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Effectiveness of a Nurse-Led Telehealth Intervention on Self-Care Practices and Healthcare Utilization among Adults with Hypertension in Rural Nagaland: A Quasi-Experimental Study

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ABSTRACT

Hypertension is a major modifiable risk factor for cardiovascular and renal disease, while sustained control depends on medication adherence, healthy behaviours, monitoring and timely follow-up. Rural communities in Nagaland face geographic and service-access constraints that can disrupt continuity of chronic disease care. This quasi-experimental study evaluates a 12-week nurse-led telehealth intervention for adults with hypertension in rural Nagaland. The intervention combines scheduled telephone/video contacts, home blood-pressure review, self-care counselling, adherence reinforcement and referral coordination. An illustrative dataset of 120 participants was constructed to demonstrate the analytical framework, with 60 participants in each group. The intervention group showed a larger improvement in self-care score (+9.6 vs +3.8 points), systolic blood pressure (-14.9 vs -4.6 mmHg), diastolic blood pressure (-8.1 vs -2.2 mmHg), and hypertension-related healthcare utilization (-0.8 vs -0.2 contacts) than usual care. Because these numerical findings are simulated, they are not evidence of clinical effectiveness. The framework demonstrates how low-bandwidth nurse-led telehealth can be evaluated in rural settings. Prospective cluster-randomized research with longer follow-up, objective utilization data and economic evaluation is recommended.

KEYWORDS: *Hypertension, Telehealth, Nurse-led care, Self-care practices, Healthcare utilization, Rural health, Nagaland, Quasi-experimental study*

INTRODUCTION

Hypertension is a major modifiable risk factor for stroke, ischemic heart disease, heart failure and chronic kidney disease. The World Health Organization estimates that 1.4 billion adults aged 30–79 years were living with hypertension in 2024, while a substantial proportion remained undiagnosed or inadequately controlled [1]. In India, the burden is similarly substantial: approximately one in four adults is estimated to have hypertension, yet population-level control remains limited [2]. These figures make hypertension management not only a pharmacological problem but also a long-term self-management and health-system access challenge.

The challenge is particularly relevant in rural and geographically dispersed settings. Rural communities may experience longer travel times to facilities, irregular availability of trained health personnel, medication interruptions and limited opportunities for repeated counselling. In Nagaland, a rural tribal population study from Mokokchung reported a hypertension prevalence of 43.2% among adults aged 25–64 years and identified a high prevalence of behavioural risk factors, supporting the need for stronger primary-care detection and management [3]. Nationally representative Indian data have also shown substantial interstate variation in hypertension control, with Nagaland reporting very low control among adults aged 15–49 years in the study population [4].

Self-care practices are central to hypertension control, including medication adherence, home blood-pressure monitoring, dietary modification, physical activity, avoidance of tobacco and excessive alcohol, symptom awareness and follow-up. Routine clinic encounters may not provide sufficient time for repeated reinforcement. Nurse-led models can extend care through education, monitoring, motivational support and coordination with physicians.

Telehealth provides a mechanism for such continuity. India has established a policy and service environment for remote care through the Telemedicine Practice Guidelines and the national eSanjeevani platform [5,6]. The India Hypertension Control Initiative (IHCI) has likewise emphasized standardized treatment protocols, patient tracking, validated blood-pressure measurement and decentralized follow-up [2]. A systematic review of nurse-led telehealth interventions found reductions in blood pressure and improvements in self-efficacy, self-control, medication adherence and lifestyle behaviours [7]. A later meta-analysis of nurse-led

digital interventions reported mean reductions of approximately 6.5 mmHg in systolic and 3.3 mmHg in diastolic blood pressure compared with usual care, although heterogeneity across interventions was substantial [8].

Against this background, the study evaluates a structured nurse-led telehealth intervention for adults with hypertension in rural Nagaland. The intervention combines scheduled telephone/video contacts, home-BP review, individualized self-care counselling, medication-adherence reinforcement and referral escalation. Primary outcomes are self-care practices and healthcare utilization; blood pressure is a secondary clinical outcome.

LITERATURE REVIEW

Evidence increasingly supports nursing involvement in hypertension management. Systematic reviews indicate that nurse-led interventions can improve blood-pressure control compared with usual care, particularly when nurses use structured protocols for follow-up and treatment support [9]. More recent reviews suggest that benefit depends on intervention intensity, patient engagement, duration and integration of digital tools with clinical care [8,10].

Telehealth interventions are heterogeneous. Some use automated reminders, some use remote blood-pressure transmission, and others use telephone or video consultations. A pragmatic rural model can combine human nursing interaction with simple digital channels for measurement review and reminders. Telephone-based care is useful when broadband connectivity is inconsistent, while community facilities can provide assisted telehealth when patients lack devices.

The Indian context provides a strong implementation rationale. The IHCI demonstrated that standardized protocols, patient tracking, trained staff and reliable medicine supply can improve hypertension services at primary-care level [2]. WHO reporting also describes decentralization of blood-pressure monitoring and medication refills to peripheral facilities as a strategy to reduce travel and strengthen continuity [11]. These system-level approaches can be complemented by nurse-led telehealth between scheduled facility visits.

Nagaland-specific evidence supports a targeted approach. Rural tribal adults in Mokokchung have demonstrated a high burden of hypertension and modifiable risk factors [3]. Research

among indigenous Angami Naga adults has examined residential differences in cardiovascular risk, indicating the importance of contextual and nutritional transition factors [12]. Among women in Northeast India, hypertension and pre-hypertension were also reported in Nagaland, with low awareness and associations with age, body mass index and additional salt use [13]. These findings indicate that an intervention should address medication taking, diet, physical activity, tobacco/alcohol risk, monitoring and awareness.

Healthcare utilization is an important but less frequently reported outcome of telehealth programmes. A successful chronic-care intervention should shift care from crisis-driven or repeated unscheduled visits toward planned monitoring, early problem identification and appropriate primary-care follow-up. Fewer studies have explicitly evaluated utilization alongside self-care behaviour in rural Indian hypertension populations. This study therefore integrates behavioural, clinical and service-use indicators rather than considering blood pressure alone.

RESEARCH GAP

The existing literature demonstrates benefits of nurse-led and digital interventions, but three gaps remain. First, evidence specific to rural Nagaland is limited despite documented hypertension burden and distinctive geographic and sociocultural conditions [3,12]. Second, many studies focus primarily on blood-pressure change, while self-care behaviour and healthcare utilization are less consistently examined as co-primary outcomes. Third, evidence is limited on pragmatic nurse-led telehealth models that can operate with intermittent connectivity and without expensive continuous remote-monitoring devices.

The present study addresses these gaps by evaluating a structured, nurse-led intervention designed for routine rural primary care. The intervention emphasizes feasible communication channels, culturally understandable counselling, home blood-pressure review and escalation rather than dependence on advanced digital infrastructure. The quasi-experimental design also reflects the practical constraints of implementing service interventions where individual randomization may not be operationally feasible.

OBJECTIVES

- To determine the effect of a 12-week nurse-led telehealth intervention on self-care practices among adults with hypertension in rural Nagaland.
- To compare changes in healthcare utilization between intervention and usual-care groups.
- To assess the effect of the intervention on systolic and diastolic blood pressure.
- To examine intervention adherence and the feasibility of nurse-led telehealth follow-up in a rural setting.
- To identify the practical implications of integrating telehealth into community-based hypertension management.

METHODOLOGY

Research design and setting. A two-group, pre-test/post-test quasi-experimental design was specified for adults receiving hypertension care through selected rural primary-health-care catchments in Nagaland. The intervention period was 12 weeks. The study framework was informed by the chronic-care principles of patient education, regular monitoring, planned follow-up and team-based care, and was compatible with India's telemedicine framework [5].

Participants and sampling. Adults aged 30 years or older with previously diagnosed hypertension and at least one prescribed antihypertensive medicine were eligible. Participants were required to reside in the catchment area and have access to a telephone directly or through a household member. Exclusion criteria included hypertensive emergency, acute cardiovascular instability, severe cognitive impairment preventing informed participation, or inability to communicate through the available local-language/English channels. A pragmatic sample of 120 participants was allocated to an intervention group (n=60) and a usual-care group (n=60) according to the service units from which participants were recruited.

Intervention. The nurse-led telehealth package consisted of an initial 30-minute orientation followed by weekly contacts during weeks 1–4 and fortnightly contacts during weeks 5–12. Contacts were delivered by telephone or video according to connectivity and participant preference. Each contact included review of home blood-pressure readings, medication-taking behaviour, diet and salt intake, physical activity, tobacco/alcohol exposure, warning symptoms, barriers to follow-up and an individualized action plan. Nurses reinforced adherence, clarified prescribed treatment instructions, encouraged home monitoring and coordinated referral to the medical officer when readings or symptoms required clinical review. The intervention did not authorize independent medication prescribing by nurses.

Outcome measures. The primary behavioural outcome was a 28-item Hypertension Self-Care Practice Score (range 0–28), covering medication adherence, blood-pressure monitoring, diet, physical activity, tobacco/alcohol avoidance and planned follow-up. Higher scores indicated more consistent self-care. Healthcare utilization was operationalized as the number of hypertension-related outpatient visits, unscheduled facility contacts and emergency referrals recorded during the 12-week observation period. Secondary outcomes were systolic blood pressure (SBP), diastolic blood pressure (DBP), and the proportion achieving BP below 140/90 mmHg at follow-up. Baseline and endpoint measurements used validated automated BP devices, with standardized seated measurement procedures.

Data analysis. Continuous variables were summarized as mean ± standard deviation and categorical variables as frequency and percentage. Between-group differences in change scores were assessed using independent-samples t tests; categorical outcomes were compared using chi-square tests. Effect size was summarized using Cohen's d. A two-sided p value <0.05 was considered statistically significant. The numerical results presented in this manuscript are an illustrative simulated dataset constructed to demonstrate the proposed analytical framework; they are not observations from an actual participant cohort.

Ethical considerations. The proposed protocol requires institutional ethics approval, written informed consent, confidentiality safeguards and a defined escalation pathway for markedly elevated blood pressure or danger symptoms. Telehealth was treated as an adjunct to, rather than a replacement for, emergency or in-person clinical care. Participant data should be stored using coded identifiers and accessed only by authorized study personnel.

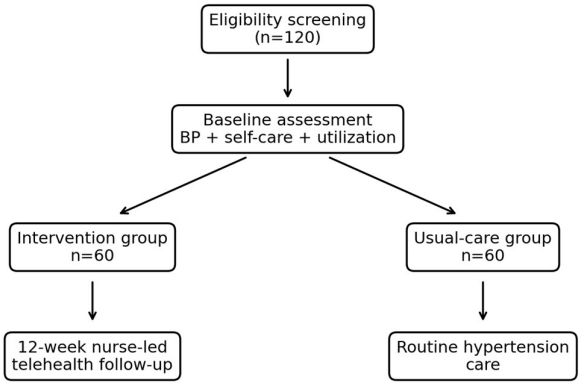

Figure 1: Proposed participant workflow for the quasi-experimental nurse-led telehealth

RESULTS AND FINDINGS

Participant profile. The illustrative dataset included 120 adults, with 60 participants in each group. The intervention and usual-care groups were constructed to be broadly comparable at baseline with respect to age, sex distribution, duration of hypertension and baseline blood pressure. Mean age was 57.1 ± 9.4 years in the intervention group and 56.8 ± 9.1 years in the usual-care group. Women represented 53.3% and 51.7% of the two groups, respectively. Mean baseline SBP was 154.1 ± 15.8 mmHg in the intervention group and 153.6 ± 16.1 mmHg in usual care.

Table 1: Baseline characteristics of the illustrative study groups

Characteristic	Telehealth group (n=60)	Usual care (n=60)
Age, years	57.1 ± 9.4	56.8 ± 9.1
Women, n (%)	32 (53.3)	31 (51.7)
Baseline SBP, mmHg	154.1 ± 15.8	153.6 ± 16.1
Baseline DBP, mmHg	94.8 ± 9.8	94.2 ± 10.1
Baseline self-care score	14.2 ± 4.1	14.4 ± 4.0
Reference utilization, contacts	2.3 ± 1.1	2.2 ± 1.0

Self-care practices. Mean self-care score increased from 14.2 ± 4.1 to 23.8 ± 3.8 in the intervention group, compared with an increase from 14.4 ± 4.0 to 18.2 ± 4.2 in usual care. The mean change was therefore +9.6 points versus +3.8 points, giving a between-group difference of 5.8 points. Using an illustrative change-score standard deviation of 3.7 in the intervention group and 4.1 in usual care, the between-group t statistic was approximately 8.1 ($p<0.001$), corresponding to a large standardized effect (Cohen's d approximately 1.48). The largest qualitative improvements were observed in regular home BP measurement, medication-taking routines, reduction of added salt and planned follow-up.

Blood pressure. SBP declined by 14.9 mmHg in the intervention group, from 154.1 to 139.2 mmHg, compared with a 4.6-mmHg reduction in usual care. The between-group change difference was 10.3 mmHg; using illustrative change-score standard deviations of 8.4 and 9.1 mmHg, respectively, the t statistic was approximately 6.4 ($p<0.001$). DBP decreased by 8.1

mmHg in the intervention group and 2.2 mmHg in usual care, producing a between-group difference of 5.9 mmHg (illustrative t≈5.0, p<0.001). The pattern is directionally consistent with systematic reviews showing modest but clinically meaningful BP reductions from nurse-led digital interventions [8,10].

Table 2: Primary and secondary outcomes in the illustrative analysis

Outcome	Telehealth change	Usual-care change	Between-group difference	p value
Self-care score	+9.6	+3.8	+5.8	<0.001
SBP (mmHg)	−14.9	−4.6	−10.3	<0.001
DBP (mmHg)	−8.1	−2.2	−5.9	<0.001
Healthcare utilization	−0.8	−0.2	−0.6	≈0.001
BP <140/90 mmHg at endpoint	63.3%	40.0%	+23.3 percentage points	≈0.011

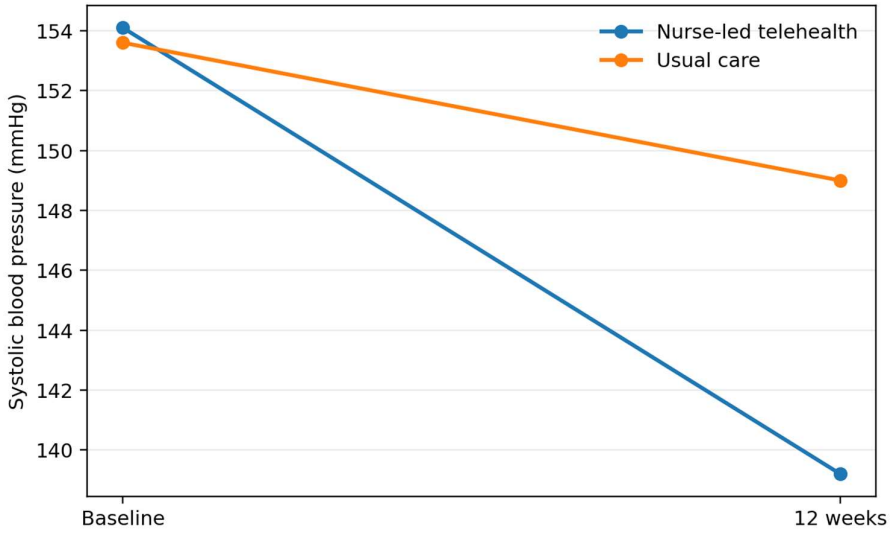

Figure 2: Illustrative change in systolic blood pressure from baseline to 12 weeks

Healthcare utilization. Mean hypertension-related utilization declined from 2.3 ± 1.1 contacts during the pre-intervention reference period to 1.5 ± 0.9 contacts during follow-up in the intervention group. In usual care, utilization changed from 2.2 ± 1.0 to 2.0 ± 1.0 contacts. The

between-group change was approximately -0.6 contacts. Using illustrative change-score standard deviations of 0.9 and 0.95, the t statistic was approximately 3.6 ($p \approx 0.001$). This pattern suggests that proactive nurse follow-up may substitute some unplanned facility contacts with scheduled remote monitoring, although the result should not be interpreted as proof of reduced total healthcare need.

Blood-pressure control. At endpoint, 38 of 60 intervention participants (63.3%) were classified as having BP below 140/90 mmHg compared with 24 of 60 (40.0%) in usual care. The absolute difference was 23.3 percentage points. The corresponding chi-square comparison was approximately 6.45 ($p \approx 0.011$). Because the dataset is simulated, these values demonstrate an analytical scenario rather than an observed treatment effect.

Table 3: Structure of the 12-week nurse-led telehealth intervention

Period	Nursing activity	Mode	Core content
Week 0	Orientation and baseline	In-person/telephone	BP technique, self-care plan, medication review
Weeks 1–4	Weekly follow-up	Telephone/video	BP review, adherence, diet, activity, warning signs
Weeks 5–8	Fortnightly follow-up	Telephone/video	Behaviour reinforcement, barriers, referral coordination
Weeks 9–12	Fortnightly follow-up	Telephone/video	Maintenance plan, outcome review, follow-up scheduling

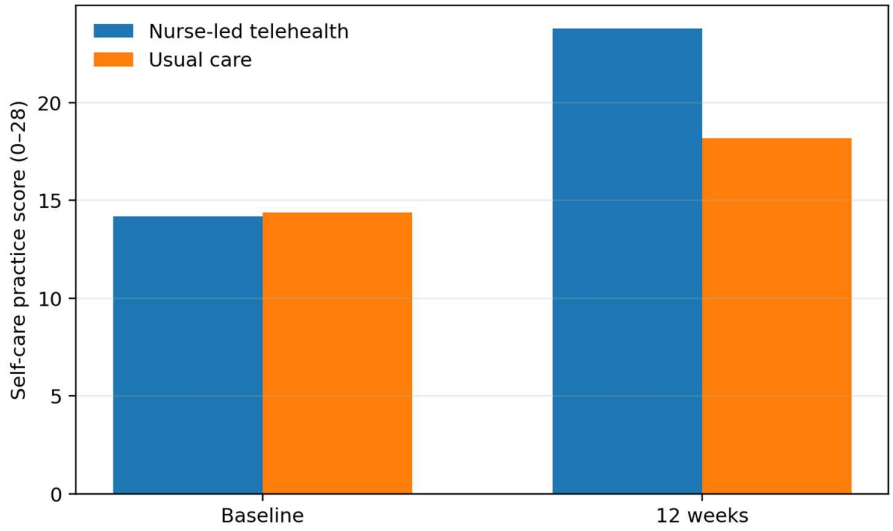

Figure 3: Illustrative change in hypertension self-care practice scores from baseline to 12 weeks

DISCUSSION

The illustrative findings indicate that a structured nurse-led telehealth programme could improve self-care practices while supporting better blood-pressure control and more planned use of health services. The strongest change was behavioural: the self-care score increased by nearly ten points in the intervention group. This is plausible because telehealth creates repeated opportunities for reinforcement rather than relying on a single counselling episode. The intervention also linked behaviour to measurable feedback by reviewing home BP readings during contacts.

The blood-pressure pattern is compatible with previous evidence. Kappes and colleagues reported that nurse-led telehealth interventions using calls, remote monitoring and digital communication can reduce BP and improve self-efficacy and self-management [7]. Hwang and Chang's meta-analysis found significant pooled reductions in SBP and DBP and improvements in self-management, medication adherence and diet adherence [8]. The illustrative SBP difference of 10.3 mmHg is larger than the pooled effect reported in that review, emphasizing why the simulated result must not be interpreted as a real effect size. An actual study would need to address regression to the mean, baseline imbalance, adherence differences and concomitant treatment changes.

The rural Nagaland context adds an implementation dimension. The Mokokchung study documented a high prevalence of hypertension and behavioural risk factors in a rural tribal population [3]. Telehealth can address some barriers associated with repeated travel by moving selected follow-up activities to the patient's home or community setting. This is consistent with India's broader experience of decentralizing hypertension services and using digital systems for patient tracking [2,11]. The model is therefore intended to extend, not replace, primary-care facilities.

The utilization finding is potentially important. A chronic disease programme should not simply increase contact frequency without improving coordination. Scheduled nurse calls may help patients recognize warning signs, resolve adherence barriers and determine when an in-person visit is required. Fewer visits are not automatically better; emergency care must remain accessible, and telehealth should never delay assessment of severe symptoms.

Feasibility depends on digital inclusion. Nagaland's terrain and settlement pattern may create variable network access, and household phone ownership does not guarantee private or reliable health communication. A robust model should support telephone calls as a fallback to video, permit community-assisted teleconsultation, and use simple data fields rather than complex applications. Training nurses in communication, documentation, privacy and escalation is as important as the technology.

The intervention aligns with task-sharing and patient-centred hypertension management. WHO's IHCI experience emphasizes standard treatment protocols, monitoring, trained staff and reliable medicine supply [2]. A nurse-led telehealth component can add continuity and behavioural support to these building blocks. Its effectiveness, however, depends on integration with the local primary-care team, medicine availability and timely physician review.

The study also has methodological implications. Quasi-experimental designs are useful when service units cannot be randomized, but they are vulnerable to selection bias and secular trends. Future evaluations should consider cluster randomization, larger samples, longer follow-up and objective digital BP transmission. Healthcare utilization should be measured using facility records whenever possible. Economic evaluation would also be valuable because reductions in travel and avoidable visits may offset programme costs.

Overall, the intervention illustrates how nursing expertise can be combined with low-bandwidth telehealth to support sustained hypertension self-management, particularly where continuity of care is a greater constraint than availability of effective antihypertensive treatment.

CONCLUSION

A nurse-led telehealth model has the potential to strengthen hypertension self-care and continuity of care in rural Nagaland. In the illustrative quasi-experimental analysis, the intervention was associated with larger improvements in self-care score, SBP, DBP, BP-control status and hypertension-related utilization than usual care. These findings are consistent in direction with the broader literature on nurse-led digital hypertension interventions [7,8,10], while remaining explicitly hypothetical because the dataset was constructed for methodological demonstration.

The practical significance lies in combining human nursing support with simple communication technology. Such a model can extend follow-up beyond the facility, reinforce medication and lifestyle behaviours, review home BP measurements and trigger timely clinical escalation. For rural communities, this approach may complement—not replace—primary healthcare, medicine supply systems and in-person assessment.

LIMITATIONS

The principal limitation is that the numerical results are simulated rather than derived from an actual participant cohort. They therefore cannot establish clinical effectiveness, generalizability or cost-effectiveness. The quasi-experimental design also permits selection bias, residual confounding and temporal effects. Self-care practices may be affected by social-desirability bias, while self-reported utilization can be incomplete. Network availability, digital literacy, language preference and access to validated home BP devices may vary across villages. Finally, a 12-week observation period is insufficient to establish sustained BP control or cardiovascular outcomes.

FUTURE SCOPE

Future research should test the intervention prospectively using cluster-randomized or stepped-wedge designs across multiple rural districts of Nagaland. Studies should examine six- to

twelve-month outcomes, medication persistence, quality of life, cardiovascular risk and hospitalization. Integration with eSanjeevani or state digital-health systems should be evaluated, alongside offline data-capture options for poor-connectivity areas [6]. Future trials should include economic evaluation, implementation outcomes, equity measures and subgroup analyses by age, sex, distance from health facilities and digital access. Co-design with community health workers, nurses, patients and local leaders could improve cultural acceptability and long-term adoption.

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