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ORIGINAL RESEARCH

Assessment of Medical Care Strategies for Primary Hypertension in Iraqi Adults: A Hospital-Based Problem-Oriented Plan

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Purpose: This study aimed to assess the medical care strategies for primary Hypertension in Iraqi adults through a hospital-based problem-oriented plan to improve patient outcomes by identifying and addressing medical problems.

Methodology: This cross-sectional study was conducted in a hospital setting of Iraqi adults diagnosed with primary hypertension. Data collection involved patient interviews, medical record reviews, and measurements of blood pressure (BP). The assessment of medical problem-oriented plans (MPOPs) was performed using the validated Alsayed_v1 tool, which includes three main components: the assessment of treatments, the MPOP classification system, and the care plan.

Results: The study participants of 80 Iraqi patients had a mean age of 52.3 years, with 55% male and 45% female. Common comorbid conditions included diabetes mellitus (40%), chronic kidney disease (30%), and coronary artery disease (20%). The most commonly prescribed antihypertensive medications were angiotensin-converting enzyme inhibitors (ACEI) (75.00%). On average, participants were taking 2.087 antihypertensive medications (SD = 0.60), with the majority (63.75%) using a combination of two medications. However, the average BP among participants was 148/92 mmHg, indicating uncontrolled hypertension in most cases (90%). The study identified an average of 3.2 MPOPs per patient, with the most common being inappropriate drug selection (25%), incorrect dosage regimen (20%), and non-adherence to treatment (15%). The chi-squared analysis revealed a significant association between gender and blood pressure status ($X^2 = 4.366$, $p = 0.037$). Additionally, the study identified 233 MPOPs across four categories: Indication (23.18%), Effectiveness (53%), Safety (7%), and Patient-related issues (17%). A multiple regression analysis was performed to identify predictors of the number of MPOPs with which heart failure was a significant predictor ($\beta = 4.931$, $p = 0.003$).

Conclusion: The findings highlight the complexity of managing hypertension in Iraqi adults and underscore the need for personalized treatment plans to address the medical problems. Implementing a problem-oriented approach in clinical practice can lead to better BP control and improved health outcomes. This study provides valuable insights for healthcare providers and policymakers to enhance hypertension management strategies in Iraq. However, the study's findings should be interpreted with caution due to limitations such as a relatively small and specific sample, reliance on self-reported data, and the cross-sectional design, which restricts causal inference.

Keywords: hypertension management, medical problem-oriented plans (MPOP), antihypertensive medication, Iraqi adults, uncontrolled blood pressure

Introduction

Hypertension, commonly referred to as high blood pressure, is a significant global health concern and a leading risk factor for various cardiovascular diseases. According to the World Health Organization (WHO), hypertension affects millions of adults worldwide and contributes to many premature deaths each year. In Iraq, the prevalence of hypertension has been steadily increasing over the past decade, posing a serious burden on the healthcare system and affecting the population's overall well-being.[1]

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Common discrepancies involved medication omissions and dose changes, particularly with insulin, antiplatelets, beta-blockers, and statins.[2] The researchers recommended standardizing reconciliation processes and using telecommunication systems for monitoring.[3–5]

Another study by Hussen and Daba (2017),[6] drug therapy problems (DTPs) and their predictors were evaluated among hypertensive patients at Dil-Chora Referral Hospital in Dire-Dawa, Ethiopia. The cross-sectional study involved 271 adult hypertensive patients on follow-up for at least three months, using a combination of medical record reviews and face-to-face interviews conducted from February to April 2015. The study revealed that 71.2% of patients experienced at least one DTP, with a mean of 1.39 DTPs per patient. The most common DTPs were the need for additional drug therapy (62.4%) and non-adherence to medications (32.8%).

Another study by AbuRuz et al (2013),[7] the impact of pharmaceutical care service on hospitalized patients with chronic kidney disease (CKD) in Jordan was evaluated. The prospective study included 130 CKD patients in nephrology wards. The clinical pharmacist assessed patients for treatment-related problems (TRPs) and implemented interventions. The study identified an average of 5.31 TRPs per patient, with efficacy-related problems being the most common. Physicians accepted 86% of the pharmacist's recommendations. The study found that 17% of TRPs were resolved, 5.5% improved, and 37.4% prevented through clinical pharmacist interventions.

While hypertension is a prevalent health issue in Iraq, there is a lack of comprehensive research and evidence-based guidelines tailored specifically to the Iraqi adult population. The existing studies primarily focus on epidemiological data, prevalence, and general management approaches. Still, there is a scarcity of research that evaluates the effectiveness of medical care strategies for primary hypertension in Iraqi adults. There is a pressing need for a problem-oriented plan that assesses and optimizes medical care strategies for hypertension locally to address this gap.

The current healthcare system in Iraq faces several challenges in effectively managing hypertension. Limited access to specialized medical facilities, shortage of essential medications, inadequate health education, and inconsistent follow-up care are some of the critical issues hindering the optimal management of hypertension among Iraqi adults. The absence of a comprehensive problem-oriented plan tailored to the local healthcare landscape contributes to the persistence of uncontrolled hypertension cases, leading to an increased risk of cardiovascular complications and reduced quality of life.

This thesis addresses a crucial knowledge gap regarding assessing and optimizing medical care strategies for primary hypertension in Iraq. The findings and recommendations from this study will not only contribute to the existing body of knowledge on hypertension management. Still, they will also provide valuable insights to healthcare policymakers, practitioners, and stakeholders, enabling them to design and implement more effective and tailored healthcare interventions for hypertensive patients in Iraq. By focusing on a problem-oriented plan, this research aims to enhance the overall quality of medical care provided to Iraqi adults with hypertension, ultimately reducing the burden of cardiovascular diseases and improving their health outcomes.

This study aims to assess medical care strategies for primary hypertension in Iraqi adults by applying a problem-oriented plan.

Materials and Methods

Design and Participants

This cross-sectional study was conducted between August 2023 and May 2024. The study was conducted in the emergency room and various cardiology clinics in the Martyr Mohammed Baqer Al-Hakim Hospital in Baghdad, Iraq. Patients with primary hypertension in the hospital were approached for participation in this study. Ethical approval was obtained from Al-Ahliyya Amman University and the hospital (51/34). The consent form was obtained from every participant as a written form and they were fully informed about the purpose of the study. This study complies with the Declaration of Helsinki.

The inclusion criteria include patients previously diagnosed with hypertension who were under antihypertensive medication, with or without co-morbidities, and those who voluntarily consented to participation in the study. Whereas

patients experiencing challenges with language comprehension, critically ill, mentally unstable, and patients diagnosed to have highly contagious diseases such as tuberculosis, coronavirus, etc, were excluded from this study.

The sample size was determined based on the total number of eligible patients admitted to the hospital during the study period. Given that this research was performed at a single center serving a limited population, the number of cases reflects the actual clinical encountered cases.

Sample Size

The minimum required sample size was 79, which was estimated at the 95% confidence level with a margin of error of 5% from 99 hypertension-related emergency department admissions at the same hospital who were presented during the preceding year.

Data Collection Process

Patients attending the emergency room and various cardiology clinics were interviewed, and data was collected using the templates available in recently published studies[8,9] with some modifications. Additionally, the patient's data were reviewed in consultation with the cardiologist to ensure accurate categorization of medication-related errors.

The data collection process involved the following steps:

1. Patient interviews: Patients were interviewed to gather comprehensive information about their demographic details, current medical issues, medical history, treatments, and lifestyle factors.
2. Form completion: The form designed for this study consisted of multiple sections aimed at capturing detailed patient information. Each section of the form is described below.
3. Consultation with cardiologists: The collected data was cross-verified with cardiologists to identify and categorize the medical problems.

The form used for data collection consisted of the following sections:

1. **Demographic Data**: This section included the patient's ID, age, gender, education level, and occupation. Collecting this information helped in understanding the background of the patients and any demographic factors that might influence the medical problems.
2. **Current Issues**: In this section, details about the patient's chief complaint (CC) were recorded, including the onset, duration, and severity of the issue. A severity score was assigned, and any associated symptoms were noted. Factors that aggravated or alleviated the symptoms were documented to provide a comprehensive view of the patient's health status.
3. **Medical Problems**: This part of the form captured information about the stage, type, or class of the medical problems the patient was facing, their current status, and the duration of these problems. This helped to understand the chronicity and progression of the patient's medical conditions.
4. **Patient History**: This section gathered details about the patient's surgeries and the number of previous hospitalizations, vaccination history, family history of diseases, lifestyle factors, occupational history, social history, and the impact of their medical conditions on daily activities. This comprehensive history provided context for the patient's current health issues and potential medication-related errors.
5. **Treatments**: Information about the patient's current medications, including the name, strength, route, and frequency of administration, was collected. The indication for each medication, its duration, time of administration, adherence to the treatment regimen, and any problems encountered were also documented. This section aimed to identify discrepancies or issues in the patient's treatment plan.
6. **Tests**: This section included the results of various laboratory tests such as blood pressure (BP), heart rate (HR), sodium (Na), potassium (K), chloride (Cl), uric acid, serum creatinine (SCr), calcium (Ca), white blood cell count (WBC), carbon dioxide (CO_2), blood urea nitrogen (BUN), glucose, hemoglobin (Hgb), hematocrit (Hct), magnesium (Mg), aspartate aminotransferase (AST), alanine aminotransferase (ALT), total bilirubin (T. bili),

total protein (T. prot), high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglycerides (TG), and total cholesterol. These lab tests helped assess the patient's overall health status and detect any abnormalities that could contribute to medication-related errors.

7. **Special Situation**: The data collection addresses specific scenarios requiring unique consideration due to their complexity and potential impact on clinical problem-solving. Examples of these special situations include cases of renal or hepatic failure, where patients' impaired organ function necessitates careful medication management and dosage adjustments. Additionally, pregnancy is highlighted as a special situation due to the need to consider both maternal and fetal health when prescribing treatments.

Assessment and Categorization of MPOPs

The Alsayed_v1 instruments[9] consist of principal components: data collection, assessment of treatments, the medical problem-oriented plan (MPOP), as well as a care plan and patient education. The template pertaining to the assessment of therapies was thought to be crucial since it aids in analyzing patient data for the presence of medical problems and provides a suitable plan.[9]

Regarding the data collection, seven parts were included: demographic data, current issues, medical problems, patient history, treatments, tests, and special situations.[8,9]

We identified the necessary data in the appropriate sources, documented the patient's data, evaluated the distinct components with documentation, and evaluated the coherence between the recommended and the patient's therapeutic indications. Effectiveness was determined by comparing the patient's therapy to the most recent evidence-based clinical practice guideline recommendations and achieving treatment objectives (treatment goals). The medication's safety was evaluated by examining the patient's symptoms and medical records for any indications of probable adverse reactions, contraindications, or preventive measures. Possible medication safety issues were also evaluated by determining whether or not the patient was at risk but not receiving prophylaxis. The adequacy of the dosage regimen was determined by comparing doses to evidence-based guidelines and recommendations or by consulting drug information resources such as Lexicomp's Drug Information. The patient's clinical characteristics were considered when determining the dosing regimen. A drug interactions tool was identified.[8–10]

After completing this analysis step for one drug, all of the patient's medications must be assessed prior to the synthesis step (MPOP tool).[9]

All medical problems reported in the assessment step were pooled and then classified according to their shared components: Indication, Effectiveness, Safety, Patient, and Miscellaneous, according to the MPOP tool.[9]

Measurements and Calculations: Part of the assessment step is to record the body mass index (BMI). The estimated glomerular filtration rate (eGFR) was also calculated to assess kidney function. These measurements provided crucial information for understanding the patient's physical health and any potential risks associated with medication use.

Categorization of MPOPs

The categorization of medication-related problems followed the methodology outlined by Alsayed et al (2022)[9] in their comprehensive medical problem-oriented plan (MPOP) classification system. The MPOP system includes an open hierarchical structure with higher levels broadly defined into five main categories: Indication, Effectiveness, Safety, Patient, and Miscellaneous. More specific subcategories were defined within these categories, and various plans (interventions) were determined for each subcategory. The classification tool was validated through several steps, including literature searching, developing assessment templates, implementing tutorials, and extensive validation to ensure the tool's appropriateness, acceptability, feasibility, interpretability, reliability, and responsiveness.[9]

The following is a brief description of the major categories of the MPOP tool:

- **Indication**: This category includes acute and chronic untreated conditions, with specified interventions such as adding non-pharmacological or pharmacological treatments.
- **Effectiveness**: This category highlights actual and potential uncontrolled conditions and interventions aimed at improving treatment effectiveness, including dose adjustments and the addition of new treatments.

- **Safety**: This category addresses actual and potential safety problems, with interventions such as replacing or discontinuing problematic treatments and implementing additional monitoring.
- **Patient-related Issues**: This category focuses on patient knowledge and adherence, emphasizing educational interventions to enhance patient understanding and compliance with treatment plans.

Statistical Analysis

Descriptive statistics were calculated for socio-demographic variables, history of present illness, chronic diseases, and treatment details. Frequencies and percentages were used for categorical variables. Meanwhile, means and standard deviations (SDs) or median and interquartile range (IQR) were computed for continuous variables, depending on the normality assessment. All analyses were performed using Jeffreys's Amazing Statistics Program (JASP) version 0.18.3.0.

Chi-squared tests determined the associations between blood pressure (BP) status (controlled vs uncontrolled) and various socio-demographic and clinical conditions. A significance level of $p < 0.05$ was considered statistically significant.

Multiple regression analysis was conducted to evaluate predictors of the number of medical problem-oriented plans (No_MPOP). The predictors included in the model were age, number of comorbidities, number of previous hospitalizations, number of antihypertensive medications, serum creatinine (SCr), low-density lipoprotein (LDL), total cholesterol, body mass index (BMI), estimated glomerular filtration rate (eGFR), gender, and presence of chronic conditions such as cardiovascular disease (CVD), heart failure (HF), diabetes mellitus (DM), chronic kidney disease (CKD), dyslipidemia (DLP), asthma, chronic obstructive pulmonary disease (COPD), and the use of various antihypertensive medications (ACE [Angiotensin-Converting Enzyme] inhibitors, ARBs [Angiotensin II Receptor Blockers], thiazides [Thiazide Diuretics], DHP CCBs [Dihydropyridine Calcium Channel Blockers], non-DHP CCBs [Non-Dihydropyridine Calcium Channel Blockers], and beta-blockers [Beta-Adrenergic Blockers]). The ANOVA test was used to assess the overall significance of the regression model, with a significance level set at $p < 0.05$. The standardized residuals histogram and Q-Q plot were evaluated to check the normality of residuals, ensuring the validity of the regression model.

Socio-Demographic and History of Present Illness Characteristics

Table 1 summarizes the study population's socio-demographic characteristics and history of present illness (N = 80). The mean age of the participants was 66.00 years (SD = 12.00). The gender distribution was almost equal, with 52.50% male and 47.50% female participants. Regarding education, 50.00% had below a bachelor's degree, 27.50% had a bachelor's degree, and 22.50% had higher than a bachelor's degree. The primary occupations were varied, but all participants were employed (100%) (Table 1).

The most common chief complaints were fatigue (31.25%), shortness of breath (18.75%), and palpitations (18.75%). Other notable complaints included nausea/vomiting (17.50%), and dizziness (10.00%). The asymptomatic cases represented 14 out of 80 patients (17.50%). The onset of symptoms was sudden in 50.00% of the cases, and gradual in 32.50%, with 17.50% having no symptoms. The duration of symptoms varied, with 31.25% experiencing symptoms for less than one week, and 30.00% for 1–4 weeks. The severity of complaints was moderate in 37.50% of the cases. The mean severity score was 3.95 (SD = 2.75) (Table 1).

Participants also reported various factors aggravating and alleviating their symptoms. Stress was identified as an aggravating factor by 35.00% of participants, physical exertion by 20.00%, and certain foods or drinks, such as caffeine, by 28.75%. Conversely, rest was the most commonly reported alleviating factor (43.75%), followed by lifestyle changes (18.75%) and medications (5.00%).

The impact of symptoms on daily activities was significant. 45.00% of participants reported interference with work, 40.00% with daily chores, and 63.75% indicated that their quality of life was impacted.

Additional health metrics recorded included a mean body mass index (BMI) of 29.200 with a standard deviation of 7.650 and a mean estimated glomerular filtration rate (eGFR) of 94.250 with a standard deviation of 32.050. These metrics provide further insight into the participants' overall health and kidney function.

Overall, the socio-demographic and clinical characteristics highlighted in Table 1 provide a comprehensive overview of the study population, indicating a diverse and predominantly elderly group with varied educational backgrounds, chief

Table 1 Socio-Demographic and History of Present Illness Characteristics of the Study Population (N = 80)

Variable	Frequency	Percent	Mean (SD*)	Median (IQR*)
Age				66.00 (12.00)
Gender				
Male	42	52.50		
Female	38	47.50		
Education				
Below Bachelor	40	50.00		
Bachelor	22	27.50		
Higher than a Bachelor degree	18	22.50		
Occupation	80	100.0		
Chief complaint				
Fatigue	25	31.25		
Shortness of breath	15	18.75		
Palpitations	15	18.75		
Nausea / Vomiting	14	17.50		
Asymptomatic	14	17.50		
Dizziness	8	10.00		
Occipital headache	6	7.50		
Chest Pain	5	6.25		
Epistaxis	4	5.00		
Blurred Vision	3	3.75		
Headache on awakening	2	2.50		
Tinnitus	2	2.50		
Others	23	28.75		
Onset				
Sudden	40	50.00		
Gradual	26	32.50		
No symptoms	14	17.50		
Duration				
< 1 week	25	31.25		
1–4 week	24	30.00		
4 week	16	20.00		
Not Applicable	14	17.50		

(*Continued*)

Table 1 (Continued).

Variable	Frequency	Percent	Mean (SD*)	Median (IQR*)
Severity of the complaint				
Mild	21	26.25		
Moderate	30	37.50		
Severe	15	18.75		
Not Applicable	14	17.50		
Severity score			3.950 (2.746)	
Aggravating factors				
Stress	2	35.00		
Physical exertion	16	20.00		
Certain foods or drinks (eg, caffeine)	23	28.75		
Medications	4	5.00		
None	9	11.25		
Alleviating factors				
Rest	35	43.75		
Lifestyle changes (eg, dietary changes, exercise)	15	18.75		
Medications	4	5.00		
None	25	31.25		
Impact on Daily Activities				
Interference with work	36	45.00		
Interference with daily chores	32	40.00		
Impact on quality of life	51	63.75		
BMI				29.200 (7.650)
eGFR				94.250 (32.050)

Abbreviations: BMI, Body Mass Index; eGFR, Estimated Glomerular Filtration Rate; IQR, Interquartile Range; SD, Standard Deviation.

complaints, and health statuses. This detailed characterization is crucial for understanding the study's context and interpreting its findings.

Chronic Diseases

Table 2 provides an overview of chronic diseases among the study population. The most prevalent conditions were diabetes mellitus (DM) (28.75%), CVD (27.50%), and asthma (13.75%). Other chronic conditions included COPD (12.50%), dyslipidemia (10.00%), stroke or transient ischemic attack (TIA) (7.50%), chronic kidney disease (CKD) (6.25%), obstructive sleep apnea (OSA) (6.25%), and heart failure (HF) (3.75%). The mean number of comorbidities was 1.30 (SD = 0.54), with most patients having one comorbidity (70.00%) (Table 2).

Table 2 Chronic Diseases of the Study Population (N = 80)

Variable	Frequency	Percent	Mean (SD)
DM	23	28.75	
CVD	22	27.50	
Asthma	11	13.75	
COPD	10	12.50	
Dyslipidemia	8	10.00	
Stroke or TIA	6	7.50	
CKD*	5	6.25	
OSA*	5	6.25	
HF*	3	3.75	
Other chronic conditions	5	6.25	
No. of co-morbidities			1.300 (0.537)
0	1	1.25	
1	56	70.00	
2	21	26.25	
3	2	2.50	

Abbreviations: CKD, Chronic Kidney Disease; OSA, Obstructive Sleep Apnea; COPD, Chronic Obstructive Pulmonary Disease; CVD, Cardiovascular Disease; DM, Diabetes Mellitus; HF, Heart Failure; IQR, Interquartile Range; SD, Standard Deviation; TIA, Transient Ischemic Attack.

Patients' History

Previous surgeries were reported by 17.50% of the participants. The mean number of previous hospitalizations was 0.225 (SD = 0.53), with 82.50% having no previous hospitalizations. Vaccination rates were high at 96.25%, and there were no reported allergies. A significant family history of CVD was noted in 88.75% of the participants, and DM in 26.25% (Table 3).

Table 3 Patients' History (N = 80)

Variable	Frequency	Percent	Mean (SD)
Previous surgeries	14	17.50	
No of previous hospitalization			0.225 (0.527)
0	66	82.50	
1	10	12.50	
2	4	5.00	
Vaccination	77	96.25	
Allergies	0	0	

(*Continued*)

Table 3 (Continued).

Variable	Frequency	Percent	Mean (SD)
Family history			
CVD*	71	88.75	
DM*	21	26.25	
Hypothyroidism	4	5.00	
Smoking status			
Cigarettes	21	26.25	
Electronic	0	0	
Pipe	17	21.25	
Physical inactivity	45	56.25	
High sodium intake	44	55.00	
Alcohol	0	0	
Caffeine	48	60.00	
Stressful job	15	18.75	
General stress	59	73.75	
Sedentary lifestyle	43	53.75	
Exposure to environmental factors (eg, noise, pollution)	20	25.00	
Appropriate support system	79	98.750	
Appropriate housing conditions	70	87.50	
Appropriate financial status	58	72.50	

Abbreviations: CVD, Cardiovascular Disease; DM, Diabetes Mellitus; SD, Standard Deviation.

Table 3 provides additional details on the study population's smoking status, lifestyle factors, and socio-economic conditions. Smoking status varied among the participants, with 26.25% smoking cigarettes and 21.25% using pipes, while no participants reported using electronic cigarettes. Physical inactivity was prevalent, with 56.25% of participants being physically inactive. High sodium intake was reported by 55.00% of the participants.

Caffeine consumption was high, with 60.00% of the participants consuming caffeine regularly. Stress was a significant factor, with 18.75% having stressful jobs and 73.75% experiencing general stress. A sedentary lifestyle was reported by 53.75% of the participants, and 25.00% were exposed to environmental factors such as noise and pollution.

Most participants had an appropriate support system (98.75%), appropriate housing conditions (87.50%), and appropriate financial status (72.50%), indicating relatively stable socio-economic conditions within the study population.

Treatment of Hypertension and Blood Pressure Status

Table 4 details the hypertension treatment and BP status. The most commonly used antihypertensive medications were ACEI (75.00%), ARBs (37.50%), thiazide diuretics (36.25%), and non-DHP CCBs (30.00%). The mean number of antihypertensive medications was 2.087 (SD = 0.60), with most patients (63.75%) using two medications. BP control was achieved in only 10.00% of the participants, while 90.00% had uncontrolled BP.

Table 4 Treatment of Hypertension and Blood Pressure Status Among the Study Participants (N = 80)

Variable	Frequency	Percent	Mean (SD)
ACEI	60	75.00	
ARB	30	37.50	
Thiazide diuretic	29	36.25	
DHP CCB	9	11.25	
Non-DHP CCB	24	30.00	
Beta blocker	15	18.75	
Other anti-HTN	12	15.00	
No. of anti-HTN			2.087 (0.599)
1	11	13.75	
2	51	63.75	
3	18	22.50	
BP status			
Controlled	8	10.00	
Uncontrolled	72	90.00	

Abbreviations: ACEI, Angiotensin-Converting Enzyme Inhibitor; ARB, Angiotensin II Receptor Blocker; DHP CCB, Dihydropyridine Calcium Channel Blocker; Non-DHP CCB, Non-Dihydropyridine Calcium Channel Blocker; Anti-HTN, Antihypertensive; BP, Blood Pressure; CVD, Cardiovascular Disease; DM, Diabetes Mellitus; SD, Standard Deviation.

Association Between Blood Pressure Status and Patient Characteristics

Chi-squared tests were conducted to determine the association between the BP status (uncontrolled versus controlled) and various conditions. The results of these tests are summarized below. The chi-squared tests revealed that gender (X^2 = 4.366, p = 0.037) was significantly associated with the BP status. Other conditions did not show significant associations (Table 5).

Table 5 Chi-Squared Test Results

Condition	X^2 Value	*df*	p
CVD	0.028	1	0.867
HF	0.346	1	0.556
Stroke or TIA	0.320	1	0.571
DM	0.061	1	0.805
BPH	0.113	1	0.737
CKD	0.593	1	0.441
DLP	0.062	1	0.804
Asthma	0.012	1	0.914

(*Continued*)

Table 5 (Continued).

Condition	X^2 Value	*df*	p
COPD	0.000	1	1.000
Insulin resistance	0.593	1	0.441
OSA	0.593	1	0.441
Other chronic conditions	0.593	1	0.441
ACEI	0.370	1	0.543
ARB	0.593	1	0.441
Thiazide	0.006	1	0.938
DHP_CCB	1.127	1	0.288
Non_DHP_CCB	0.238	1	0.626
BB	0.228	1	0.633
Other anti-HTN	3.529	1	0.060
Gender	4.366	1	0.037
Education	1.187	2	0.552

Abbreviations: ACEI, Angiotensin-Converting Enzyme Inhibitors; ARB, Angiotensin II Receptor Blockers; BB, Beta Blocker; BPH, Benign Prostatic Hyperplasia; CKD, Chronic Kidney Disease; COPD, Chronic Obstructive Pulmonary Disease; CVD, Cardiovascular Disease; *df*, degree of freedom; DHP_CCB, Dihydropyridine Calcium Channel Blockers; DLP, Dyslipidemia; DM, Diabetes Mellitus; HF, Heart Failure; Non_DHP_CCB, Non-Dihydropyridine Calcium Channel Blockers; OSA, Obstructive Sleep Apnea; TIA, Transient Ischemic Attack.

Predictors of the Number of Medical Problem-Oriented Plans

Figure 1 illustrates the distribution of medical problem-oriented plans (MPOPs) identified among the study participants, categorized into four main areas: Indication, effectiveness, safety, and patient-related issues. A total of 54 MPOPs (23.18%) were identified under the Indication category, with 19 patients (23.75%) having MPOPs related to indications. The Effectiveness category had the highest number of MPOPs, with 123 MPOPs (52.79%) identified, affecting 73 patients (91.25%). Under the Safety category, 17 MPOPs (7.30%) were identified, with 6 patients (7.50%) having safety-related MPOPs. Lastly, the Patient-related Issues category had 39 MPOPs (16.74%), affecting 38 patients (47.50%) (Figure 1).

Table 6 provides a comprehensive overview of the MPOPs identified among the study population. The table categorizes MPOPs into four primary areas: Indication, Effectiveness, Safety, and Patient-related issues, and details the frequency and percentage of each type of MPOP, along with the number and percentage of patients affected.

The Indication category includes 54 MPOPs, representing 23.18% of the total MPOPs identified. Within this category, two main subtypes were noted. The IAb1 subtype, which involves untreated chronic conditions requiring the addition of non-pharmacological treatments, accounted for 40 MPOPs (17.17%), affecting 22 patients (27.50%). The IAb2 subtype, which involves untreated chronic conditions requiring the addition of pharmacological treatments, accounted for 14 MPOPs (6.01%), affecting 5 patients (6.25%).

The Effectiveness category contained the highest number of MPOPs, with 123 identified, making up 52.79% of the total MPOPs. This category addresses issues related to both actual and potential uncontrolled conditions. Specifically, 81 MPOPs (34.76%) were related to actual uncontrolled conditions, affecting 66 patients (82.50%), while 42 MPOPs

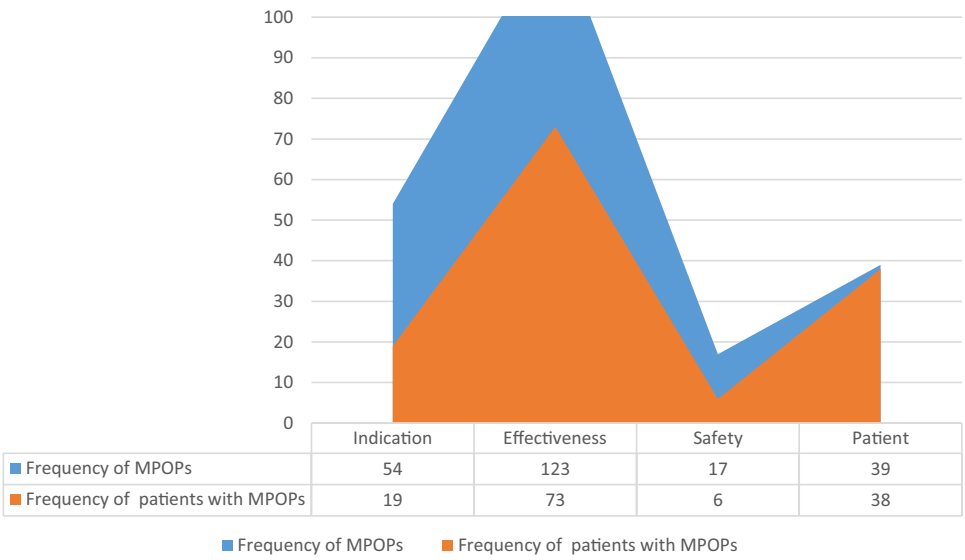

Figure 1 Distribution of Medical Problem-Oriented Plans (MPOPs) among study participants.

(18.03%) were associated with potential uncontrolled conditions, affecting 40 patients (50.00%). Additionally, within this category, the IIA1 subtype (involving the replacement of ineffective treatments) accounted for 1 MPOP (0.43%), the IIB2 subtype (involving the addition of new pharmacological treatments) accounted for 40 MPOPs (17.17%), and the IICa1 subtype (involving dose increases due to under-dosing) accounted for 42 MPOPs (18.03%). The IIEa1 subtype (involving additional monitoring tests or investigations) was identified in 1 MPOP (0.43%), and the IIEb3 subtype (involving gradual replacement of ineffective treatments) was noted in 39 MPOPs (16.74%).

Table 6 A List of the Medical Problems-Oriented Plan Identified in the Study Population (N = 80)

Variable	MPOP description	Frequency of MPOPs	Percent of MPOPs*	Frequency of patients with MPOPs	Percent of patients with MPOPs	Mean (SD)
Indication		54	23.18%	19	23.75%	0.675 (1.188)
IAb1	**I**: Indication **A**: Untreated condition **b**: Chronic disease **1**: Add non-pharmacological treatment	40	17.17%	22	27.50%	0.275 (0.449)
IAb2	**I**: Indication **A**: Untreated condition **b**: Chronic disease **1**: Add pharmacological treatment	14	6.01%	5	6.25%	0.063 (0.244)
Effectiveness		123	52.79%	73	91.25%	1.663 (1.396)
Actual uncontrolled condition		81	34.76%	66	82.50%	1.025 (0.595)
Potential uncontrolled condition		42	18.03%	40	50.00%	0.525 (0.551)
IIA1	**II**: Effectiveness **A**: Replace **1**: Add the new intervention with abrupt discontinuation of the previous one	1	0.43%	1	1.25%	0.013 (0.112)

(*Continued*)

Table 6 (Continued).

Variable	MPOP description	Frequency of MPOPs	Percent of MPOPs*	Frequency of patients with MPOPs	Percent of patients with MPOPs	Mean (SD)
IIB2	**II**: Effectiveness **B**: Add **2**: Newly add the pharmacological treatment	40	17.17%	38	47.50%	0.500 (0.528)
IICa1	**II**: Effectiveness **C**: Dosing **a**: Under-dose (low strength or concentration) 1. Increase the dose	42	18.03%	41	51.25%	0.525 (0.503)
IIEa1	**II**: Effectiveness **E**: Monitoring **a**: Need for additional monitoring test or investigation **1**: Perform the monitoring test or investigation	1	0.43%	1	1.25%	0.487 (0.528)
IIEb3	**II**: Effectiveness **E**: Monitoring **b**. A need for repeated / more frequent monitoring test or investigation **3**. Add pharmacological treatment (when / if)	39	16.74%	38	47.50%	0.013 (0.112)
Safety		17	7.30%	6	7.50%	0.087 (0.326)
Actual safety problems		7	3.00%	6	7.50%	0.087 (0.326)
Potential safety problems		10	4.29%	0	0.00%	0.000 (0.000)
IIIA1	**III**: Safety **A**: Replace **1**: Add the new intervention with abrupt discontinuation of the previous one	8	3.43%	4	5.00%	0.050 (0.219)
IIIB2	**III**: Safety **B**: Discontinue **2**: Gradually discontinue the problematic treatment	3	1.29%	1	1.25%	0.013 (0.112)
IIICf6	**III**: Safety **C**: Dosing **f**. Incorrect timing of administration (too early, too late - more than 60 minutes outside the correct interval, unknown, morning or evening, before or after meal) **6**. Change the timing of administration	3	1.29%	1	1.25%	0.013 (0.112)
IIIEa1	**III**: Safety **E**: Monitoring **a**: Need for additional monitoring test or investigation **1**: Perform the monitoring test or investigation	3	1.29%	1	1.25%	0.013 (0.112)
Patient		39	16.74%	38	47.50%	0.487 (0.503)

(*Continued*)

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Table 6 (Continued).

Variable	MPOP description	Frequency of MPOPs	Percent of MPOPs*	Frequency of patients with MPOPs	Percent of patients with MPOPs	Mean (SD)
IVAb1	**IV**: Patient **A**: Knowledge **b**: Non-pharmacological therapy **1**. Patient education	39	16.74%	38	47.50%	0.487 (0.503)
Miscellaneous		0	0.00%	0	0.00%	0.000 (0.000)

Note: *Percentage is within the total number of MPOPs (N = 233).

Safety-related MPOPs were identified in 17 instances, representing 7.30% of the total MPOPs. This category includes 7 actual safety problems (3.00%), affecting 6 patients (7.50%), and 10 potential safety problems (4.29%). The IIIA1 subtype (involving the abrupt discontinuation of problematic treatments) accounted for 8 MPOPs (3.43%), affecting 4 patients (5.00%), while the IIIB2 subtype (involving the gradual discontinuation of problematic treatments) accounted for 3 MPOPs (1.29%), affecting one patient (1.25%). The IIICf6 subtype (involving changes in the timing of medication administration due to incorrect timing) was identified in 3 MPOPs (1.29%), affecting one patient (1.25%). The IIIEa1 subtype (involving additional monitoring tests or investigations) accounted for 3 MPOPs (1.29%), affecting one patient (1.25%).

The Patient-related issues category included 39 MPOPs, making up 16.74% of the total MPOPs. All MPOPs in this category were related to the IVAb1 subtype, which involves non-pharmacological therapy and patient education. This subtype accounted for 39 MPOPs (16.74%), affecting 38 patients (47.50%).

The multiple regression analysis was performed to evaluate the predictors of No_MPOP (number of medical problem-oriented plans). The regression analysis results are summarized in Tables 7–9. The ANOVA results (Table 8) indicate that the regression model is statistically significant ($F = 2.291$, $p = 0.006$), suggesting that the predictors included in the model explain a significant portion of the variance in No_MPOP. As shown in Table 9, the regression coefficients indicate that HF (1) ($\beta = 4.931$, $p = 0.003$) was a significant predictor of No_MPOP. Other variables did not show significant contributions. The standardized residuals histogram and Q-Q plot.

Table 7 Model Summary and ANOVA Results for Multiple Regression Analysis

Model	R	R^2	Adjusted R^2	RMSE	Autocorrelation	Durbin-Watson	F	p
H_0	0.000	0.000	0.000	2.257	0.029	1.933	-	-
H_1	0.696	0.485	0.273	1.924	0.110	1.779	2.291	0.006

Notes: Adjusted R^2, Adjusted coefficient of determination; Autocorrelation, A measure of the correlation of a time series with its own past and future values; Durbin-Watson, A test statistic used to detect the presence of autocorrelation in the residuals from a regression analysis.
Abbreviations: F, F-statistic, a measure used in ANOVA; H_0, Null hypothesis; H_1, Alternative hypothesis; p, p-value, indicating the significance level; R, Correlation coefficient; R^2, Coefficient of determination; RMSE, Root Mean Square Error.

Table 8 ANOVA Results

Source	Sum of Squares	*df*	Mean Square	F	p
Regression	195.087	23	8.482	2.291	0.006
Residual	207.301	56	3.702		
Total	402.388	79			

Abbreviations: *df*, Degrees of freedom; F, F-statistic, a measure used in ANOVA; Mean Square, The average of the squared differences (Sum of Squares divided by *df*); p, p-value, indicating the significance level; Sum of Squares, The sum of the squared differences between each observation and the overall mean.

Table 9 Coefficients for Multiple Regression Analysis

Predictor	Unstandardized Coefficient	Standard Error	lStandardized Coefficient	t	p
(Intercept)	−12.244	5.911		−2.071	0.043
Age	0.024	0.038	0.077	0.629	0.532
No. of co-morbidities	−0.946	0.683	−0.225	−1.385	0.171
No of previous hospitalization	0.153	0.460	0.036	0.332	0.741
No. of anti-HTN	−0.177	0.848	−0.047	−0.208	0.836
SCr	3.630	2.014	0.400	1.803	0.077
LDL	0.024	0.043	0.243	0.558	0.579
Total chol	0.011	0.041	0.115	0.269	0.789
BMI	0.114	0.058	0.256	1.979	0.053
eGFR	0.021	0.019	0.245	1.070	0.289
Gender	0.198	0.476		0.417	0.678
CVD	0.241	0.735		0.328	0.744
HF	4.931	1.614		3.055	0.003
DM	−0.728	0.731		−0.995	0.324
CKD	1.611	1.098		1.467	0.148
DLP	0.233	0.901		0.259	0.797
Asthma	0.435	0.851		0.512	0.611
COPD	−0.038	0.837		−0.045	0.964
ACEI	−0.519	1.728		−0.301	0.765
ARB	−0.506	1.713		−0.296	0.769
Thiazide	−0.197	0.855		−0.230	0.819
DHP_CCB	0.002	0.895		0.002	0.998
Non_DHP_CCB	0.115	0.935		0.123	0.902
BB	0.265	0.913		0.290	0.773

Abbreviations: (Intercept), The constant term in the regression equation; ACEI, Angiotensin-Converting Enzyme Inhibitors; Age, The age of the participants; ARB, Angiotensin II Receptor Blockers; Asthma, A chronic respiratory condition; BB, Beta Blocker; BMI, Body Mass Index; CKD, Chronic Kidney Disease; COPD, Chronic Obstructive Pulmonary Disease; CVD, Cardiovascular Disease; DHP_CCB, Dihydropyridine Calcium Channel Blockers; DLP, Dyslipidemia; DM, Diabetes Mellitus; eGFR, Estimated Glomerular Filtration Rate; Gender, The gender of the participants; HF, Heart Failure; LDL, Low-Density Lipoprotein; No of previous hospitalization, The number of previous hospitalizations each participant has had; No. of anti-HTN, The number of antihypertensive medications each participant is taking; No. of co-morbidities, The number of comorbidities each participant has; Non_DHP_CCB, Non-Dihydropyridine Calcium Channel Blockers; p, p-value, indicating the significance level; SCr, Serum Creatinine; Standard Error, The standard deviation of the sampling distribution of a statistic; Standardized Coefficient, The coefficient that has been standardized to have a mean of zero and a standard deviation of one; t, t-statistic, used to test hypotheses about the coefficient; Thiazide, Thiazide diuretics; total chol, Total Cholesterol; Unstandardized Coefficient, The raw coefficient in the regression equation.

Discussion

Hypertension, or high blood pressure, is a critical global health issue and a major risk factor for cardiovascular diseases, impacting millions of adults worldwide and causing numerous premature deaths annually.[11] Effective management of hypertension requires understanding various socio-demographic, clinical, and treatment-related factors. Previous research

has highlighted the complexity of hypertension management, particularly in populations with high comorbidity rates and diverse socio-economic backgrounds.[12] In Iraq, the prevalence of hypertension has been rising over the past decade, creating significant challenges for the healthcare system and affecting the population's overall health.[6,13] Despite its widespread nature, comprehensive research and evidence-based guidelines specifically for the Iraqi adult population are lacking. Current studies mainly address epidemiological data and general management, but there is a pressing need for research focused on the effectiveness of medical care strategies for primary hypertension in Iraq. The Iraqi healthcare system struggles with limited access to specialized medical facilities, shortages of essential medications, inadequate health education, and inconsistent follow-up care,[3] all of which hinder effective hypertension management. This research aims to fill this knowledge gap by assessing and optimizing medical care strategies for primary hypertension in Iraqi adults through a problem-oriented plan,[9] providing valuable insights to healthcare policymakers and practitioners to enhance hypertension care and reduce the cardiovascular disease burden in Iraq.

This study investigated the socio-demographic and clinical characteristics of hypertensive patients, their treatment regimens, and their BP control status. The results indicated that only 10% of participants achieved controlled BP levels, with HF identified as a significant predictor of the number of medical problem-oriented plans (No_MPOP). Gender differences were also noted, with male patients showing more challenges in controlling BP, similar to a previous study.[14] Low medication adherence, inadequate patient education on lifestyle changes, and maybe delays in follow-up care or treatment intensification could all help to explain the significantly poor BP control noted in this study.[4,15] These problems may be reflections of systematic failures in clinical decision-making and patient involvement in primary care environments. Healthcare professionals should so apply organized hypertension control programs stressing patient education, frequent monitoring, and tailored therapy changes.[5] Policymakers should also take into account enhancing rules encouraging interdisciplinary approaches and motivating adherence to evidence-based procedures.

The study population was predominantly elderly, with varied educational backgrounds, chief complaints, and health statuses. The study identified predictors of the number of medical problem-oriented plans (No_MPOP) using multiple regression analysis, with HF being a significant predictor. The study also categorized medical problem-oriented plans into four main areas: Indication, Effectiveness, Safety, and Patient-related issues, according to Alsayed et. Al. classification method[8,9] provided a comprehensive overview of the frequency and percentage of each type of the MPOP.

The unexpectedly low rate of controlled BP (10%) among participants was notable, suggesting potential issues with treatment adherence, medication efficacy, or healthcare access. The findings align with studies by Ayalew et al (2015) and Al-Azzam et al (2016), which also reported significant challenges in managing chronic conditions among patients with multiple comorbidities and polypharmacy issues. These studies emphasized the need for effective, comprehensive, tailored treatment strategies to address these challenges.

A study conducted in Jordan aimed to identify DRPs in outpatients with chronic diseases. A sample of patients from five hospitals representing public, private, and military sectors were assessed for DRPs. The study found that out of 3112 patients, data were collected from 2898 patients, with a mean age of 56.59 years. The most common chronic diseases observed were hypertension, diabetes mellitus, and dyslipidemia. The research identified DRPs and categorized them into six main areas: indication, effectiveness, safety, knowledge, adherence, and miscellaneous. The authors concluded that implementing clinical pharmacy services is a recommended strategy for identifying and addressing DRPs in Jordanian health settings.[16]

A previous study found that the most common cardiovascular diseases encountered were hypertension, rheumatic heart disease, and functional heart failure and cor pulmonale.[17] A total of 164 DTPs were identified, with the mean number of DTPs being 1.69. Similar to our study, the presence of HF was significantly associated with DTPs, while the number of co-morbidities also had a significant association with the number of DTPs, unlike in our study. Similarly, the number of drugs did not show a significant association with the number of DTPs. The study identified seven basic categories of DTPs, including unnecessary drug therapy, need for additional drug therapy, need for additional drug product, too low dose, adverse drug reaction, too high dose, and patient compliance.[17] Non-compliance with medication regimens is also a notable issue, with nearly half of the patients exhibiting non-compliance primarily due to a lack of caution in medication use. The findings underscore the importance of effective medication management and the need for improved pharmaceutical care to enhance patient outcomes and minimize drug-related complications.

The most common TRPs were efficacy-related problems according to a previous Jordanian study.[7] The study found that the pharmacists' recommendations were accepted by physicians, leading to an increase in the number of patients receiving appropriate progression-modifying therapy and appropriate management of complications. It found an average of 5.31 TRPs per patient, with a high acceptance rate of pharmacist recommendations by physicians at 86%. The study concluded that clinical pharmacists substantially contributed to the care of hospitalized CKD patients through optimizing progression-modifying therapies, medication safety, and management of CKD complications.

Several factors can explain the low rate of BP control observed in this study. First, the high prevalence of comorbid conditions such as diabetes and cardiovascular diseases complicates hypertension management. Second, socio-economic factors, including educational background and health literacy, likely impact patients' ability to adhere to treatment regimens and make informed health decisions. Lastly, the gender differences in BP control may reflect underlying biological, behavioral, or social determinants of health.

While interpreting these results, caution is warranted due to the small sample size (N=80) and the specific population studied. These factors may limit the generalizability of the findings to broader populations. Additionally, self-reported data on medication adherence and lifestyle factors could introduce bias.

Based on the findings, we hypothesize that targeted interventions focusing on patient education, particularly among those with lower educational backgrounds and males, could improve BP control rates. Additionally, comprehensive management plans that address comorbid conditions and involve regular monitoring and follow-up may be more effective.[3–5]

The study highlights the need for healthcare providers to adopt a holistic approach to managing hypertensive patients. This includes prescribing medications and providing continuous education and support to help patients manage their condition effectively. Policymakers should also consider these factors when designing public health interventions to address hypertension and its associated comorbidities.

Future research should focus on larger, more diverse populations to validate these findings and explore the reasons for gender differences in BP control. Longitudinal studies are needed to assess the long-term impacts of different intervention strategies on hypertension management outcomes. Additionally, qualitative research could provide deeper insights into patients' experiences and challenges in managing hypertension. Moreover, the utilization of digital health tools, including mobile health applications and telemonitoring, is a novel approach with the potential to improve patient engagement and monitor treatment outcomes over time.[3–5]

This study has some limitations. The sample size is relatively small, and the participants were drawn from a specific population, which may not represent the general population. Relating self-reported data to certain variables, such as medication adherence, could introduce bias. Moreover, the cross-sectional design limits the ability to infer causal relationships between the variables studied. Although the sample size is relatively small, it accurately represents the patient population within this setting and provides meaningful insights relevant to this study objectives.

The novelty of our study is the assessment and classification of treatment-related problems among Iraqi hypertension patients using the validated MPOP framework—more especially, the Alsayed_v1 tool. To the best of our knowledge, this is the first study in Iraq to use such a methodical, evidence-based approach to hypertension control, providing customized treatments transcending conventional descriptive research. This structure makes it possible to evaluate clinically holistically for treatment appropriateness, safety, efficacy, and patient-related barriers.

Conclusion

This study underscores the complex interplay of socio-demographic, clinical, and treatment-related factors in hypertension management. The identification of heart failure as a significant predictor of treatment complexity and the gender differences in BP control provide important directions for tailored clinical interventions. Enhancing patient education, addressing comorbid conditions comprehensively, and considering socio-economic factors will improve hypertension management and patient outcomes. Future research should continue to explore these areas to develop more effective strategies for managing this prevalent chronic condition.

Additional studies should build on these results by testing intervention-based approaches that establish patient-centred treatment plans and follow-up protocols to enhance BP control. These observations may be verified in longitudinal and multicenter studies in heterogeneous populations of patients in Iraq and other countries. Moreover, qualitative studies

complement these quantitative findings by exploring in-depth the reasons for patient adherence behaviors, access to care, and barriers by gender. The effectiveness and cost-effectiveness of diverse care teams, including clinical pharmacists, in managing hypertension should also be assessed. Moreover, the utilization of digital health tools, including mobile health applications and telemonitoring, is a novel approach with the potential to improve patient engagement and monitor treatment outcomes over time.

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Author Contributions

The corresponding author supervised the research and was involved in all of the research steps. All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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