.5)	13 (31.7)	0.885
	Not examined	101 (69.2)	73 (69.5)	28 (68.3)	
Exam completeness	Completed	7 (4.8)	1 (1.0)	6 (14.6)	0.001
	Not complete	139 (95.2)	104 (99.0)	35 (85.4)	

Ability to Complete Physical Examination and Management of HTN and T2DM

Logistic regression modelling was used to evaluate the ability of COs to conduct physical examinations in managing HTN & T2DM. Results showed no association between blood pressure measurement (OR=1.675, 95% CI; *P* = 0.194), weight measurement (OR=0.810, 95% CI; *P* = 0.579) and foot examination (OR=1.025, 95% CI; 0.467-2.249, *P* = 0.951). However, COs were twice less likely to manage HTN & T2DM if they did not measure patients' waist circumference (OR=2.671, 95% CI; 1.076- 6.626, *P* = 0.034). Additionally, failure to conduct a complete physical exam was associated with a 17-fold decrease in the probability of successful management of HTN & T2DM patients (OR=17.989, 95% CI; 2.086-155.097, *P* = 0.009). This emphasises the importance of a thorough physical exam for treating HTN & T2DM patients (*Table 8*).

Table 8: Association between clinical officers' ability to complete physical examination and management of hypertension and type 2 diabetes mellitus

Category	Characteristic	OR	95% CI	*P*-value
Blood Pressure	Done	Ref.	-	0.194
	Not done	1.675	0.769-3.647	
Weight	Taken	Ref.	-	0.579
	Not taken	0.810	0.385-1.703	
Waist Circumference	Measured	Ref.	-	0.034
	Not measured	2.671	1.076-6.626	
Feet Examination	Examined	Ref.	-	0.951
	Not examined	1.025	0.467-2.249	
Exam Completeness	Completed	Ref.	-	-0.009
	Not complete	17.989	2.086-155.097	

Determination of Target Ranges for Body Mass Index in Patients with HTN and T2DM

Table 9 revealed that participants were asked to identify the best BMI targets and calculate their patient's BMI. 30.8% (*n* = 45) correctly calculated it, 39.7% (*n* = 58) used an incorrect formula, and 29.5% (*n* = 43) were unsure. Additionally, 52.1% (*n* = 76) supplied correct BMI optimal targets, 29.5% (*n* = 43) gave incorrect ones, and 18.5% (*n* = 27) were uncertain. There was no major difference in the participants' capability to determine BMI when members were divided into those who could

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

manage patients with HTN & T2DM (*P* = 0.572). However, there was a slight fluctuation in the optimal BMI targets that was not significant (*P* = 0.090).

Table 9: Calculation and target ranges for body mass index (BMI) by clinical officers for patients with hypertension and type 2 diabetes mellitus

Category	Characteristics	Total n (%)	Unable to manage	Able to manage	*P*-value
BMI calculation	Correct formula	45 (30.8)	30 (28.6)	15 (36.6)	0.572
	Not sure	43 (29.5)	33 (31.4)	10 (24.4)	
	Wrong formula	58 (39.7)	42 (40.0)	16 (39.0)	
BMI optimum targets	Correct values	76 (52.1)	51 (48.6)	25 (61.0)	0.090
	Not sure	27 (18.5)	24 (22.9)	3 (7.3)	
	Wrong values	43 (29.5)	30 (28.6)	13 (31.7)	

Ability to Calculate BMI and Determine Optimum Targets and Management of HTN and T2DM

The binary logistic regression analysis conducted to identify the correlation between managing HTN & T2DM and ascertaining BMI yielded no association (OR, 1.356; 95% CI, 0.577-3.185; OR, 1.626; *P* = 0.485) or among those unsure (95% CI, 0.634-4.175; *P* = 0.599) compared to those who accurately calculated their BMI (*Table 10*).

Table 10: Association between clinical officers' ability to calculate BMI and Optimum BMI targets and management of hypertension and type 2 Diabetes Mellitus

Category	Independent variable	O. R	95% CI	*P*-value
Ability to calculate BMI	Correct formula	Ref.	-	-
	Not sure	1.626	0.634-4.175	0.599
	Wrong formula	1.356	0.577-3.185	0.485
Target BMI values	Optimum value	Ref.	-	-
	Not sure of the Value	4.346	1.176-16.059	0.028
	Wrong values	1.025	0.447-2.350	0.953

Steps Followed by COs to Measure Blood Pressure in Patients with HTN and T2DM

During the CO study, 68.5% (*n* = 100) of COs gave their patients rest for at least 5 minutes, 82.9% (*n* = 121) placed an armrest at heart level, 84.2% (*n* = 123) applied a cuff to the skin, 78.1% (*n* = 114) adjusted the cuff to fit 80%, 80.0% (*n* = 118) deflated the cuff to zero and 74.7% (*n* = 109) took blood pressure by auscultation. Comparing those who managed HTN & T2DM to those who did not, while there was a difference regarding resting time (*P* = 0.044), no significant differences were found when taking into account armrest at heart level (*P* = 0.333), application of the cuff on the skin (*P* = 0.199), fit of the cuff at 80% (*P* = 0.652), deflation of the cuff to zero (*P* = 0.949), and BP taken by auscultation (*P* = 0.949).

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

Table 11: Steps followed by clinical officers to measure blood pressure in patients with hypertension and type 2 diabetes mellitus

Category	Characteristic	Total n (%)	Unable to manage *n* = 105	Able to manage *n* = 41	*p*-value
Patient rest at least 5 min	Rested	100 (68.5)	77 (73.3)	23 (56.1)	0.044
	Not rested	46 (31.5)	28 (26.7)	18 (43.9)	
Armrest at heart level	Armrest	121 (82.9)	89 (84.8)	32 (78.0)	0.333
	Arm hanging	25 (17.1)	16 (15.2)	9 (22.0)	
Cuff applied to the skin	Applied to skin	123 (84.2)	91 (86.7)	32 (78.0)	0.199
	Applied on cloth	23 (15.3)	14 (13.3)	9 (22.0)	
Cuff fits at least 80%	Fitting cuff	114 (78.1)	83 (79.0)	31 (75.6)	0.652
	Cuff not fitting	32 (21.9)	22 (15.1)	10 (6.8)	
Cuff deflated to Zero	Cuff at zero	118 (80.0)	85 (81.0)	33 (80.5)	0.949
	Cuff not at zero	28 (19.2)	20 (19.0)	8 (19.5)	
BP taken by auscultation	Auscultated	109 (74.7)	79 (75.2)	30 (73.2)	0.796
	Not auscultated	37 (25.3)	26 (24.8)	11 (26.8)	
BP repeated to confirm	BP repeated	32 (21.9)	20 (19.0)	12 (29.3)	0.180
	BP not repeated	114 (78.1)	85 (81.0)	29 (70.7)	

Measurement of Blood Pressure and Ability to Manage Patients with HTN and T2DM

There was a marginal correlation found between the ability to manage hypertension and type 2 diabetes patients and taking the necessary steps for measuring blood pressure (binary logistic regression). The analysis showed that the patient resting for at least five minutes had an association with being able to manage HTN & T2DM (OR, 2.141; 95% CI, 0.970-4.726; *P* = 0.059); however, there were no correlations found with the arm resting at heart level (OR, 0.620; 95% CI, 0.248-1.552; *P* = 0.307), placing the cuff on the skin directly (OR, 0.552; 95% CI, 0.218-1.400; *P* = 0.211), using a cuff that fits around the upper arm at least 80% of the way (OR, 0.820; 95% CI, 0349-1.928; *P* = 0.649), cuff deflated at zero (OR, 0951; 95%CI,0.380-2.379;*P* = 0.915) and auscultation-measured BP (OR, 0805; 95% CI, 0380 - 2379 ; P = 0625) as well as getting a second BP reading to confirm (OR, 1785; 95 % CI, 0775 - 1924 ; P = 0173).

Table 12: Association between steps followed to measure blood pressure and clinical officers' ability to manage patients with hypertension and type 2 diabetes mellitus

Category	Independent Variable	Odds Ratio	95% CI	*P*-value
Patient rest for at least 5 minutes.	Rested	Ref.	-	-
	Not rested	2.141	0.970-4.726	0.059
Armrest at heart level	Armrest	Ref.	-	-
	Arm hanging	0.620	0.248-1.552	0.307
Cuff applied to the skin	Applied to skin	Ref.	-	-
	Applied on cloth	0.552	0.218-1.400	0.211
Cuff fit at least 80%	Fitting cuff	Ref.	-	-
	Cuff not fitting	0.820	0.349-1.928	0.649
Cuff deflated to Zero	Cuff at zero	Ref.	-	-
	Cuff not at zero	0.951	0.380-2.379	0.915
BP taken by auscultation	Auscultated	Ref.	-	-
	Not auscultated	0.805	0.337-1.924	0.625
BP repeated to confirm	BP repeated	Ref.	-	-
	BP not repeated	1.784	0.775-4.105	0.173

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

Interpretation of Laboratory and Radiological Results of Patients with HTN and T2DM

Out of the 146 respondents, 53.4% (*n* = 78) reported the correct fasting glucose level, and 27.4% (*n* = 40) reported the right two-hourly postprandial glucose level. When stratified into COs who could or could not manage HTN & T2DM, only 8.2% (*n* = 12) correctly interpreted glycated haemoglobin levels, while 17.1% (*n* = 25) and 5.4% (*n* = 8) could interpret urine analysis and serum cholesterol levels respectively. The results of the chest X-ray were reported correctly in 7.3%, 14.6%, 4.9%, and 9.8% for each respective subgroup, but none of them were significantly different from one another. Of those surveyed, 2.7% (*n* = 4) were able to interpret four out of seven laboratory results, while 15.1% (*n* = 22) knew three out of seven results - these proportions were distributed similarly across both subgroups (*Table 13*).

Table 13: Interpretation of laboratory and radiological results for hypertension and type 2 diabetes mellitus and their related complications

Category	Characteristic	Total n (%)	Unable to manage ***n* = 105**	Able to manage ***n* = 41**	p-value
Fasting glucose	Not sure	6 (4.1)	4 (3.8)	2 (4.9)	0.354
	Correct	78 (53.4)	60 (57.1)	18 (43.9)	
	Wrong	62 (42.5)	41 (39.0)	21 (51.2)	
Two hourly postprandial glucose	Not sure	53 (36.3)	41 (39.0)	12 (29.3)	0.422
	Correct	40 (27.4)	26 (24.8)	14 (34.1)	
	Wrong	53 (36.3)	38 (36.2)	15 (36.6)	
Glycated Hemoglobin-A-1C(HB1AC)	Not sure	103 (70.5)	72 (68.6)	31 (75.6)	0.695
	Correct	12 (8.2)	9 (8.6)	3 (7.3)	
	Wrong	31 (21.2)	24 (22.9)	7 (17.1)	
Urine analysis	Not sure	99 (67.8)	68 (64.8)	31 (75.6)	0.409
	Correct	25 (17.1)	19 (18.1)	6 (14.6)	
	Wrong	22 (15.1)	18 (17.1)	4 (9.8)	
Cholesterol	Not sure	135 (92.5)	97 (92.4)	38 (92.7)	0.961
	Correct	8 (5.4)	6 (5.7)	2 (4.9)	
	Wrong	3 (2.1)	2 (1.9)	1 (2.4)	
Chest X-ray	Not sure	102 (69.9)	70 (66.7)	32 (78.0)	0.403
	Correct	20 (13.7)	16 (15.2)	4 (9.8)	
	Wrong	24 (16.4)	19 (18.1)	5 (12.2)	
ECG	Not sure	137 (93.8)	100 (95.2)	37 (90.2)	0.259
	Correct	0 (0)	0 (0.0)	0 (0.0)	
	Wrong	9 (6.2)	5 (4.8)	4 (9.8)	
Ability to interpret 3 out of 7 results	Able to interpret	22 (15.1)	15 (14.3)	7 (17.1)	0.672
	Unable to interpret	124 (84.9)	90 (85.7)	34 (82.9)	
Ability to interpret 4 out of 7 results	Able to interpret	4 (2.7)	2 (1.9)	2 (4.9)	0.323
	Unable to interpret	142 (97.3)	103 (98.1)	39 (95.1)	

Ability to Interpret Laboratory and Radiological Results and Manage HTN and T2DM

The capability of COs to read laboratory and radiological results and manage HTN & T2DM was examined using binary logistic regression (*Table 14*). There was no correlation between incorrect or uncertain fasting glucose levels or two-hour postprandial glucose levels and their ability to manage HTN & T2DM. Likewise, glycated

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

haemoglobin-A-1C, urine protein analysis, and cholesterol values were not associated with the capability to handle HTN & T2DM. Additionally, misinterpretation of chest X-rays had no effect on their capacity to properly manage the condition. An overall analysis of the relationship between COs' ability to manage HTN & T2DM and their ability to interpret laboratory results did not observe any correlation or four out of seven tests.

Table 14: Association between clinical officers' ability to interpret laboratory radiological results and manage hypertension and type 2 diabetes mellitus

Category	Characteristic	OR	95% CI	*P*-value
Fasting glucose	Correct	Ref.	-	-
	Not sure	1.037	0.196-5.472	0.574
	Wrong	0.602	0.282-1.284	0.189
Two hourly postprandial glucose	Correct	Ref.	-	-
	Not sure	1.952	0.771-4.942	0.158
	Wrong	1.590	0.612-4.129	0.341
GlycatedHemoglobin-A- 1C(HB1AC)	Correct	Ref.	-	-
	Not sure	0.689	0.169-2.807	0.604
	Wrong	1.049	0.218-5.041	0.952
Urine protein analysis	Correct	Ref.	-	-
	Not sure	0.736	0.264-2.051	0.558
	Wrong	1.631	0.378-7.041	0.512
Cholesterol	Correct	Ref.	-	-
	Not sure	0.758	0.142-4.053	0.746
	Wrong	0.667	0.037-11.936	0.783
Chest X-ray	Correct	Ref.	-	-
	Not sure	0.536	0.165-1.738	0.299
	Wrong	0.968	0.221-4.236	0.965
Ability to interpret 3 out of 7 results	Able to interpret	Ref.	-	-
	Unable to interpret	1.279	0.477-3.432	0.625
Ability to interpret 4 out of 7 results	Able to interpret	Ref.	-	-
	Unable to interpret	2.543	0.344-18.795	0.360

Treatment and Follow-up of Patients Presenting with HTN and T2DM

Patients with HTN and T2DM have to take medication their whole lives, which necessitates continual treatment and check-up appointments. We asked the patients about their understanding of the first-line drugs used to control hypertension and type 2 diabetes mellitus side effects. Furthermore, we questioned the participants on the patient follow-up protocols they implemented at their health centres.

Prescription of Correct First-line Medication and Management of HTN and T2DM

Table 15 showed that COs who prescribed different drugs were twice as likely to manage patients presenting with hypertension and diabetes (OR=2.116, 95% CI: 1.168-4.628, P = 0.040) compared to those who prescribed the recommended first-line medications (ACEI). In contrast, those prescribing the wrong medications were five times less likely to successfully treat patients (OR=5.250, 95% CI; 1.376-20.036, P = 0.015) than those prescribed metformin for managing stable type 2 diabetes mellitus.

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

Table 15: Association between prescription of correct first-line medication and management of hypertension and type 2 diabetes mellitus

	1st Line Medication	Odds Ratio	95% CI	*P*-value
Hypertension	ACEI	Ref.	-	-
	Other drugs	2.116	0.968-4.628	0.060
Type 2 Diabetes Mellitus	Metformin	Ref.	-	-
	Other drugs	5.250	1.376-20.036	0.015

Clinical Offices' Knowledge of Management of Pre-Hypertensive Patients

Clinical officers were asked how they manage patients with pre-hypertension. It was found that 87.7% (*n* = 128) advised lifestyle modifications, 5.5% (*n* = 8) prescribed anti-hypertensive therapies, and 6.8% (*n* = 10) prescribed medications alongside lifestyle modifications (*Table 16*). Of those who advised patients to modify their lifestyles, 75.6% (*n* = 31) were able to manage those with HTN & T2DM. Significantly, the proportion of COs managing HTN & T2DM patients varied in the pre-hypertension management distribution (*P* = 0.001).

Table 16: Knowledge of Clinical officers on the management of pre-hypertensive patients

Category	Total *n* = 146	Unable to manage *n* = 105	Able to manage *n* = 41	*P*-value
Anti-hypertensive	8 (5.5)	6 (5.7)	2 (4.9)	0.001
Anti-hypertensive and lifestyle modification	10 (6.8)	2 (1.9)	8 (19.5)	
Lifestyle modification	128 (87.7)	97 (92.4)	31 (75.6)	

Knowledge of Treatment of Patients with Pre-hypertension

Using binary logistic regression, we were able to calculate the connection between managing HTN & T2DM and COs' knowledge regarding how they handle pre-hypertensive patients. We took into account the impact that gender may have on this result and found that when COs prescribed anti-hypertensive medication and advised lifestyle modifications simultaneously, it made them 99% more likely to effectively handle HTN & T2DM in comparison to those who only gave advice. 95% CI, 0.016-0.934; *P* = 0.002). However, prescribing anti-hypertensive medication for prehypertensive patients was unrelated to HTN & T2DM management (OR, 0.816; 95% CI, 0.145-4.597; *P* = 0.817) in terms of changing one's lifestyle (*Table 17*).

Table 17: Association between clinical officers' knowledge of pre-hypertension and ability to manage hypertension

Category	Odds Ratio	95% CI	*P*-value
Lifestyle Modification	Ref.	-	-
Anti-hypertensive medication	0.816	0.145-4.597	0.817
Anti-hypertensive medication and Lifestyle Modification	0.079	0.016-0.934	0.002

Patients Follow up and Clinical Officers' Ability to Manage Patients with HTN and T2DM

A regression analysis showed that the ability to follow-up was not linked to COs' ability to manage HTN & T2DM patients (OR, 1.115; 95% CI, 0.488-2.545; *P* = 0.796). Similarly, the availability of a dedicated HTN/T2DM clinical day (OR, 2.065; 95% CI, 0.809-5.267; *P* = 0.129), personnel tasked with managing HTN & T2DM patients (OR, 1.818; 95% CI, 0.718-4.600; *P* = 0.207) and a room or

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

section designated for the management of HTN & T2DM patients (OR, 1.245; 95% CI, 0.473-3.277; *P* = 0.657) did not have an effect either on COs' ability to manage HTN & T2DM patients (*Table 18*). In contrast, health facilities lacking these structures had a 15-fold lower possibility of managing HTN & T2DM patients (OR, 15.774; 95% CI, 5.386-46

Table 18: Association between Patient Follow-up and Ability of Clinical Officers to Manage Patients with Hypertension and type 2 diabetes mellitus

Category	Characteristics	Odds Ratio	95% CI	*P*-value
Ability to follow up	Able to follow	Ref.	-	-
	Unable to follow	1.115	0.488-2.545	0.796
Assigned clinic day	Assigned day for follow up	Ref.	-	-
	No assigned day	2.065	0.809-5.267	0.129
Assigned staff to the NCD clinic	Assigned staff	Ref.	-	-
	No staff assigned	1.818	0.718-4.600	0.207
Assigned Room for follow up	Room available	Ref.	-	-
	No room dedicated	1.245	0.473-3.277	0.657
Assigned day, staff and room combined	All available	Ref.	-	-
	Not available	15.774	5.386-46.193	<0.001

Availability of Treatment Protocols and/or Guidelines

The World Health Organization (WHO) has provided specific protocols and guidelines for the treatment of patients with HTN & T2DM. These guidelines were based on heart disease 2002 and adjusted to suit the Kenyan context (MOH, 2018). In the survey, clinical officers were asked if their healthcare facilities had management plans for HTN & T2DM. Just 37.0% (54 people) answered yes to having diabetes management protocols, and 19.9% (29 people) reported having related hypertension protocols. Further analysis showed that only 2.7% (4 people) had guidelines in place to oversee stroke, heart failure and renal disease. 82.9% (*n* = 34) of those who said they had guidelines to manage hypertension could effectively do so, a significant difference compared to those who could not manage HTN & T2DM with *P* = 0.001 value. In addition, 41.5% (17 people) of those who had diabetes management protocols were able to treat patients with HTN & T2DM, which had a P = 0.001 value too; yet this percentage was higher than 7.3% (3 people) of COs who could manage HTN & T2DM with heart failure guideline- *P* = 0.034-, but similar when it comes to stroke guideline-*P* = 0.205- and renal disease guideline-*P* = 0.889-.

Table 19: Availability of Treatment Protocols and Guidelines

Category	Availability	Total *n* = 146	Unable to manage *n* = 105	Able to manage *n* = 41	*P*-Value
Hypertension Guidelines	Yes	54 (37.0)	20 (19.0)	34 (82.9)	<0.001
	No	92 (63.0)	85 (81.0)	7 (17.1)	
Diabetes Guidelines	Yes	29 (19.9)	12 (11.4)	17 (41.5)	<0.001
	No	117 (80.1)	93 (88.6)	24 (58.5)	
Stroke Guidelines	Yes	4 (2.7)	4 (3.8)	0 (0.0)	0.205
	No	142 (97.3)	101 (96.2)	41 (100.0)	
Heart Failure Guidelines	Yes	4 (2.7)	1 (1.0)	3 (7.3)	0.034
	No	142 (97.3)	104 (99.0)	38 (92.7)	
Renal Disease Guidelines	Yes	4 (2.7)	3 (2.9)	1 (2.4)	0.889
	No	142 (97.3)	102 (97.1)	40 (97.6)	

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

Availability of Treatment Guidelines and Ability to Manage HTN and T2DM

A binary regression model was used to assess the impact of participants' gender on their ability to manage HTN & T2DM patients, taking into account any available guidelines. It was found that 79% of COs had difficulty managing these patients due to a lack of guidelines for managing hypertension (OR, 21.339; 95% CI, 8.197-55.863; *p* = 0.001) compared to those who did have them. Similarly, patients with diabetes were five times less likely to be managed by a CO without diabetes management protocols (OR, 5.443; 95% CI, 2.290-12.934; *p* = 0.001) in comparison with those who had access to relevant guidelines. Although a correlation between respondents' ability to manage HTN & T2DM and the availability of guidelines for heart failure was not significant (OR, 7.773; 95% CI, 0.767-78.779; *p* = 0.083), no correlation could be established between the availability of renal disease guidelines and a CO's capacity manage HTN & T2DM (OR, 1.309; 95% CI, 0.103-13.233; *p* = 0.820). Additionally, no CO reported being able to manage patients with HTN & T2DM, so the association between the availability of stroke guidelines and the ability to manage them could not be established either (*Table 20*).

Table 20: Association between the availability of treatment protocols and/or guidelines and the ability of clinical officers to manage hypertension and type 2 diabetes mellitus

Category	Availability	Odds Ratio	95% CI	*P*-value
Hypertension Guidelines	Yes	Ref.	-	
	No	21.399	8.197-55.863	<0.001
Diabetes Guidelines	Yes	Ref.	-	-
	No	5.443	2.290-12.934	<0.001
Stroke Guidelines	Yes	Ref.	-	-
	No	-	-	-
Heart Failure Guidelines	Yes	Ref.	-	-
	No	7.773	0.767-78.779	0.083
Renal Disease Guidelines	Yes	Ref.	-	-
	No	1.309	0.103-13.233	0.820

DISCUSSION

This study evaluated the ability of clinicians to manage patients with hypertension and type 2 diabetes in rural health facilities in Kisumu County, Kenya. Of the 146 participants, 41 were able to manage these patients, while 105 could not. Lack of knowledge about risk factors, inadequate physical examination, inability to identify first-line drugs and lack of treatment guidelines are barriers to patient management. However, prescribing anti-hypertensive drugs concurrently with lifestyle counselling was associated with patient management (OR 0.079; 95% CI 0.016-0.934; P = 0.002). The study highlights the importance of adequate training and access to guidelines and resources in rural healthcare settings.

Demographic Characteristics of Study Participants

Demographic characteristics, including gender, seniority, medical facility, department, and employer, did not differ between CAs that could manage HTN and T2DM patients and those who could not. Previous studies have reported mixed results on the correlation between experience and knowledge. In this study, a binary regression model controlling for sex found no association between length of service, facility or employer level, and ability to manage HTN patients and T2DM.

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

Training at Post-diploma Level for COs Managing Patients with HTN & T2DM

Analysis of the demographic characteristics of participants showed no significant variations in gender, duration of service (<10> years), the level of healthcare facility (from dispensaries to county-level facilities) or department (general OPD, MCH or HIV), and their employer (county government or support partner) between COs able and unable to manage patients with HTN & T2DM. This confirms a previous study in Egypt that found no correlation between years of experience and knowledge score mean percentage (Abolfotouh et al. 2011). A binary regression model was also used to control for gender differences, yet, it still did not find any association between duration of service, level of health facility or employer with managing patients with HTN & T2DM.

Diagnosis Procedures for Patients Presenting with HTN & T2DM

The study examined the clinical agents' knowledge (CA) regarding risk factors and physical examination for patients with HTN and T2DM. Among CAs, 28.8% recognised two risk factors, while 26.7% recognised three. Specifically, 41.5% and 31.7% of public officials who were aware of 3 and 4 risk factors, respectively, were able to manage patients with HTN and type 2 diabetes, compared with 36.2% of those who knew only 2 ($P < 0.001$) (Ministry of Health, 2018). Knowledge of at least three risk factors was associated with a higher ability to manage patients (78%). A comprehensive physical exam, including blood pressure, weight, waist circumference, and examination of the feet, is important for diagnosis. However, no association was found between BMI calculation or other experimental interpretations and the ability of CA to manage HTN and T2D (Abolfotouh et al., 2011). This shows the potential of management without complicated means.

Treatment and Follow-ups of Patients Presenting with HTN & T2DM

The study investigated clinicians' knowledge of first-line drugs for HTN and T2D. ACEIs and metformin have been recommended (Cooper et al. 2007; Lastra et al. 2008; Inzucchi et al. 2015). CAs who misprescribed drugs were less likely to manage HTN and T2D patients ($P = 0.040$; $P = 0.015$). Lifestyle changes such as reducing alcohol intake, reducing sodium, increasing physical activity, and controlling weight are important for preventing hypertension (Puddey et al. 1992. Sacks et al. 2001; Arroll & Beaglehole). 1992; Stevens et al. 1993; Horr & Nissen 2016). CAs that suggested lifestyle modification along with medication showed better patient management (75.6%). The frequency of eye exams did not correlate with CHV's ability to manage HTN and T2DM (Tumosa, 2008).

Equipment and National Guidelines Utilised in Management of HTN & T2DM

The management of HTN and T2DM required specific equipment, but the ability of the CA to identify or demonstrate its use was not correlated with patient management ($P = 0.089$). In rural areas, access to equipment is limited, with essential tools such as ophthalmoscopes and stylus pens (Mendis et al., 2012; Tumosa, 2008). The lack of guidelines for HTN and T2DM was associated with CA's inability to manage patients. Ensuring the availability and training of guidelines is critical for FBOs in rural health settings, as they are often the first point of contact for patients with HTN and T2D (WHO 2002; MOH 2018; Alebiosu 2009; Abolfotouh et al. 2011).

CONCLUSION AND RECOMMENDATIONS

In summary, the quality or level of training or courses taken on hypertension or diabetes mellitus (or both) was not linked to the ability of Clinical officers (COs) to manage patients with HTN & T2DM. Failure to recognise risk factors and perform a thorough physical exam hindered COs in

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

diagnosing HTN & T2DM. Difficulties in establishing first-line drugs for HTN & T2DM and unavailability of resources (like scheduled follow-up days, staff, and rooms) were barriers to COs managing HTN & T2DM at rural health facilities. The absence of clinical tools did not hamper the capability of COs to manage HTN & T2DM; however, the lack of national clinical guidelines/protocols was associated with the failure of COs to manage HTN & T2DM.

Recommendations

The need for continuous mentorship through specialist reverse referrals in order to improve the clinical skills (i.e., history taking and physical examination) of COs at rural healthcare facilities. The provision and updating of initial treatment protocols for COs along with a planned appointment day, a designated room, and assigned staff for following up patients with HTN & T2DM; and supplying national clinical guidelines/protocols to COs in order to facilitate their management of HTN & T2DM cases.

REFERENCES

Abolfotouh, M. A., Soliman, L. A., Abolfotouh, S. M., & Raafat, M. (2011). Knowledge and practice of PHC physicians toward the detection and management of hypertension and other CVD risk factors in Egypt. *International journal of hypertension*, *2011*.

Alebiosu, O. C. (2009). Knowledge of diabetes and hypertension care among health care workers in southwest Nigeria. *Postgraduate Medicine*, *121*(1), 173-177.

Arroll, B., & Beaglehole, R. (1992). Does physical activity lower blood pressure: a critical review of the clinical trials. *Journal of clinical epidemiology*, *45*(5), 439-447.

Baldwin, W., & Amato, L. (2012). *Fact sheet: global burden of noncommunicable diseases*. World Population Data Sheet.

Benjamin, E. J., Virani, S. S., Callaway, C. W., Chamberlain, A. M., Chang, A. R., Cheng, S., ... & Muntner, P. (2018). Heart disease and stroke statistics—2018 update: a report from the American Heart Association. *Circulation*, *137*(12), e67-e492.

Cooper, S. A., Whaley-Connell, A., Habibi, J., Wei, Y., Lastra, G., Manrique, C., ... & Sowers, J. R. (2007). Renin-angiotensin-aldosterone system and oxidative stress in cardiovascular insulin resistance. *American Journal of Physiology-Heart and Circulatory Physiology*, *293*(4), H2009-H2023.

Garcia-Touza, M., & Sowers, J. R. (2012). Evidence-Based Hypertension Treatment in Patients With Diabetes. *The Journal of Clinical Hypertension*, *14*(2), 97-102.

Horr, S., & Nissen, S. (2016). Managing hypertension in type 2 diabetes mellitus. *Best practice & research Clinical endocrinology & metabolism*, *30*(3), 445-454.

Inzucchi, S. E., Bergenstal, R. M., Buse, J. B., Diamant, M., Ferrannini, E., Nauck, M., ... & Matthews, D. R. (2012). Management of hyperglycaemia in type 2 diabetes: a patient-centred approach. Position statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetologia*, *55*, 1577-1596.

Joshi, R., Alim, M., Kengne, A. P., Jan, S., Maulik, P. K., Peiris, D., & Patel, A. A. (2014). Task shifting for noncommunicable disease management in low and middle income countries–a systematic review. *PloS one*, *9*(8), e103754.

KNBS. (2013). *Kisumu County fact sheet.* Kenya National Bureau of Statistics

Laslett, L. J., Alagona, P., Clark, B. A., Drozda, J. P., Saldivar, F., Wilson, S. R., ... & Hart, M. (2012). The worldwide environment of

Article DOI: https://doi.org/10.37284/eajhs.6.1.1357

cardiovascular disease: prevalence, diagnosis, therapy, and policy issues: a report from the American College of Cardiology. *Journal of the American College of Cardiology*, *60*(25S), S1-S49.

Lastra, G., Whaley-Connell, A., Manrique, C., Habibi, J., Gutweiler, A. A., Appesh, L., ... & Sowers, J. R. (2008). Low-dose spironolactone reduces reactive oxygen species generation and improves insulin-stimulated glucose transport in skeletal muscle in the TG (mRen2) 27 rat. *American Journal of Physiology-Endocrinology and Metabolism*, *295*(1), E110-E116.

Mendis, S., Davis, S., & Norrving, B. (2015). Organisational update: the world health organisation global status report on noncommunicable diseases 2014; one more landmark step in the combat against stroke and vascular disease. *Stroke*, *46*(5), e121-e122.

MOH (2015). Kenya National Strategy for the Prevention and Control of Noncommunicable Diseases In: *Kenya National Strategy for the Prevention and Control of Noncommunicable Diseases*. Nairobi: Ministry of Health

MOH. (2018). Kenya National Guidelines for Cardiovascular Diseases Management. In: *Division of Noncommunicable Diseases*. Division of Noncommunicable Diseases, Nairobi

National Academies of Sciences, Engineering, and Medicine. (2015). *Improving diagnosis in health care*. National Academies Press.

Polonsky, K. S. (2012). The past 200 years in diabetes. *New England Journal of Medicine*, *367*(14), 1332-1340.

Puddey, I. B., Parker, M., Beilin, L., Vandongen, R., & Masarei, J. R. (1992). Effects of alcohol and caloric restrictions on blood pressure and serum lipids in overweight men. *Hypertension*, *20*(4), 533-541.

Sacks, F. M., Svetkey, L. P., Vollmer, W. M., Appel, L. J., Bray, G. A., Harsha, D., ... & Cutler, J. A. (2001). Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. *New England journal of medicine*, *344*(1), 3-10.

Tumosa, N. (2008). Eye disease and the older diabetic. *Clinics in geriatric medicine*, *24*(3), 515-527.

WHO (2002) *WHO CVD-risk management package for low-and medium-resource settings*. World Health Organization.

WHO (2017) *Assessing national capacity for the prevention and control of noncommunicable diseases: report of the 2017 global survey*. World Health Organization.

