









Analysis of medication adherence of chronic hypertensive patients in Pakistani community via open survey method

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Abstract

Aim: Hypertension, a prevalent chronic condition, significantly contributes to cardiovascular diseases worldwide. Effective management of hypertension is highly dependent on patient adherence to prescribed medications, as the correct dose at the right time can lead to desirable therapeutic results. This study aims to analyze medication adherence among hypertensive patients in Islamabad and Rawalpindi through an open survey.

Methods: A prospective cross-sectional study was conducted from 17th March 2024 to 30th May 2024, targeting hypertensive populations in Islamabad and Rawalpindi. 246 patients were recruited using a sample size formula, and a General Medication Adherence Scale (GMAS) questionnaire was used to collect data. All the tests were conducted as two-sided, with a significance level of $P < 0.05$ using Python.

Results: Among 246 participants (mean age 57.1 years), most were married, literate, and living with families, 63% were from Islamabad, and 78.9% were employed. The study found high adherence in behavior-related areas but low adherence due to costs. Gender showed a statistically significant correlation ($P = 0.03$) by independent t -test. At the same time, ANOVA tests revealed that educational level ($P = 0.02$), monthly income ($P = 0.001$), family support ($P = 0.04$), and medication costs ($P = 0.001$) significantly impacted adherence, while factors like social status, employment status, and smoking did not have a considerable influence.

Conclusions: 72.4% of patients adhered to their prescribed therapy, and 27.6% did not highlight a critical issue that requires urgent intervention. Variables like gender, educational status, social status, occupation, and living with family are strongly associated with adherence. Common problems include taking multiple medications, lack of awareness about the importance of adherence, and financial constraints.

Keywords

Hypertension, medication adherence, Islamabad, open survey, GMAS



Introduction

Hypertension (HTN), another name for high blood pressure, is a frequent illness marked by elevated arterial pressure. According to the American Heart Association, HTN is diagnosed when a person's blood pressure is continuously 130/80 mmHg or above [1] (Table 1). Studies show chronic HTN's continuous strain on the artery walls causes atherosclerotic plaques, resulting in endothelial dysfunction and arterial hardness [2]. This pathological alteration decreases the blood flow and increases the risk of cardiovascular events like stroke and heart attacks together with microvascular (neuropathy, retinopathy, nephropathy) problems, which result in arterial damage and end-organ dysfunction [1].

Table 1. Categories and management of blood pressure [1]

Blood pressure category	Systolic and/or diastolic (mmHg)	Drug therapy
Normal	Less than 120 and less than 80	No antihypertensive drug indicated
Prehypertension	120–129 and less than 80	No antihypertensive drug indicated
HTN stage 1	130–139 or 80–89	Thiazide-type diuretics for most; may consider ACEI, ARB, BB, CCB, or combination
HTN stage 2	140 or higher or 90 or higher	Two-drug combination (usually thiazide-type diuretic and ACEI or ARB, BB, CCB)
Hypertensive crises	Higher than 180 and/or higher than 120	Antihypertensive drugs for compelling indications (diuretics, ACEI, ARB, BB, CCB) as needed

ACEI: angiotensin-converting enzyme inhibitor; ARB: angiotensin-receptor blocker; BB: beta blocker; CCB: calcium channel blocker; HTN: hypertension

Ensuring patients' adherence to treatment regimens is essential for achieving optimum health outcomes and lowering healthcare expenses associated with preventable complications because some disorders cannot be fully cured and require long-term maintenance [3]. Different factors and elements may influence the prevalence rates of hypertensive disorders in Pakistan, which may be gender, age, or social and economic status, which covers the public from 25 to 30% of the whole population of Pakistan, which is an alarming number. These numbers require significant and substantial steps and initiatives in modifications of health policies to deal with this deadly disease, which affects both men and women [4]. For patients in which HTN is not controlled, medications in combination are used at a high rate or who are at greater risk of heart disorders [5] as illustrated in Table 1.

Patients are educated by physicians, pharmacists, and other experts on the importance of dietary changes, adherence activities, and medication regulation. Face-to-face encounters focus on maximizing health outcomes [6]. Adherence activities are crucial for managing HTN, including following medical advice for regulating HTN [7, 8]. The General Medication Adherence Scale (GMAS) questionnaire helps assess if patients stick to their medication plans, ensuring they stay on track. The GMAS, developed by Naqvi et al. [9], evaluates various aspects of medication adherence, with each part receiving a score contributing to an overall score. Emphasizing these points was intended to aid in good awareness of adherence to drugs and patient behavior in the country's capital for maximizing adherence percentages and good results in areas. So, it aimed to comprehensively evaluate medication adherence among patients using the GMAS questionnaire among hypertensive patients of Islamabad and Rawalpindi, Pakistan, and identify factors influencing medication adherence.

Materials and methods

Methodology

A prospective cross-sectional study was conducted from 17th March 2024 to 30th May 2024, targeting hypertensive populations in Islamabad and Rawalpindi. The study focused on the open community by selecting various neighborhoods within the cities of Islamabad and Rawalpindi. Patients with chronic HTN were identified in these communities, regardless of their affiliation with specific healthcare facilities, and were administered the GMAS questionnaire to assess their adherence to HTN therapy.

Inclusion and exclusion criteria

Adult patients (age 18 years and older) who were diagnosed with HTN (> 3 months), taking antihypertensive drugs, and fluent in Urdu and English were included in the current study. Because it was difficult to distinguish between patients who could handle their own medicine and those who needed assistance, patients with severe physical limitations were excluded. Exclusion was also done on hospitalized patients whose prescription regimens were managed by hospital staff nurses.

Sample size and sampling

The sample size calculation assumed a 95% confidence level and a 5% margin of error to estimate the necessary sample size for the primary investigation. The “sample size formula” used to determine the sample size is:

$$N = t^2 \times \frac{p(1-p)}{m^2}$$

where p is the estimated cut-off point of antihypertensive medication adherence for obtaining optimum blood pressure management, which is 80%, N is the required sample size, t is the confidence level at 95% (standard value of 1.96), and m is the margin of error at 5% (standard value of 0.05).

$$\begin{aligned} N &= 1.96^2 \times \frac{0.80 \times (1 - 0.80)}{0.05^2} \\ &= 3.8416 \times \frac{0.16}{0.0025} \\ &= \frac{0.6146}{0.0025} \\ &= 245.8 \\ &\approx 246 \end{aligned}$$

So, 246 participants were recruited using a sample size formula with a sampling method that was convenience-based, focusing on individuals within the community who met the inclusion criteria.

Data collection tool

For this study, the validated GMAS questionnaire was used. The research team, comprising six members divided into three teams of two, conducted surveys in various communities in Islamabad and Rawalpindi and filled the questionnaire by asking questions. They assessed participants' perceived knowledge about antihypertensive medications and adherence to regimens across the following three sections with eleven items.

GMAS-1: Five questions evaluated perceived knowledge about “Drug Abuse Due to Patient Behavior (Intentional or Unintentional)”. Questions included:

- Do you find it challenging to remember to take your medication regularly?
- Have you ever forgotten to take your medication due to busyness (e.g., household chores, travel, social engagements)?
- Do you stop taking medication when you feel better?
- Do you stop due to adverse side effects (e.g., stomach acidity, digestive disturbances)?
- Do you stop medication without informing the doctor?

GMAS-2: Four questions measured perceived knowledge about the “Burden of Multiple Diseases or Excessive Medications”. Questions included:

- Do you stop taking your medication for this illness because of other medicines?
- Do you find remembering difficult due to regimen complexity (e.g., timing, dosage)?
- Have you forgotten medication due to condition deterioration or additional medicines?

- Do you modify dosage or usage without consulting the doctor?

GMAS-3: Two questions addressed “Financial Constraints as a Cause of Non-Adherence”. Questions included:

- Do you refrain from buying medications because they are expensive?
- Do you stop using medication because they are not cost-effective?

Participants answered using a four-point Likert scale: “Always-0”, “Mostly-1”, “Sometimes-2”, and “Never-3”. Responses were then interpreted using an adherence scoring mechanism, with each question scored from 0 to 3. The total score ranges from 0–33, a higher score indicating a high adherence level. The final score was stratified into five groups: high (30–33), good (27–29), partial (17–26), low (11–16), and poor (≤ 10).

Ethical consideration

The research was deemed low risk and, as such, was reviewed and approved by the Institutional Ethical Review Board and Bio-Ethical Committee (BEC) of Quaid-i-Azam University, Islamabad, with protocol approval number PHM/2023-224. All patients gave written informed consent to participate in the study.

Data analysis

Filled questionnaires were analyzed using Python 3.9.20. First, data was cleaned using different cleaning libraries, and some missing data was removed. Then, the required features or columns in the dataset were added to satisfy the needs of the analytical approach. Descriptive statistics (mean, standard deviation, and percentages) accounted for demographic data, and appropriate statistical tests were used to compare these variables across different independent variables, involving ANOVA for continuous and normally distributed data and independent sample *t*-test for dependent variables, respectively.

Results

The sociodemographic and clinical features of 246 participants with an average age of 57.1 years are presented in [Table 2](#). The gender distribution was nearly equal, with 47.6% males and 52.4% females. A significant proportion of participants were married (82.1%), a lower proportion (9.3%) was widowed, 7.3% were divorced, and only 1.2% were single. Most participants (93.9%) live with their families, and 63% of participants were from Islamabad, while the remaining were from Rawalpindi. 6.9% of participants were illiterate, while 65.4% held a university degree, 78.9% of the participants were actively employed, and regarding monthly income, 53.3% of participants earned between 30,001 and 40,000 PKR each month. Regarding smoking status, 12.6% were previous smokers, 21.1% were current smokers, and 66.3% didn't smoke. 61.4% of participants take medicines with a doctor's prescription, 9.3% without a doctor's prescription, and 29.3% take both. Regarding HTN treatment, 41.9% of participants began medication 2 to less than five years ago, while 58.1% had been on it for five years or more. Overall, patients in our cohort took 7.5 (2.5) medications daily, including anti-hypertensive and other medicines that may interfere with adherence to antihypertensives.

[Table 3](#) shows adherence levels across different domains. Patient behavior-related non-adherence had an adherence score of 11.2 ± 1.3 , indicating high adherence. Similarly, additional disease and pill burden (ADPB) had a score of 12.2 ± 1.5 , showing high adherence. However, cost-related non-adherence (CRNA) scored 3.25 ± 1.0 , showing partial adherence. The total score of GMAS-11 was 26.5 ± 2.1 , indicating partial to good adherence.

Based on the value of the adherence count summed of every response, the outcome is given to each response, either “Adherent” or “Non-Adherent”. [Figure 1](#) shows the percentage of patients who are adherent or non-adherent to their hypertensive drug treatment. 72.4% of respondents were 80% adherent, and 27.6% of patients/respondents were not 80% adherent/non-adherent.

Table 2. Participants' sociodemographic and clinical characteristics (N = 246)

Characteristic	Categories	M (SD)	N (%)
Age	-	57.1 (8.4)	-
Gender	Female	-	129 (52.4)
	Male	-	117 (47.6)
Social status	Single	-	3 (1.2)
	Married	-	202 (82.1)
	Widowed	-	23 (9.3)
	Divorced	-	18 (7.3)
	With family	-	231 (93.9)
Living status	Alone	-	15 (6.1)
	Islamabad	-	155 (63.0)
Living area	Rawalpindi	-	91 (37.0)
	Illiterate	-	17 (6.9)
Educational level	Primary education	-	14 (5.7)
	Secondary education	-	31 (12.6)
	Post-secondary education	-	23 (9.3)
	University education or higher	-	161 (65.4)
	Currently working	Yes	-
Monthly income	No	-	52 (21.1)
	Less than 20,000 PKR	-	13 (5.3)
Smoker	20,001–30,000 PKR	-	86 (34.9)
	30,001–40,000 PKR	-	131 (53.3)
	More than 40,000 PKR	-	16 (6.5)
	Yes	-	52 (21.1)
Total number of medications taken/day	No	-	163 (66.3)
	Previously	-	31 (12.6)
	-	7.5 (2.5)	-
Frequency of all medications/day	-	2.6 (1.5)	-
All medications are taken by	Prescription	-	151 (61.4)
	Without a doctor's prescription	-	23 (9.3)
	Both	-	72 (29.3)
When did you start taking treatment for hypertension	2- less than 5 years	-	103 (41.9)
	5 years or more	-	143 (58.1)
Who is providing your medication	By myself	-	173 (70.3)
	A family member/caregiver	-	29 (11.8)
	Both	-	44 (17.9)
Cost of your medication	Considered expensive	-	183 (74.4)
	Considered cheap	-	38 (15.4)
	Other	-	25 (10.2)

M: mean; N: number; SD: standard deviation; -: not applicable

Table 3. GMAS-11 constructs scores

Domain	Score (M ± SD)	Level of adherence
Patient behavior-related non-adherence	11.2 ± 1.3	High adherence
Additional disease and pill burden	12.2 ± 1.5	High adherence
Cost-related non-adherence	3.25 ± 1.0	Partial adherence
Total overall score	26.5 ± 2.1	Partial-good adherence

GMAS: General Medication Adherence Scale; M: mean; SD: standard deviation

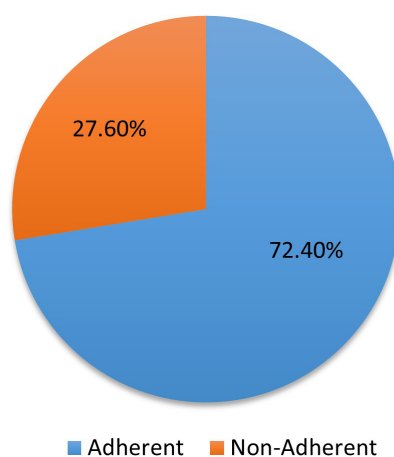


Figure 1. Outcome distribution of hypertensive drug treatment

An independent sample *t*-test was used to investigate the study respondents' significant statistical variations in drug adherence (Table 4). The test revealed significant differences in medication adherence among females (30.51 ± 3.29) along males (29.24 ± 2.41) ($t = 1.629, P = 0.03$). Moreover, the results showed no significant statistical differences in adherence to medications between patients living with family or those living alone in Islamabad or Rawalpindi.

Table 4. Independent samples *t*-test for the differences in medication adherence

Variable	Categories	N	Mean	SD	<i>t</i> -value	<i>P</i> -value
Gender	Female	129	30.51	3.29	1.629	0.03*
	Male	117	29.24	2.41		
Living situation	With a family	231	21.78	2.14	0.189	0.53
	Alone	15	29.56	4.72		
Living area	Islamabad	155	29.35	3.29	-0.201	0.61
	Rawalpindi	91	20.10	3.43		
Currently working	Yes	194	31.51	2.37	2.51	0.35
	No	52	29.44	3.21		

* *P*-value significant level < 0.05. *N*: number; *SD*: standard deviation

A one-way ANOVA was conducted to determine the influence of independent variables (social status, monthly income, educational level, using medications with or without prescription, smoking status, year of starting hypertensive, who was providing medications, and cost). The study found substantial variations in medication adherence based on characteristics such as monthly income and educational level ($P < 0.05$). There were additionally significant statistical variations in prescription adherence, referring to the availability ($P = 0.04$) along with the price ($P = 0.001$) of medication. However, the results showed no significant statistical differences in medication adherence, referring to variables such as social status ($P = 0.141$), smoking ($P = 0.12$), and using medications with or without prescriptions ($P = 0.54$) as explained in Table 5.

Discussion

Non-adherence is one of the most considerable challenges that clinicians confront when managing HTN. Unfortunately, due to time restrictions, clinicians do not discuss medication adherence with their patients [10]. HTN is a chronic condition that is a risk factor for several complications, such as chronic kidney disease, stroke, and ischemic heart disease. Hence, the aim was to evaluate the medication adherence and the factors impacting the medication adherence of HTN patients in Islamabad and Rawalpindi.

Prior research indicates that measuring adherence and patient compliance is complex and primarily relies on patients [3, 11]. We found that 72.4% of participants adhered to antihypertensive medications, while the rest did not. These findings are fewer compared to the results of earlier studies that used various

Table 5. Differences in hypertensive medication adherence by one-way ANOVA

Variable	Sum of squares	df	Mean square	F-value	P-value
Social status	Between groups	3	17.035	1.671	0.141
	Within groups	242	9.653		
Educational level	Between groups	4	14.542	1.06	0.02*
	Within groups	241	9.659		
Monthly income	Between groups	3	9.914	1.42	0.001*
	Within groups	242	9.703		
Smoking	Between groups	2	14.603	1.35	0.12
	Within groups	243	9.670		
Using medications with/without prescriptions	Between groups	2	2.346	0.314	0.54
	Within groups	243	9.740		
Who is providing the medication	Between groups	2	68.939	5.17	0.04*
	Within groups	243	9.422		
Cost of medication	Between groups	2	49.759	3.30	0.001*
	Within groups	243	9.514		

* P-value significant level < 0.05

adherence to medication methods for assessment [12]. Gender showed a statistically significant link ($P = 0.03$), however, the results of other research studies often contradict each other on the impact of gender on the rate of drug adherence. According to some researchers, female patients exhibit a higher level of adherence [13]. At the same time, other studies failed to find a relationship between gender and medication adherence [14].

In the study group, the income level was significantly correlated ($P = 0.001$), however, inconsistent results were observed and, thus, were mostly uncertain [14, 15]. The socioeconomic status of research respondents and their household members, as well as the extent of their insurance coverage, might impact the cost of medical services and compliance with medications. This conclusion can result from the fact that even at government hospitals, patients must pay for their prescription drugs. This was further supported by a noteworthy link ($P = 0.001$) found in this study between the level of adherence and medication cost consideration.

Education level may favor drug adherence by assisting patients in comprehending the nature of their illness and the significance of treatment. This aligns with prior research demonstrating a favorable relationship between educational status and degree of adherence [11, 13].

Family support is beneficial in treatment and medication adherence [16]. Patients in this study were asked if they took their prescriptions independently or with help from family members. The findings indicate a strong relationship ($P = 0.04$) between the degree of adherence and family help in giving medicine. Comparable results were also observed in other investigations [12, 17]. Large-scale prospective studies, including additional cities and rural areas, would provide a more comprehensive view of medication adherence across different regions and populations and determine the causal association between medication adherence among HTN patients and social support.

Conclusions

In conclusion, the study on medication adherence among hypertensive patients in Islamabad and Rawalpindi, Pakistan, reveals significant non-adherence challenges. While 72.4% of patients adhered to their prescribed therapy, 27.6% did not highlight a critical issue that requires urgent intervention. Variables like gender, educational status, social status, occupation, and living with family are strongly associated with adherence. Common problems include taking multiple medications, lack of awareness about the importance of adherence, and financial constraints. The study highlights the crucial role of healthcare professionals in improving adherence through education, motivation, and support. Addressing these issues through enhanced training for healthcare providers and patient education initiatives is essential for improving treatment outcomes and managing HTN effectively in Pakistan.

Limitations of study

While several variables were analyzed, other potentially influential factors such as comorbidities, psychological factors, or healthcare access were not included, which could limit the comprehensiveness of the findings. Also, every effort was made to minimize bias in the survey design and data collection; potential sources of bias could include the convenience-based sampling method, which may limit the generalizability of the findings to a broader population. Another limitation of our study is the inevitable selection bias of patients; probably, the most considerable prevalence of non-adherence exists among patients unwilling to participate in clinical studies.

Abbreviations

GMAS: General Medication Adherence Scale

HTN: hypertension

Declarations

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The authors acknowledge all patients who had consented to participate in this project.

Author contributions

SA and SK: Conceptualization, Supervision, Writing—review & editing. MN: Formal analysis, Investigation, Writing—original draft. AJM, MSA, and UR: Investigation, Writing—original draft. EA: Conceptualization, Methodology, Writing—original draft. AS: Conceptualization, Visualization, Writing—review & editing. All authors read and approved the submitted version.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical approval

The research was deemed low-risk, reviewed, and approved by the Institutional Ethical Review Board of Quaid-i-Azam University, Islamabad, with protocol approval number PHM/2023-224.

Consent to participate

Informed consent to participate in the study was obtained from all participants.

Consent to publication

Informed consent to publication was obtained from relevant participants.

Availability of data and materials

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

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References

1. Whelton PK, Carey RM, Aronow WS, Casey DE Jr, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2018;71:e127–248. [DOI] [PubMed]
2. Xu J, Branscheidt M, Schambra H, Steiner L, Widmer M, Diedrichsen J, et al.; SMARTS Study Group. Rethinking interhemispheric imbalance as a target for stroke neurorehabilitation. *Ann Neurol*. 2019; 85:502–13. [DOI] [PubMed] [PMC]
3. Ferreira PD Jr, Simoes JA Sr, Velho DC Sr. Adherence to Antihypertensive Therapy and Its Determinants: A Systematic Review. *Cureus*. 2024;16:e59532. [DOI] [PubMed] [PMC]
4. Jafar TH, Jehan I, De Silva HA, Naheed A, Gandhi M, Assam P, et al. Multicomponent intervention versus usual care for management of hypertension in rural Bangladesh, Pakistan and Sri Lanka: study protocol for a cluster randomized controlled trial. *Trials*. 2017;18:272. [DOI] [PubMed] [PMC]
5. Hussain M, Awan FR, Gujjar A, Hafeez S, Islam M. A case control association study of *ACE* gene polymorphism (I/D) with hypertension in Punjabi population from Faisalabad, Pakistan. *Clin Exp Hypertens*. 2018;40:186–91. [DOI] [PubMed]
6. Machaalani M, Seifeddine H, Ali A, Bitar H, Briman O, Chahine MN. Knowledge, Attitude, and Practice Toward Hypertension Among Hypertensive Patients Residing in Lebanon. *Vasc Health Risk Manag*. 2022;18:541–53. [DOI] [PubMed] [PMC]
7. Hugtenburg JG, Timmers L, Elders PJ, Vervloet M, van Dijk L. Definitions, variants, and causes of nonadherence with medication: a challenge for tailored interventions. *Patient Prefer Adherence*. 2013;7:675–82. [DOI] [PubMed] [PMC]
8. Vrijens B, De Geest S, Hughes DA, Przemyslaw K, Demonceau J, Ruppert T, et al. A new taxonomy for describing and defining adherence to medications. *Br J Clin Pharmacol*. 2012;73:691–705. [DOI] [PubMed] [PMC]
9. Naqvi AA, Hassali MA, Rizvi M, Zehra A, Iffat W, Haseeb A, et al. Development and validation of a novel General Medication Adherence Scale (GMAS) for chronic illness patients in Pakistan. *Front Pharmacol*. 2018;9:1124. [DOI] [PubMed] [PMC]
10. Piña IL, Di Palo KE, Brown MT, Choudhry NK, Cvengros J, Whalen D, et al. Medication adherence: Importance, issues and policy: A policy statement from the American Heart Association. *Prog Cardiovasc Dis*. 2021;64:111–20. [DOI] [PubMed]
11. Alhabib MY, Alhazmi TS, Alsaad SM, AlQahtani AS, Alnafisah AA. Medication Adherence Among Geriatric Patients with Chronic Diseases in Riyadh, Saudi Arabia. *Patient Prefer Adherence*. 2022;16: 2021–30. [DOI] [PubMed] [PMC]
12. Shruthi R, Jyothi R, Pundarikaksha HP, Nagesh GN, Tushar TJ. A Study of Medication Compliance in Geriatric Patients with Chronic Illnesses at a Tertiary Care Hospital. *J Clin Diagn Res*. 2016;10:FC40–3. [DOI] [PubMed] [PMC]
13. Mahmood S, Jalal Z, Hadi MA, Orooj H, Shah KU. Non-Adherence to Prescribed Antihypertensives in Primary, Secondary and Tertiary Healthcare Settings in Islamabad, Pakistan: A Cross-Sectional Study. *Patient Prefer Adherence*. 2020;14:73–85. [DOI] [PubMed] [PMC]
14. Gast A, Mathes T. Medication adherence influencing factors—an (updated) overview of systematic reviews. *Syst Rev*. 2019;8:112. [DOI] [PubMed] [PMC]
15. Bergland OU, Halvorsen LV, Søråas CL, Hjørnholm U, Kjær VN, Rognstad S, et al. Detection of Nonadherence to Antihypertensive Treatment by Measurements of Serum Drug Concentrations. *Hypertension*. 2021;78:617–28. [DOI] [PubMed]

16. Chin SS, Lau SW, Lim PL, Wong CM, Ujang N. Medication adherence, its associated factors and implication on glycaemic control in patients with type 2 diabetes mellitus: A cross-sectional study in a Malaysian primary care clinic. *Malays Fam Physician*. 2023;18:14. [DOI] [PubMed] [PMC]
17. Saha SK, Adhikary A, Jha A, Mehta VK. Use of Interventions to Overcome Medication Non-Adherence. *International Journal of Asian Business and Information Management*. IJABIM. 2021;12:289–318. [DOI]