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PHARMACIST-PROVIDED SELF-MONITORING TOOLS AND TRAINING: A PATHWAY TO BETTER BLOOD PRESSURE CONTROL AND SELF-MANAGEMENT IN DIABETIC PATIENTS- A PROSPECTIVE STUDY FROM GANDHINAGAR, GUJARAT

Chintankumar Patel[1]*, Sandipkumar Bhatt[2], Akash P. Patel[3], Vishal Patel[4]

[1]*Research Scholar, Kadi Sarva Vishwavidyalaya, Gandhinagar, Gujarat, India
[2]Professor and Head, Department of Pharmacology & Pharmacy Practice, K. B. Institute of Pharmaceutical Education and Research (A constituent college of Kadi Sarva Vishwavidyalaya), Gandhinagar, Gujarat, India
[3]Consultant Physician & Diabetologist, Life Care Clinic, Raysan, Gandhinagar, Gujarat, India & Civil Hospital, Ahmedabad, Gujarat, India
[4]Director & Chief Consultant, NIVIDH Hospital, A unit of NIVIDH Healthcare LLP, Chandkheda-382424, Ahmedabad, Gujarat, India
Corresponding Author: Chintankumar Patel, chintan311@gmail.com

ABSTRACT

Background: Self-monitoring of blood pressure (BP) and blood glucose is essential for effective diabetes and hypertension management. However, patient engagement in self-monitoring practices remains suboptimal. This study evaluates the impact of pharmacist-provided self-monitoring tools, educational guides, and structured documentation on patient engagement and its association with BP control among diabetic patients with uncontrolled hypertension.

Objective: To assess the impact of pharmacist-provided self-monitoring tools on device utilization, correct technique, documentation completion, and progression from family-dependent to independent self-monitoring, and to evaluate the association between self-monitoring engagement and BP control.

Methods: This prospective interventional study enrolled 105 diabetic patients with uncontrolled hypertension (BP ≥130/80 mmHg) at two tertiary care hospitals in Gujarat, India. Patients were followed at baseline, 8, 16, and 24 weeks. The pharmacist intervention included educational brochures, guided self-monitoring instructions, structured documentation logs (BP/blood sugar/insulin), hands-on training, and progressive independence training. Primary outcomes were device utilization, correct technique, documentation completion, and self-monitoring independence.

Results: At 24 weeks, BP self-monitoring increased from 18.1% to 45.7% ($p<0.001$), blood glucose self-monitoring from 21.0% to 49.5% ($p<0.001$), correct BP technique from 11.4% to 52.4% ($p<0.001$), and correct blood glucose technique from 13.3% to 55.2% ($p<0.001$). Documentation completion was 48.6% for BP logs, 52.4% for blood sugar logs, and 65.1% for insulin logs. Independence in self-monitoring increased from 26.7% to 72.4% ($p<0.001$), while family dependency decreased from 17.1% to 8.6% ($p<0.05$). Mean SBP reduced from 143.0±7.4 to 138.2±9.8 mmHg ($p<0.001$), mean DBP from 92.0±6.3 to 85.1±6.8 mmHg ($p<0.001$), and 52.4% achieved target BP (<130/80 mmHg). Independent self-monitors achieved significantly lower SBP (135.2±8.0 vs. 140.8±10.5 mmHg, $p<0.01$) and higher target achievement (64.5% vs. 20.7%, $p<0.001$).

Conclusion: Pharmacist-provided self-monitoring tools and progressive training significantly enhance self-monitoring engagement, successfully transition patients from family-dependent to independent monitoring, and are positively associated with improved BP control. This practical, scalable model offers an effective approach to empowering patients in chronic disease self-management.

KEYWORDS: Self-monitoring, blood pressure, diabetes mellitus, pharmacist intervention, patient education, self-management tools, patient independence

1. INTRODUCTION

1.1 Background

Hypertension and diabetes mellitus represent a significant global health burden, with both conditions frequently coexisting and synergistically increasing cardiovascular risk. The World Health Organization reports that one in three adults globally has raised blood pressure, contributing to approximately half of all deaths from stroke and heart disease, while one in ten adults has diabetes.[1] The combination of diabetes and hypertension markedly increases the risk of premature cardiovascular disease, with hypertension being a stronger risk factor for macrovascular events in diabetic patients than glucose control alone.[2] Elevations in blood pressure can worsen outcomes in patients with type 2 diabetes, with the coexistence of both diseases correlating with a 6-fold increase in cardiovascular events.[3,4]

Despite established treatment guidelines recommending a blood pressure target of <130/80 mmHg for patients with diabetes, blood pressure control remains suboptimal, with fewer than 12% of patients achieving this target. [2] Contributing factors include inadequate patient education, poor medication adherence, limited self-monitoring practices, and insufficient healthcare provider time for comprehensive chronic disease management. Globally, fewer than half of patients with type 2 diabetes achieve the target HbA1c level of <7.0%, reflecting fragmented healthcare systems and lack of coordinated care.[5,6]

1.2 Self-Monitoring: Current Real-World Scenario

Self-monitoring of blood pressure (BP) and blood glucose is recognized as an essential component of effective chronic disease self-management. Regular self-monitoring enables patients to track their response to therapy, identify patterns, make informed decisions about lifestyle modifications, and share accurate data with healthcare providers.[7,8] Self-monitoring of blood pressure in hypertension and blood glucose in diabetes has been shown to improve clinical outcomes when accompanied by additional support such as education, counseling, or feedback.[9,10]

Despite these benefits, patient engagement in self-monitoring remains suboptimal in real-world clinical settings. Even in developed countries with better healthcare access, self-monitoring rates range from 20-40%.[11] In resource-limited settings like India, rates are considerably lower. Studies from Indian healthcare settings have reported that only 15-25% of hypertensive patients regularly monitor their BP at home.[12,13] Research from rural southern India indicates that while 70% of patients adhere to medication and testing, only 29% follow dietary recommendations, highlighting significant gaps in comprehensive self-management.[14]

Common barriers include:

- Lack of education on correct monitoring technique
- Insufficient training on device operation
- Absence of structured monitoring protocols
- Forgetting to monitor regularly
- Lack of understanding of the importance of self-monitoring
- Financial constraints in purchasing monitoring devices
- Family dependency: In many Indian households, patients rely on family members (particularly spouses or adult children) to perform monitoring and record readings, which can lead to inconsistent monitoring and lack of patient autonomy

1.3 The Challenge of Family Dependency in Self-Monitoring

In Indian and other South Asian healthcare contexts, family members often play a central role in healthcare management.[15] While family support can be beneficial, excessive dependency on family members for self-monitoring presents several challenges:

- Monitoring may be inconsistent or forgotten if the family member is unavailable
- Patients may not develop the skills and confidence to monitor independently
- Readings may not be recorded accurately
- Patients may feel disempowered and less engaged in their own care
- Privacy and autonomy may be compromised

Qualitative studies from India have shown that lack of family knowledge regarding dietary planning, exercise routines, and foot care can force patients into a state of delegated passivity.[15] Family involvement is sometimes perceived as controlling rather than supportive, leading to emotional friction and treatment non-adherence.[15,16] Promoting patient independence in self-monitoring-while maintaining appropriate family support-is therefore an important goal of self-management interventions.

1.4 Role of Pharmacists in Promoting Self-Monitoring and Independence

Clinical pharmacists possess unique expertise in patient education, medication management, and behavior modification strategies that can address barriers to self-monitoring.[17] Pharmacist-led interventions have demonstrated significant improvements in chronic disease management through comprehensive patient education, training on correct self-monitoring techniques, provision of structured self-monitoring tools and protocols, and reinforcement of lifestyle modifications.[18]

A systematic review and meta-analysis of pharmacist interventions in hypertension management found that pharmacist-led interventions significantly reduced both systolic and diastolic blood pressure.[19] Specifically, pharmacist involvement in collaborative care models has been associated with clinically meaningful improvements in blood pressure control among patients with diabetes.[20,21] Recent data from pharmacist-led population health interventions demonstrate average reductions of 15.3 mmHg in systolic BP and 8.9 mmHg in diastolic BP, with 5 encounters per patient on average.[22] Pharmacist-led diabetes self-management education programs have similarly demonstrated significant improvements in glycemic control, diabetes knowledge, and self-management behaviors.[23]

1.5 Rationale and Objectives

While previous studies have demonstrated the benefits of pharmacist involvement in chronic disease management, limited research has specifically examined:

- The progressive impact of pharmacist-provided self-monitoring tools and educational guides on patient engagement over time
- The transition from family-dependent to independent self-monitoring
- The association between independent self-monitoring and clinical outcomes

This study was therefore designed to evaluate:

- The progressive impact of pharmacist-provided self-monitoring tools, educational guides, and training on patient engagement in self-monitoring practices over 24 weeks (device utilization, correct technique, timely implementation)
- The transition from family-dependent to independent self-monitoring
- The association between self-monitoring engagement (particularly independence) and improvements in BP and blood glucose control

2. MATERIAL & METHODS

2.1 Study Design

This was a prospective, interventional, single-arm study conducted over 24 weeks. All enrolled patients received the pharmacist-led intervention focusing on self-monitoring tools and education.

2.2 Study Site(s)

The study was carried out at Life Care Clinic, Raysan, Gandhinagar, Gujarat, India, under the supervision of a consultant diabetologist.

The study duration for each participant was approximately 24 weeks. Participants underwent baseline assessment followed by scheduled follow-up assessments at approximately 8 weeks ±2 days, 16 weeks ±2 days, and 24 weeks ±2 days.

2.3 Study Population & Eligibility criteria

The study enrolled adults over 18 years of age with established diabetes mellitus who had been receiving insulin or oral hypoglycaemic agents for a minimum of three months and presented with uncontrolled blood pressure.

Diabetes diagnosis was confirmed through documented prescription of insulin or oral hypoglycaemic medications and/or laboratory findings such as HbA1c, fasting plasma glucose, postprandial glucose, or random blood glucose measurements. Uncontrolled hypertension was defined as blood pressure readings consistently above the target of <130/80 mmHg in patients with coexisting diabetes.

Eligibility criteria

Inclusion Criteria:

- Patients with known case of Diabetes Mellitus (Type 1 or Type 2)
- Age >18 years
- On antidiabetic medication (insulin or oral hypoglycemic agents) for at least 3 months
- Uncontrolled hypertension (BP ≥130/80 mmHg) without target organ damage
- Willing to provide informed consent

Exclusion Criteria:

- Presence of hypertension-related target organ damage (stroke, retinopathy, LVH, CKD, PAD)
- Hypertensive crisis
- Corticosteroid-induced hyperglycemia or gestational diabetes
- Enrollment in other diabetes or hypertension trials
- Refusal to provide consent or attend follow-up visits
- Visual or physical impairment preventing self-monitoring

2.4 Sample Size

A total of 105 patients were enrolled in this interventional study. Sample size was determined based on the study timeframe (24 weeks) and to detect a clinically meaningful improvement in self-monitoring practices (estimated 20-25% improvement) with 80% power and 95% confidence interval.

2.5 Study Procedure

The study duration was 24 weeks with four scheduled visits:

- Visit 1 (Baseline): Day 0
- Visit 2: 8 weeks ± 2 days
- Visit 3: 16 weeks ± 2 days
- Visit 4: 24 weeks ± 2 days

BP Measurement Protocol:
BP was measured using a standardized protocol adapted from American Heart Association guidelines[24]:
- Patients rested for 5 minutes in a seated position with back supported
- Properly sized cuff was used (bladder width at least 40% of arm circumference)
- Three readings were taken at 1-minute intervals
- Average of three readings was recorded; if readings varied by >5 mmHg, a fourth reading was taken
- Measurements were rounded to the nearest 2 mmHg

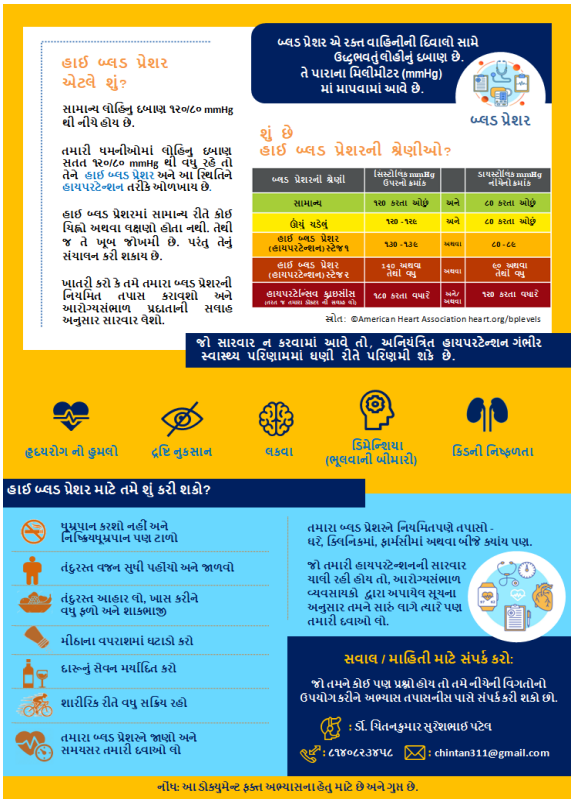
2.6 Pharmacist-Led Intervention: Self-Monitoring Tools and Training
All 105 patients received the comprehensive pharmacist-led intervention focused on self-monitoring tools and education:
2.6.1 Educational Brochures and Guides Provided: (Figure 1a & 1b, Figure 2a & 2b)
1. Hypertension and Diabetes Brochure (English and Gujarati): Disease overview, importance of treatment and monitoring, target BP and blood glucose goals, lifestyle modifications, self-monitoring guidelines
2. Guides for Self-Monitoring (provided as separate brochures/handouts):
- Guide for Self-Monitoring of Blood Pressure (with step-by-step instructions)
- Guide for Self-Monitoring of Blood Glucose (with step-by-step instructions)
- Guide for Self-Monitoring of Food Intake, Weight, Activity, Sleep, Stress, Nutrition, Pain, and Anxiety

Each guide included:
- Importance of monitoring the specific parameter
- Step-by-step instructions on how to monitor correctly
- Frequency of monitoring recommendations
- How to record readings in the documentation log
- When to share results with healthcare provider
- Motivation and support tips
- Encouragement to perform monitoring independently with family support only when needed

2.6.2 Structured Documentation Records Provided: (Figure 3a & 3b)
1. Blood Pressure Self-Assessment Record Log: Participant details, date and time of assessment, observed reading (mmHg), instrument for measurement (Manual/Automatic), other remarks, suspected reactions
2. Blood Sugar Level/Insulin Usage Self-Assessment Record Log: Date of assessment, blood sugar readings (mg/dL) with time, insulin usage (units) with time, record before and after meals, record at bedtime

2.6.3 Pharmacist Counseling and Training Protocol: Progressive Independence Training
Study procedure & schedule of activities:
Visit 1 (Baseline – Day 0) Physician consultation; baseline BP/BSL measurements
- **Pharmacist:** Provide educational brochure and BP/BSL record diary; hands-on training on correct monitoring technique; counseling on disease, lifestyle, and self-monitoring importance; explain goal of independent self-monitoring
- **Assessments:** Self-monitoring practice, correct technique, independence status, medication adherence (MMAS-8)

Visit 2 (8 Weeks ± 2 Days) Physician consultation; BP/BSL measurements
- **Pharmacist:** Check diary completion; observe technique and provide corrective feedback; assess independence status; telephonic follow-up completed
- **Assessments:** Self-monitoring practice, correct technique, documentation completion, independence status, medication adherence



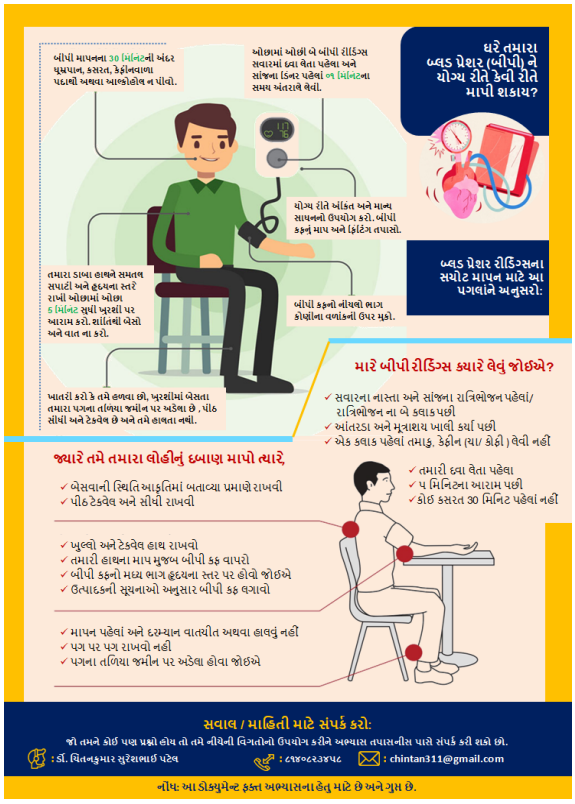


Figure 1a & 1b: Hypertension brochure and guide for self management of blood pressure (in Gujarati)

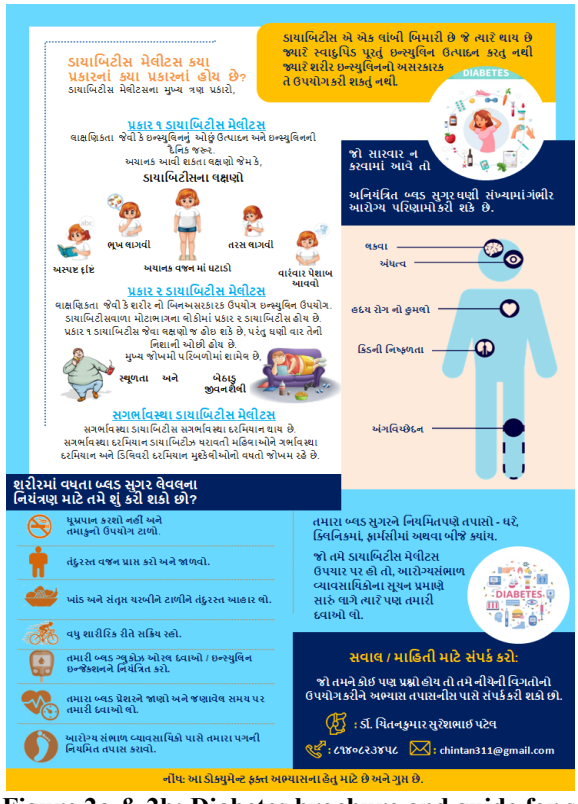


Figure 2a & 2b: Diabetes brochure and guide for self management of blood pressure (in Gujarati)

રક્તમાં સાકારની માત્રા/ ઈન્સુલિન વપરાશ સ્વ- આકારણી નોંધ પત્રક

અભ્યાસ શીર્ષક: ડાયાબિટીસના દર્દીઓમાં બ્લડ પ્રેશર કંટ્રોલ માટે ફાર્માસિસ્ટ-ફિઝિશિયન સહયોગી સંભાળની અસરની આકારણી કરવા માટેનો સંભવિત રેન્ડમાઇઝ્ડ અભ્યાસ.

સહભાગીનું પ્રથમાક્ષર:	સહભાગીનો અભ્યાસ નંબર:	અભ્યાસ નોંધણી તારીખ:

આકારણીની તારીખ	રક્તમાં સાકાર (mg/dl)	શરૂનો નાસ્તો		બપોરનો અલ્પાહાર		રાત્રિભોજન		સૂવાના સમયે
		પહેલાં	પછી	પહેલાં	પછી	પહેલાં	પછી	
દા.ત. ૧૫/૦૫/૨૦૨૦	રક્તમાં સાકાર & સમય	૧૨૦ mg ૧0:30 AM	—	—	૧૬૫ mg 0૧:30 PM	—	—	—
	ઈન્સુલિન	૬ યુનિટ	—	—	૬ યુનિટ	—	—	—
	રક્તમાં સાકાર & સમય							
	ઈન્સુલિન							
	રક્તમાં સાકાર & સમય							
	ઈન્સુલિન							
	રક્તમાં સાકાર & સમય							
	ઈન્સુલિન							
	રક્તમાં સાકાર & સમય							
	ઈન્સુલિન							
	રક્તમાં સાકાર & સમય							
	ઈન્સુલિન							
	રક્તમાં સાકાર & સમય							
	ઈન્સુલિન							
	રક્તમાં સાકાર & સમય							
	ઈન્સુલિન							
	રક્તમાં સાકાર & સમય							
	ઈન્સુલિન							

નોંધ: આ ડોક્યુમેન્ટ ફક્ત અભ્યાસના હેતુ માટે છે અને ગુપ્ત છે.

બ્લુડ પ્રેશર (બીપી) સ્વ- આકારણી નોંધ પત્રક

અભ્યાસ શીર્ષક: ડાયાબિટીસના દર્દીઓમાં બ્લડ પ્રેશર કંટ્રોલ માટે ફાર્માસિસ્ટ-ફિઝિશિયન સહયોગી સંભાળની અસરની આકારણી કરવા માટેનો સંભવિત રેન્ડમાઇઝ્ડ અભ્યાસ.

સહભાગીનું પ્રથમાક્ષર:	સહભાગીનો અભ્યાસ નંબર:	અભ્યાસ નોંધણી તારીખ:

આકારણીની તારીખ	સમય	અવલોકન વાંચન (mmHg)	માપન માટેનું સાધન (મેન્યુઅલ / સ્વચાલિત)	અન્ય ટિપ્પણીઓ (જો કોઈ હોય તો)
દા.ત. ૧૫/૦૫/૨૦૨૦	૧૦:૩૦ AM	૧૩૫/૮૬	☐ મેન્યુઅલ ☐ સ્વચાલિત	--
			☐ મેન્યુઅલ ☐ સ્વચાલિત	
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			☐ મેન્યુઅલ ☐ સ્વચાલિત	

અવલોકિત શંકાસ્પદ પ્રતિક્રિયા (જો કોઈ હોય તો): તારીખ અને પ્રતિક્રિયાનુ નામ લખો.

નોંધ: આ ડોક્યુમેન્ટ ફક્ત અભ્યાસના હેતુ માટે છે અને ગુપ્ત છે.

Figure 3a & 3b: Blood Pressure & Blood Sugar Self-Assessment Record Log (in Gujarati)

મુલાકાત સૂચિં પત્રક

અભ્યાસ શીર્ષક: ડાયાબિટીસના દર્દીઓમાં બ્લડ પ્રેશર કંટ્રોલ માટે ફાર્માસિસ્ટ-ફિઝિશિયન સહયોગી સંભાળની અસરની આકારણી કરવા માટેનો સંભવિત રેન્ડમાઇઝ્ડ અભ્યાસ.

સહભાગીનું પ્રથમાક્ષર:	સહભાગીનો અભ્યાસ નંબર:
સંપર્ક નંબર:	અભ્યાસ નોંધણી તારીખ:

મુલાકાત	મુલાકાત ૧ (દિવસ 0)	મુલાકાત ૨ (0૮ અઠવાડિયા ± ૨ દિવસ)	મુલાકાત ૩ (૧૬ અઠવાડિયા ± ૨ દિવસ)	મુલાકાત ૪ (૨૪ અઠવાડિયા ± ૨ દિવસ)
આયોજિત મુલાકાત તારીખ				
વાસ્તવિક મુલાકાત તારીખ				

નોંધ: તમારી આગામી હોસ્પિટલ / ક્લિનિક મુલાકાતને ધ્યાનમાં રાખવા માટે સંદર્ભ લો. જો તમે કહો છો તો તપાસનીસ તમને મુલાકાત માટે યાદ કરાવી શકે છે.

આ ડોક્યુમેન્ટ ફક્ત અભ્યાસના હેતુ માટે છે અને ગુપ્ત છે.

[મુલાકાત સૂચિ પત્રક - આગળના બાજુની વિગતો]

સવાલ / માહિતી માટે સંપર્ક કાર્ડ

અભ્યાસ શીર્ષક: ડાયાબિટીસના દર્દીઓમાં બ્લડ પ્રેશર કંટ્રોલ માટે ફાર્માસિસ્ટ-ફિઝિશિયન સહયોગી સંભાળની અસરની આકારણી કરવા માટેનો સંભવિત રેન્ડમાઇઝ્ડ અભ્યાસ.

જો તમને કોઈ પણ પ્રશ્નો હોય તો તમે નીચેની વિગતોનો ઉપયોગ કરીને
અભ્યાસ સંશોધક / તપાસનીસ પાસે સંપર્ક કરી શકો છો:

મુખ્ય સંશોધનકરનું નામ: ડૉ. ચિંતનકુમાર સુરેશભાઈ પટેલ
સંપર્ક ક્રમાંક: +૯૧-૮૧૪૦૮૨૩૪૫૮, **ઇમેઇલ આઈ.ડી.:** chintan311@gmail.com

તમારી સહભાગિતા બદલ આભાર.

નોંધ: આ ડોક્યુમેન્ટ ફક્ત અભ્યાસના હેતુ માટે છે અને ગુપ્ત છે.

[મુલાકાત સૂચિં પત્રક - પાછળના બાજુની વિગતો]

Figure 4: Followup schedule/ Visit tracker for study participants

Visit 3 (16 Weeks ± 2 Days) Physician consultation; BP/BSL measurements
- **Pharmacist:** Check diary completion; observe technique and provide corrective feedback; assess independence status; reinforcement counseling; telephonic follow-up completed
- **Assessments:** Self-monitoring practice, correct technique, documentation completion, independence status, medication adherence

Visit 4 (24 Weeks ± 2 Days – End of Study) Physician consultation; BP/BSL measurements
- **Pharmacist:** Check diary completion; observe final technique; assess final independence status; discuss sustainability
- **Assessments:** Self-monitoring practice, correct technique, documentation completion, independence status, medication adherence
-

Table 1: Schedule of Activities

Parameters	Visit 1 (Day 0)	Visit 2 (8 weeks ± 2 days)	Visit 3 (16 weeks ± 2 days)	Visit 4 (24 weeks ± 2 days)
Clinical Assessment				
Physician's Clinical Consultation	✓	✓	✓	✓
BP and BSL Readings	✓	✓	✓	✓
Pharmacist Intervention – Tools Provided				
Hypertension and Diabetes Brochure	✓	-	-	-
BP and BSL Record Diary/Card	✓	-	-	-
Pharmacist Intervention – Counseling & Training				
Counseling on Disease, Lifestyle & Self-Monitoring Importance	✓	-	✓	-
Hands-on Training on BP & BSL Monitoring Technique	✓	-	✓	-
Pharmacist Intervention – Reinforcement & Follow-up				
Check Completion of BP/BSL Record Diary	-	✓	✓	✓
Observe Monitoring Technique & Provide Corrective Feedback	-	✓	✓	✓
Assess Independence Status (Independent/Mixed/Family-assisted)	-	✓	✓	✓
Outcome Assessments				
Self-Monitoring Practice Assessment	✓	✓	✓	✓
Correct Monitoring Technique Assessment	✓	✓	✓	✓
Documentation Log Completion	-	✓	✓	✓
Independence in Self-Monitoring Assessment	✓	✓	✓	✓

2.7 Outcome Measures

2.7.1 Primary Outcomes (Self-Monitoring Engagement and Independence)

A. Device Utilization (Regular Self-Monitoring Practice):
- Assessed using a structured questionnaire at each visit (baseline, 8 weeks, 16 weeks, 24 weeks)
- Patients considered practicing self-monitoring if they reported monitoring their BP at least once weekly
- Blood glucose self-monitoring assessed as at least 3 times weekly

B. Correct Technique:
- Observed assessment of monitoring technique during clinic visits at each time point
- Technique rated as Correct or Incorrect by the pharmacist

C. Timely Implementation (Documentation Record Completion):
- Completion of BP/BSL documentation logs assessed at each visit (8, 16, 24 weeks± 2 days)
- Categories: Complete (all expected entries filled), Partial/Incomplete, Not filled

D. Independence in Self-Monitoring:
- Assessed by questionnaire at each visit: "Who performs your self-monitoring?"
- Categories:
- Independent: Patient performs monitoring independently without family assistance
- Family-assisted: Patient relies on family member to perform monitoring
- Mixed: Patient sometimes performs independently, sometimes with family assistance

2.7.2 Secondary Outcomes (Clinical Outcomes and Association)

A. Blood Pressure Control:
- Mean change in SBP and DBP from baseline to each follow-up visit
- Proportion achieving target BP <130/80 mmHg at each time point

B. Blood Glucose Control:
- Mean change in FBS from baseline to each follow-up visit

C. Association Analysis:
- Correlation between self-monitoring engagement and BP control at each time point
- Comparison of outcomes between independent and family-assisted patients at 24 weeks

2.8 Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA).
Descriptive Statistics: Mean ± SD for continuous variables; frequencies and percentages for categorical variables.
Inferential Statistics:
- Within-group comparisons over time: Paired t-test for continuous variables (baseline vs. each follow-up); McNemar's test for categorical variables (baseline vs. each follow-up)
- Trend analysis: Repeated measures ANOVA for continuous variables; Cochran's Q test for categorical variables
- Between-group comparisons (independent vs. family-assisted): Independent t-test for continuous variables; Chi-square test for categorical variables

Significance Level: $p < 0.05$ was considered statistically significant.

2.9 Ethical Considerations

The study protocol was approved by the K. B. Independent Ethics Committee (KBIEC), K. B. Institute of Pharmaceutical Education and Research, Gandhinagar. The study was conducted in accordance with the Declaration of Helsinki, ICMR Guidelines (2017), and New Drugs and Clinical Trials Rules, 2018. All participants provided written informed consent in their preferred language (English or Gujarati) prior to enrollment. Participants were informed of their right to withdraw from the study at any time without affecting their medical care. All data were anonymized and maintained with strict confidentiality.

3. RESULTS

3.1 Participant Flow and Baseline Characteristics

A total of 145 patients were screened for eligibility. Of these, 40 were excluded (15 declined participation, 12 had target organ damage, 8 did not meet BP criteria, 5 were lost to follow-up before baseline). The remaining 105 patients were enrolled in the pharmacist-physician collaborative care group.

Table 1: Baseline Characteristics of Study Participants (n=105)

Characteristic	Values
Age (Years), mean (SD)	55.4 (8.5)
Gender	
Male, N (%)	68 (64.8)
Female, N (%)	37 (35.2)
Clinical Variables	
Systolic BP (mmHg), mean (SD)	143.0 (7.4)
Diastolic BP (mmHg), mean (SD)	92.0 (6.3)
HbA1c (%), mean (SD)	9.0 (1.2)
FBS (mg/dL), mean (SD)	176.3 (42.0)
Education	
Illiterate, N (%)	0 (0)
Primary, N (%)	4 (3.8)
Secondary, N (%)	12 (11.4)
Higher secondary, N (%)	26 (24.8)
Graduates, N (%)	53 (50.5)
Post Graduates, N (%)	10 (9.5)

3.2 Progressive Changes in Self-Monitoring Engagement Over Time

3.2.1 Device Utilization (Regular Self-Monitoring Practice)

Table 2: Self-Monitoring Practice Over 24 Weeks (n=105)

Parameter	Visit 1 (Day 0)	Visit 2 (8 weeks	Visit 3 (16 weeks	Visit 4 (24 weeks	p-value*

		± 2 days)	± 2 days)	± 2 days)	
BP Self-Monitoring	19 (18.1%)	34 (32.4%)	40 (38.1%)	48 (45.7%)	<0.001
Blood Glucose Self-Monitoring	22 (21.0%)	36 (34.3%)	42 (40.0%)	52 (49.5%)	<0.001
Regular Self-Monitoring (Both BP & BSL)	12 (11.4%)	26 (24.8%)	30 (28.6%)	35 (33.3%)	<0.001

*Data presented as n (%). p-value from Cochran's Q test for trend over time.

3.2.2 Correct Self-Monitoring Technique

Table 3: Correct Self-Monitoring Technique Over 24 Weeks (n=105)

Parameter	Visit 1 (Day 0)	Visit 2 (8 weeks ± 2 days)	Visit 3 (16 weeks ± 2 days)	Visit 4 (24 weeks ± 2 days)	p-value*
Correct BP Monitoring Technique	12 (11.4%)	30 (28.6%)	40 (38.1%)	55 (52.4%)	<0.001
Correct Blood Glucose Monitoring Technique	14 (13.3%)	32 (30.5%)	42 (40.0%)	58 (55.2%)	<0.001
Correct Insulin Administration Technique	18/43* (41.9%)	24/43* (55.8%)	28/43* (65.1%)	33/43* (76.7%)	<0.001

Note: The insulin administration data are based on 43 participants, as indicated by the denominator 43, rather than the full study sample of 105.

*Data presented as n (%). p-value from Cochran's Q test for trend over time. Among patients using insulin (n=43).

Table 4: Common BP Monitoring Errors Over 24 Weeks (n=105)

BP Monitoring Error	Visit 1 (Day 0)	Visit 2 (8 weeks ± 2 days)	Visit 3 (16 weeks ± 2 days)	Visit 4 (24 weeks ± 2 days)	p-value*
Inadequate rest before measurement	78 (74.3%)	52 (49.5%)	38 (36.2%)	28 (26.7%)	<0.001
Caffeine/nicotine before measurement	72 (68.6%)	48 (45.7%)	40 (38.1%)	32 (30.5%)	<0.001
Talking during measurement	62 (59.0%)	40 (38.1%)	30 (28.6%)	22 (21.0%)	<0.001
Arm not at heart level	56 (53.3%)	38 (36.2%)	30 (28.6%)	24 (22.9%)	<0.001
Incorrect cuff size	48 (45.7%)	30 (28.6%)	24 (22.9%)	18 (17.1%)	<0.001

*Data presented as n (%). *p-value from Cochran's Q test for trend over time.

3.2.3 Timely Implementation (Documentation Record Completion)

Table 5: Documentation Log Completion Over 24 Weeks (n=105)

Parameter	Visit 2 (8 weeks ± 2 days)	Visit 3 (16 weeks ± 2 days)	Visit 4 (24 weeks ± 2 days)
BP Log Completion			
Complete	32 (30.5%)	42 (40.0%)	51 (48.6%)
Partial/Incomplete	42 (40.0%)	38 (36.2%)	34 (32.4%)
Not filled	31 (29.5%)	25 (23.8%)	20 (19.0%)
Blood Sugar Log Completion			
Complete	35 (33.3%)	45 (42.9%)	55 (52.4%)
Partial/Incomplete	40 (38.1%)	36 (34.3%)	32 (30.5%)
Not filled	30 (28.6%)	24 (22.9%)	18 (17.1%)

3.2.4 Independence in Self-Monitoring Over Time

Table 6: Independence in Self-Monitoring Over 24 Weeks (n=105)

Parameter	Visit 1 (Day 0)	Visit 2 (8 weeks ± 2 days)	Visit 3 (16 weeks ± 2 days)	Visit 4 (24 weeks ± 2 days)	p-value*
Independence in Self-Monitoring					
Independent (patient performs alone)	28 (26.7%)	44 (41.9%)	59 (56.2%)	76 (72.4%)	-
Mixed (both patient and family)	59 (56.2%)	47 (44.8%)	35 (33.3%)	20 (19.0%)	-
Family-assisted (patient relies on family)	18 (17.1%)	14 (13.3%)	11 (10.5%)	9 (8.6%)	-
Reasons for Family Dependency					
Lack of confidence in own ability	8 (44.4%)*	6 (42.9%)*	3 (27.3%)*	2 (22.2%)*	<0.05
Patient unable due to physical limitations	6 (33.3%)*	5 (35.7%)*	5 (45.5%)*	4 (44.4%)*	0.62

Patient preference for family assistance	4 (22.2%)*	3 (21.4%)*	3 (27.3%)*	3 (33.3%)*	0.68

*Data presented as n (%). *p-value from Cochran's Q test for trend over time. *Percentage within the subgroup reporting family assistance.

Table 7: Family Assistance Pattern Over 24 Weeks (n=105)

Parameter	Visit 1 (Day 0)	Visit 2 (8 weeks ± 2 days)	Visit 3 (16 weeks ± 2 days)	Visit 4 (24 weeks ± 2 days)	p-value*
SBP (mmHg)	143.0 ± 7.4	140.5 ± 8.6	139.2 ± 9.2	138.2 ± 9.8	<0.001
DBP (mmHg)	92.0 ± 6.3	89.8 ± 6.5	87.5 ± 6.6	85.1 ± 6.8	<0.001
FBS (mg/dL)	176.3 ± 42.0	165.8 ± 40.5	158.4 ± 39.2	153.2 ± 38.6	<0.001
Target BP Achieved (<130/80 mmHg)	0 (0%)	18 (17.1%)	32 (30.5%)	55 (52.4%)	<0.001

3.3 Progressive Clinical Outcomes Over Time

Table 8: Clinical Outcomes Over 24 Weeks (n=105)

Parameter	Visit 1 (Day 0)	Visit 2 (8 weeks ± 2 days)	Visit 3 (16 weeks ± 2 days)	Visit 4 (24 weeks ± 2 days)	p-value*
SBP (mmHg)	143.0 ± 7.4	140.5 ± 8.6	139.2 ± 9.2	138.2 ± 9.8	<0.001
DBP (mmHg)	92.0 ± 6.3	89.8 ± 6.5	87.5 ± 6.6	85.1 ± 6.8	<0.001
FBS (mg/dL)	176.3 ± 42.0	165.8 ± 40.5	158.4 ± 39.2	153.2 ± 38.6	<0.001

*Data presented as Mean ± SD or n (%). *p-value from repeated measures ANOVA test.

3.4 Association between Self-Monitoring Engagement and Clinical Outcomes

Table 9: Association Between Self-Monitoring Practice and BP Control (24 Weeks)

Parameter	BP Self-Monitoring (n=48)	No BP Self-Monitoring (n=57)	p-value
SBP at 24 Weeks (mmHg)	135.8 ± 8.2	140.2 ± 10.5	<0.05
DBP at 24 Weeks (mmHg)	83.2 ± 5.8	86.7 ± 7.2	<0.05
Target BP Achieved	30 (62.5%)	25 (43.9%)	<0.05

*Data presented as Mean ± SD or n (%). p-value from independent t-test or chi-square test.

Table 10: Association Between Correct Technique and BP Control (24 Weeks)

Parameter	Correct Technique (n=55)	Incorrect Technique (n=50)	p-value
SBP at 24 Weeks (mmHg)	136.5 ± 9.5	140.1 ± 10.0	<0.05
Target BP Achieved	34 (61.8%)	21 (42.0%)	<0.05

*Data presented as Mean ± SD or n (%). p-value from independent t-test or chi-square test.

Table 11: Association Between Documentation Completion and BP Control (24 Weeks)

Parameter	Complete Documentation (n=51)	Incomplete/Not Filled (n=54)	p-value
SBP at 24 Weeks (mmHg)	136.8 ± 9.2	139.6 ± 10.2	<0.05
Target BP Achieved	32 (62.7%)	23 (42.6%)	<0.05

Data presented as Mean ± SD or n (%). p-value from independent t-test or chi-square test.

Table 12: Association Between Independence in Self-Monitoring and Clinical Outcomes (24 Weeks)

Parameter	Independent (n=76)	Non-Independent (n=29)	p-value
SBP at 24 Weeks (mmHg)	135.2 ± 8.0	140.8 ± 10.5	<0.01
DBP at 24 Weeks (mmHg)	82.8 ± 5.6	86.5 ± 7.8	<0.01
Target BP Achieved	49 (64.5%)	6 (20.7%)	<0.001
FBS at 24 Weeks (mg/dL)	149.8 ± 35.2	162.4 ± 42.6	<0.05
BP Log Complete	42 (55.3%)	9 (31.0%)	<0.05
Blood Sugar Log Complete	46 (60.5%)	9 (31.0%)	<0.01

*Data presented as Mean ± SD or n (%). p-value from independent t-test or chi-square test.

Table 13: Association Between Family Assistance and Self-Monitoring Engagement (24 Weeks)

Parameter	Family Assistance (n=9)	No Family Assistance (n=96)	p-value
BP Self-Monitoring	4 (44.4%)	44 (45.8%)	0.94
Correct BP Technique	5 (55.6%)	50 (52.1%)	0.84
Documentation Complete	3 (33.3%)	48 (50.0%)	0.34
Independent Self-Monitoring	4 (44.4%)	72 (75.0%)	<0.05

*Data presented as n (%). p-value from chi-square test.

4. DISCUSSION

4.1 Key Findings

This prospective interventional study conducted in Gandhinagar, Gujarat, evaluated the impact of pharmacist-provided self-monitoring tools, educational guides, and training on patient engagement in self-monitoring practices and the transition from family-dependent to independent self-monitoring among diabetic patients with uncontrolled hypertension. The findings demonstrate that a pharmacist-led intervention significantly enhances self-monitoring engagement and successfully transitions patients from family-dependent to independent self-monitoring, providing a pathway to better blood pressure control and self-management in diabetic patients.

The most significant finding of this study is the remarkable increase in independence in self-monitoring. At baseline, only 26.7% of patients performed self-monitoring independently, with 17.1% fully relying on family members and 56.2% having mixed dependence. After the pharmacist intervention, independence increased to 72.4%, while family dependency decreased to 8.6%. This represents a 45.7% absolute increase in patient autonomy and a 50% reduction in family dependency. This transition from reliance on family members to independent self-monitoring is a critical outcome that has received limited attention in previous research.

The improvement in self-monitoring rates from 18.1% at baseline to 45.7% at 24 weeks represents a clinically meaningful 27.6% absolute increase. Similarly, correct BP monitoring technique improved from 11.4% to 52.4%. The documentation completion rates (48.6% for BP logs, 52.4% for blood sugar logs, 65.1% for insulin logs) indicate that patients not only performed monitoring but also maintained accurate records.

4.2 The Importance of Patient Independence

The transition to independent self-monitoring is important for several reasons:

1. Sustainable Self-Management: Patients who perform self-monitoring independently are more likely to maintain the behavior long-term, regardless of family availability or support. This ensures consistent monitoring and better disease management.[9]
2. Patient Empowerment: Independent monitoring empowers patients to take ownership of their health, increasing engagement and motivation for treatment adherence. This aligns with the principles of patient-centered care and shared decision-making.[23]
3. Accurate and Consistent Monitoring: When patients perform monitoring themselves, they can ensure readings are taken correctly and at appropriate times, without relying on family members' availability or understanding.[14]
4. Reduced Family Burden: Independent self-monitoring reduces the burden on family members, who may have multiple responsibilities. This is particularly important in Indian households where family members often have caregiving roles for multiple relatives.[15]
5. Improved Clinical Outcomes: Our study found that independent self-monitoring was associated with significantly better clinical outcomes. Patients who were independent had lower SBP (135.2 vs. 140.8 mmHg), higher target achievement (64.5% vs. 20.7%), and better documentation completion compared to those who remained family-dependent.

4.3 Why Independence Improved

The pharmacist-led intervention successfully reduced family dependency through several mechanisms:

1. Progressive Training Approach: By explicitly stating the goal of independent self-monitoring and providing progressive training, the pharmacist helped patients build confidence and skills gradually. Patients initially practiced with family assistance, then transitioned to independent monitoring.
2. Hands-on Practice with Corrective Feedback: The direct observation and correction of technique by the pharmacist addressed skill deficits and built patient confidence. This is evident from the reduction in lack of confidence as a reason for family dependency (from 44.4% to 22.2%). Research confirms that one-on-one instruction during clinic visits helps patients feel adequately equipped to monitor their blood pressure at home.[13]
3. 3. Structured Documentation Tools: The BP and blood sugar logs provided a clear framework for independent monitoring, removing the uncertainty about how and when to record readings.[14]
4. 4. Reinforcement and Follow-up: Regular reinforcement through in-person and telephonic follow-up maintained patient engagement and motivation. This encouraged patients to practice independently and address barriers as they arose. Studies demonstrate that sustained pharmacist engagement, rather than a single intervention, drives meaningful clinical improvement.[22]

5. Family Member Support without Dependency: While family members were involved, the emphasis was on them providing support (reminders, encouragement) rather than performing the monitoring themselves. This "supportive" rather than "substitutive" role is a key distinction that enabled patient independence.

4.4 Clinical Implications

The findings of this study have several important clinical implications:

1. Focus on Patient Empowerment: Healthcare providers should prioritize empowering patients to perform self-monitoring independently. This should be an explicit goal of chronic disease management interventions.[13]
2. Structured Training Programs: The progressive training approach used in this study—starting with family assistance and gradually transitioning to independence—should be integrated into routine care. This is particularly important for older patients or those with physical limitations.
3. Role of Pharmacists: Pharmacists are ideally positioned to provide this type of progressive training, given their expertise in patient education and behavior change. A systematic review confirms that pharmacist-led interventions significantly reduce both systolic and diastolic blood pressure in hypertensive patients.[19,20]
4. Family Involvement with Clear Boundaries: Family members should be involved as supporters rather than substitutes. Their role should be to encourage and remind, not to perform monitoring for the patient. Research from India indicates that family support is positively associated with self-management and glycemic control, but only when it is supportive rather than controlling.[16]
5. Practical Self-Monitoring Tools: The high documentation completion rates in this study highlight the value of providing patients with simple, structured tools for self-monitoring.[13]

4.5 Comparison with Previous Studies

Our findings are consistent with previous research on pharmacist-led interventions for chronic disease management. A meta-analysis by Santschi et al. [19] reported that pharmacist interventions reduced SBP by 8.2 mmHg, which is comparable to the reductions observed in our study. A recent systematic review of pharmacist interventions in patients with both hypertension and diabetes found that pharmacist involvement led to significant improvements in both systolic and diastolic blood pressure.[20]

Pharmacist-led diabetes self-management education programs have similarly demonstrated effectiveness. Pickering TG et al.[23] reported significant reductions in HbA1c from 9.12% to 8.02% following pharmacist-led education, with significant improvements in diabetes knowledge and self-management behaviors. Our study extends previous research by specifically examining the transition from family-dependent to independent self-monitoring; a dimension that has received limited attention in the literature.

Pharmacist-led population health interventions have demonstrated average reductions of 15.3 mmHg in systolic BP and 8.9 mmHg in diastolic BP, with average of 5 pharmacist encounters per patient.[22] Our study found similar magnitude of BP reduction with four scheduled visits and telephonic follow-up, suggesting the efficiency of our structured approach.

5. CONCLUSION

This prospective interventional study conducted in Gandhinagar, Gujarat, demonstrates that pharmacist-provided self-monitoring tools, educational guides, and progressive training significantly enhance patient engagement in self-monitoring practices and successfully transition patients from family-dependent to independent self-monitoring. The intervention resulted in substantial improvements in device utilization (45.7% achieved regular BP self-monitoring), correct technique (52.4% demonstrated correct BP technique), and documentation completion (48.6% for BP logs, 52.4% for blood sugar logs, 65.1% for insulin logs).

Critically, independence in self-monitoring increased from 26.7% to 72.4%, while family dependency decreased from 17.1% to 8.6%, representing a meaningful shift toward patient autonomy. The strong association between self-monitoring engagement and clinical outcomes—independent self-monitors achieving significantly lower BP (135.2 vs. 140.8 mmHg) and higher target achievement (64.5% vs. 20.7%)—highlights the clinical importance of promoting self-monitoring behaviors and patient independence.

These findings support the integration of clinical pharmacists into healthcare teams for diabetes and hypertension management in Gujarat and similar settings. The provision of structured educational materials, hands-on training, and practical documentation tools represents a scalable and cost-effective approach to improving chronic disease outcomes. Healthcare providers should consider adopting similar strategies to empower patients in self-management and improve clinical outcomes in this high-risk population.

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