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The impact of continuous professional development on enhancing nurse-pharmacist collaboration in the management of hypertension: A comprehensive review

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Abstract

Background: Hypertension is a global health crisis, with projections indicating that over 1.5 billion individuals will be affected by 2025, significantly increasing the risks of heart disease and stroke. Despite effective treatments, only about 50% of hypertensive patients achieve optimal blood pressure control. Effective management often requires a collaborative approach involving healthcare professionals, particularly nurses and pharmacists.

Methods: This review examines historical and contemporary studies focusing on team-based care strategies that incorporate pharmacists and nurses to enhance hypertension management. Emphasis is placed on controlled trials, systematic reviews, and innovative care models, including the Chronic Care Model (CCM) and Patient-Centered Medical Home (PCMH).

Results: Evidence indicates that team-based interventions significantly improve blood pressure outcomes. For instance, studies demonstrate that pharmacist-led initiatives can reduce systolic blood pressure (SBP) by an average of 10.7 mm Hg compared to standard care. Similarly, nurse-led interventions utilizing stepped-treatment algorithms have led to substantial decreases in SBP, particularly among diverse populations.

Conclusion: Collaborative care models that integrate nurses and pharmacists into hypertension management have shown promising results in enhancing patient outcomes. This approach not only improves blood pressure control but also fosters a patient-centered healthcare environment. Future research should address the integration of technology and further investigate the long-term sustainability of these interventions.

Keywords: Hypertension, team-based care, pharmacists, nurses, blood pressure management

1. Introduction

By 2025, it is anticipated that over 1.5 billion people globally would suffer from hypertension, contributing to 50% of heart disease risk and 75% of stroke risk [1]. For several decades, it has been well recognized that reducing blood pressure (BP) by lifestyle modifications, pharmacological interventions, or a combination of both may significantly diminish a patient's future illness risk [2]. For every 10-mm Hg reduction in systolic blood pressure (SBP), the average risk of death from heart disease and stroke drops by 30% and 40%, respectively [3]. Although the therapy of hypertension significantly decreases cardiovascular morbidity and death, barely fifty percent of individuals with hypertension achieve optimal blood pressure management [4-6]. Numerous factors contribute to inadequate blood pressure management beyond lifestyle decisions, including deficient patient medication adherence and physicians' inability to enhance treatment, known as clinical inertia [7-10]. A very successful strategy for improving blood pressure management is team-based treatment, particularly including pharmacists and nurses [11-13].

We examine care delivery strategies that are propelling healthcare change. We examine significant historical studies related to team-based care practices aimed at improving blood pressure management, emphasizing recent controlled trials and systematic reviews. This will not be a comprehensive assessment of the literature due to the multitude of articles on team-

based treatment. This article will concentrate on meticulously constructed controlled clinical trials, research using modern technologies, cost-effectiveness assessments, and prospective models to enhance blood pressure regulation.

2. Chronic Care Model

The Chronic Care Model (CCM) was established as a framework for reconfiguring healthcare and rectifying shortcomings in the management of chronic illnesses, including hypertension. The six domains are decision support, self-management assistance, delivery design, information systems, community resources, and health care systems. Enhancing and unifying these domains has demonstrated the potential to engage patients, elicit responsive health care teams, and enhance health services and treatment outcomes, while also being cost-effective [14-22]. This model underscores the significance of patients with chronic conditions as their primary caregivers and highlights the necessity of support from providers, family, and community in self-management [23]. Consequently, patients occupy the core of the care model, with providers, family, and community interacting in various manners to influence and bolster health decisions. Collaborative care is characterized by a joint definition of issues; goal formulation, strategic planning, and implementation of action plans; a spectrum of self-management education and support services; and proactive and ongoing follow-up. This care model acknowledges a cooperative alliance among the patient, provider, and care team, each contributing their specialized knowledge to manage the individual's health and participating in the decision-making process. The collaborative cooperation between patient and physician is crucial for proactively managing chronic illness during scheduled appointments and for making necessary revisions to the treatment plan to provide optimum care [24-28].

3. Patient-Centered Medical Home and Teams

The Patient-Centered Medical Home (PCMH) was established to supplant episodic care predicated on illness and patient grievances, aiming to deliver continuous, comprehensive care for chronic conditions and preventive health. The PCMH is endorsed by the American Academy of Family Physicians, the American Academy of Pediatrics, and the American College of Physicians, and is widely promoted as a potential mechanism for enhancing healthcare quality and reducing costs [29, 30]. The PCMH underscores the necessity for patient care to be structured around the patient's needs and their rapport with their primary physician, allowing for the formation and reformation of physician-led teams based on patient requirements. The physician assigns responsibilities to other team members to conduct medication histories, identify obstacles to disease management, provide lifestyle modification counseling, and adjust medications in accordance with hypertension protocols. Regular communication among team members on goal-oriented treatment enables the physician to tackle more intricate issues and urgent matters. Preliminary evidence suggests that the Patient-Centered Medical Home (PCMH) can enhance healthcare delivery outcomes, elevate physician satisfaction, and reduce healthcare costs. Additionally, the personal rapport among the patient, physician, and team has been instrumental in addressing barriers to care frequently encountered by minorities and other vulnerable populations [31].

Several significant research published before 2000 were examined. A more extensive compilation of controlled studies about team-based care is available in the systematic reviews,

which are also addressed below. The first research on team-based treatment was published in *Circulation* in 1973 by McKenney and associates [32]. A total of 50 patients were randomized into either regular pharmacy services or an intervention group. The community pharmacist assessed patients and collaborated with two doctors at an urban health center in Detroit, including visiting the clinic to examine medical records, and the pharmacist proposed modifications to treatment. Patients in the intervention group attended monthly appointments with the pharmacist at one of three community pharmacies for a duration of five months. Blood pressure was assessed in the physician's office, where it worsened in the control group from 163/93 mm Hg to 166/101 mm Hg over the course of 5 months. Nonetheless, blood pressure in the intervention group improved from 157/99 mm Hg at baseline to 146/90 mm Hg (between group $p < .001$). Blood pressure management declined in the intervention group after the cessation of the intervention [33].

Bogden and colleagues [34] assessed the impact of a pharmacist operating inside a medical resident training clinic. Patients with uncontrolled hypertension were randomly assigned to a control group ($n=46$) or an intervention group ($n=49$). Systolic blood pressure (SBP) fell by 23 mm Hg in the intervention group and by 11 mm Hg in the control group ($p < .001$). Blood pressure control was attained in 55% of the intervention group, in contrast to 20% of the control group ($p < .001$).

Borenstein and colleagues [35] studied the comanagement of hypertension by physicians and pharmacists within an integrated healthcare system. Patients were randomized into two groups: the comanaged group ($n=98$), which visited a pharmacist-operated hypertension clinic, and the usual care group ($n=99$). Patients were evaluated biweekly to triweekly, with the pharmacist consulting the physician at each appointment on the proposed treatment regimen derived from an evidence-based algorithm. Systolic blood pressure (SBP) was markedly decreased in the co-managed group compared to the standard care group at 6, 9, and 12 months (22 vs 9 mm Hg, 25 vs 10 mm Hg, and 22 vs 11 mm Hg, respectively, $p < .01$ at all intervals). A greater proportion of patients in the comanaged group (60%) attained blood pressure control compared to the standard care group (43%, $P=.02$).

One of the first published investigations on nurses (Logan *et al.*) [36] was executed in the patient's workplace and contrasted blood pressure with that of a control group overseen by the patient's family physician. Unlike the trial conducted by Borenstein and associates, the nurses independently prescribed and modified pharmacological treatment without obtaining physician consent, whereas doctors conducted weekly reviews of the records for nurse-managed patients. The study encompassed 457 participants, revealing that nurse-managed patients were more inclined to receive a new antihypertensive agent (95% vs 63%, $p < .001$), receive two antihypertensive agents (44% vs 18%, $p < .001$), adhere to the medication regimen (68% vs 49%, $p < .005$), and attain target blood pressure at six months (49% vs 28%, $p < .001$).

Rudd and colleagues [37] performed a randomized controlled study (RCT) comparing nurse case management ($n=74$) to a control group ($n=76$). Nurses assessed patients at baseline and provided instruction on the use of an automated blood pressure device, methods to enhance medication adherence, and recognition of adverse drug events. The nurses conducted supplementary telephone communications at 1 week and at 1, 2, and 4 months; autonomously adjusted medication dosages; and consulted the physician to get authorization for the initiation of any new blood pressure medication. Significantly,

only patients assigned to nurse case management were provided with portable blood pressure monitors, which may have improved blood pressure control independently of nursing interventions via increased patient self-monitoring. Systolic blood pressure (SBP) decreased by 14.2 mm Hg in the intervention group and 5.7 mm Hg in the control group ($p < .01$) at the six-month mark. The intervention group used much more drugs and had a greater number of medication alterations (223 vs 52, $p < .01$) compared to the control group. At six months, medication adherence was 81% in the intervention group and 69% in the control group ($P = .03$).

Compelling research by Mundinger *et al.* [38] investigated the management of several illnesses, including hypertension, provided by nurse practitioners in comparison to doctors. The majority of patients were Hispanic immigrants, all of whom were recruited after a visit to the emergency department or urgent care and were randomized to receive treatment from either a nurse practitioner ($n = 806$) or a physician ($n = 510$). The nurse practitioners and doctors had equivalent responsibilities regarding prescribing, consulting, recommending, or admitting patients, and the key outcome, quality of life, showed no significant difference between the groups. Diastolic blood pressure (DBP) was marginally superior when administered by nurse practitioners in comparison to doctors (137/82 mm Hg vs 139/85 mm Hg; $P = .28$ for systolic blood pressure and $P = .04$ for DBP) across a one-year period after baseline measurements.

Numerous systematic studies have been undertaken to assess different quality-improvement (QI) initiatives aimed at improving blood pressure regulation. In 2006, Walsh and colleagues [11] released their results in a report produced for the Agency for Healthcare Research and Quality (AHRQ). Sixty-three controlled studies of quality improvement techniques aimed at improving hypertension management were discovered. Most research integrated several strategies, and a taxonomy was established to classify the different quality improvement approaches. The median decreases in systolic blood pressure (SBP) for several interventions were as follows: audit/feedback (1.3 mm Hg), provider education (2.7 mm Hg), provider reminder systems (6.8 mm Hg), self-management (3.6 mm Hg), patient education (8.1 mm Hg), and organizational transformation (10.1 mm Hg). The authors discovered that the most substantial statistically significant improvements were associated with team-based treatment (37 comparisons), resulting in a median decrease in SBP of 9.7 mm Hg and a 21.8% net gain in SBP control.

A subsequent meta-analysis of pharmacy-based interventions was conducted by Machado *et al.* [39], evaluating 13 studies encompassing 2200 participants. The authors discovered that pharmacists' interventions significantly decreased systolic blood pressure (SBP) by 10.7 standard deviations (SD), equating to 11.6 mm Hg ($P = .002$), while control groups exhibited no change. These results corroborate the conclusions of prior meta-analyses and systematic reviews.

Carter and colleagues [12] conducted a meta-analysis assessing the efficacy of nurse- or pharmacist-assisted hypertension therapy in team-based care. This analysis revealed a markedly increased probability of managed blood pressure in trials employing nurses (odds ratio [OR], 1.69; 95% confidence interval [CI], 1.48–1.93), pharmacists inside clinics (OR, 2.17; CI, 1.75–2.68), and community pharmacists (OR, 2.89; CI, 1.83–4.55) in comparison to standard treatment. The authors endeavored to identify the most efficacious elements of team-based care and discovered that the reductions in systolic blood pressure (SBP, in mm Hg) included: pharmacist-recommended

therapy to the physician (−9.3), patient education delivered by nurse or pharmacist (−8.8), pharmacist-executed intervention (−8.4), assessment of medication adherence (−7.9), nurse-implemented intervention (−4.8), and utilization of a treatment algorithm (−4.0).

The latest Cochrane Review [40] on quality improvement interventions for managing blood pressure in hypertensive patients identified 72 randomized controlled trials encompassing six intervention types: (1) self-monitoring; (2) patient-directed educational interventions; (3) health professional-directed educational interventions; (4) care led by health professionals (nurses or pharmacists); (5) organizational interventions to enhance care delivery; and (6) appointment-reminder systems. Self-monitoring correlated with a moderate net decrease in systolic blood pressure (SBP) (weighted mean difference [WMD] −2.5 mm Hg; 95% CI, −3.7 to −1.3 mm Hg) and diastolic blood pressure (DBP) (WMD −1.8 mm Hg; 95% CI, −2.4 to −1.2 mm Hg). Educational initiatives aimed at patients or health professionals seem improbable to provide significant net decreases in blood pressure independently. Appointment reminder systems exhibited variability, yielding inconclusive results; however, most trials demonstrated an increase in the attendance rate for follow-up visits by nearly 2.5 times. Additionally, two small trials indicated enhanced blood pressure control (OR, 1.85, 95% CI, 1.37–2.44) favoring the intervention. The authors of the Cochrane Review concluded that a systematic approach involving registration, recall, and regular review, combined with a robust stepped-care strategy for antihypertensive medication, is the most effective method for improving high blood pressure management. They also noted that nurse- or pharmacist-led care showed promise, with the majority of randomized controlled trials linked to improved blood pressure control and reductions in mean systolic and diastolic blood pressure [41].

Chisholm-Burns *et al.* [13] did a meta-analysis and found 298 studies in the United States that assessed pharmacist-delivered direct patient care for different chronic diseases. The authors observed substantial enhancements in blood pressure, glycated hemoglobin (HbA1c), low-density lipoprotein cholesterol, adverse drug reactions, medication compliance, quality of life, and patient knowledge ($p < .05$).

A recent systematic review and meta-analysis conducted by Clark and colleagues [42] examined trials of nurse-led treatments for hypertension in primary care, aiming to determine the significance of nurse prescription as an intervention. Interventions using a stepped-treatment approach demonstrated more significant decreases in systolic blood pressure (WMD, −8.2 mm Hg; 95% CI, −11.5 to −4.9) vs standard care. Nonetheless, this was not correlated with an increased attainment of blood pressure objectives. Nurse-led clinics using structured prescription algorithms in primary care settings demonstrated more significant decreases in systolic and diastolic blood pressure compared to standard treatment. Notably, when data were aggregated, nurse-led interventions markedly reduced SBP among African American participants compared to standard care, while showing little variation for other ethnic minority groups. This research indicates that nurse-led hypertension management results in better blood pressure outcomes compared to physician-led or standard treatment.

4. Constraints of Prior Research and Deficiencies in Understanding

The aforementioned studies underscore the persistent advantage of team-based treatment in enhancing blood

pressure management. Nonetheless, the authors of the systematic reviews and others recognized numerous limitations in the published literature, including small patient sample sizes, a limited number of pharmacist or nurse interventionists, absence of a control group, lack of intention-to-treat analyses, and failure to account for potentially confounding covariates. Randomization does not always eradicate all disparities between groups, especially in trials with limited sample sizes [43]. Consequently, factors like sex, race, education, baseline blood pressure, and body mass index must be controlled in the studies. Typically, the trials were performed at individual locations, which might result in contamination if the intervention included altering provider behavior, and the physician-treated patients in both the control and intervention groups [44]. A benefit of a restricted number of medical offices or intervention providers is the capacity to maintain the high integrity of the intervention. Nevertheless, this may also make the findings less generalizable. Furthermore, in several trials, the assessment of blood pressure was compromised due to the measurements being conducted by the intervention provider or an individual with a vested interest in the outcomes, resulting in a lack of blinding. In other investigations, inconsistent blood pressure measures (e.g., standard office readings) were used as the outcome variable [45-47].

5. Randomized Trials Involving Pharmacists

Lee and colleagues [45] performed the Federal Study of Adherence to drugs in the Elderly (FAME), a multiphase investigation at Walter Reed Army Medical Center including 200 individuals prescribed four or more drugs, 92% of whom had hypertension. After a run-in period, all patients were provided with an extensive pharmacy program to enhance adherence, which included education and prepackaged drug adherence assistance (blister packs). Following 3 to 8 months in phase 1, patients were randomized to receive either standard treatment or continuous pharmaceutical medication for an additional 6 months. Patients assigned to standard treatment got conventional pill bottles with a 90-day supply. Patients assigned to pharmacy care received bi-monthly follow-up from pharmacists along with prescription blister packs to enhance adherence. After the phase 1 period including blister packs and pharmacy care, systolic blood pressure (SBP) decreased from 133.2±14.9 mm Hg to 129.9±16.0 mm Hg ($P=.02$). During phase 2, systolic blood pressure (SBP) reverted to baseline levels in patients resuming standard treatment (133.3±21.5 mm Hg), but it further improved in individuals undergoing the ongoing intervention (124.4±14.0 mm Hg, $P=.005$ between groups). This research does not clarify whether the effectiveness of the intervention was due to unit dosage packaging, the pharmacist, or a combination of both.

Carter and colleagues [46] performed a cluster randomized trial with 179 individuals participating in a 9-month intervention study. Research nurses assessed blood pressure at baseline and 2, 4, 6, and 9 months. Ambulatory 24-hour blood pressure was assessed at baseline and after 9 months. Pharmacists working in medical offices provided targeted suggestions to doctors and patients to enhance blood pressure management. The predominant recommendation was to escalate pharmacotherapy. The mean adjusted difference in systolic blood pressure (SBP) was 8.7 mm Hg (95% CI, 4.4–12.9) favoring the intervention group, whereas the difference in diastolic blood pressure (DBP) was 5.4 mm Hg (CI, 2.8–8.0). The 24-hour blood pressure values indicated a mean drop in systolic blood pressure of 8.8 mm Hg (confidence interval,

5.0–12.6) and diastolic blood pressure of 4.6 mm Hg (confidence interval, 2.4–6.8) in the intervention group relative to the control group. The blood pressure objective was attained in 89% of patients within the intervention group and 53% in the control group (adjusted odds ratio, 8.9; confidence interval, 3.8–20.7; $p<.001$).

Upon completion of this study, the investigators conducted a retrospective analysis of a cohort comprising 103 patients who consented to participate. Blood pressure measurements were obtained at baseline and 9 months during the intervention, followed by assessments at 18- and 27-months post-baseline (9 and 18 months after the intervention's cessation). This cohort exhibited characteristics akin to those of the larger study population. At 27 months (18 months post-intervention cessation), the systolic blood pressure (SBP) was 132.7±11.5 mm Hg in the intervention group and 143.0±12.2 mm Hg in the control group ($p<.001$), with blood pressure control rates of 59% and 31%, respectively ($P=.0048$). This research indicates that the brief intervention had enduring effects [47].

A second cluster randomized trial (Carter *et al.*) [48, 49] was executed at six family medicine clinics in Iowa. The research assigned the clinics to control or intervention groups, enrolling 402 patients with uncontrolled hypertension for six months. Clinical pharmacists employed in these offices provided drug therapy recommendations to doctors by national standards. Research nurses conducted blood pressure readings and 24-hour blood pressure monitoring. The modified difference in SBP was -12.0 mm Hg (95% CI, -24.0 to 0.0; $p<.05$) between the intervention and control groups at 6 months. The 24-hour blood pressure values exhibited comparable disparities across the groups. Blood pressure was at target in 29.9% of patients in the control group and 63.9% in the intervention group (adjusted odds ratio, 3.2; confidence interval, 2.0–5.1; $p<.001$). The authors performed a retrospective assessment to ascertain if the intervention's effect persisted after its cessation. Eighteen months post-intervention, blood pressure measured 130.0±16.0 mm Hg in the intervention group and 138.1±20.4 mm Hg in the control group ($P=.0023$). Blood pressure was at target in 67% of patients in the intervention group and 36% in the control group ($p<.001$). This research indicates that the 6-month pharmacist intervention had enduring benefits, likely associated with prescription modifications that led to sustained blood pressure management.

Recently, Bosworth and colleagues [50-52] commenced a Veterans Affairs (VA)-funded study examining cardiovascular disease (CVD) risk, emphasizing medication management (e.g., blood pressure, HbA1c, lipids, coagulation) and behavioral outcomes (e.g., medication adherence, physical activity) facilitated by a pharmacist via telephone. This research will be conducted in two VA primary care clinics. The intervention is customized for the requirements of at-risk susceptible individuals and targets various cardiovascular disease-related behaviors and medication management risks. The research will recruit 500 individuals with cardiovascular disease, who will be randomly assigned to either the educational control group or the intervention group. Patients assigned to the intervention group will undergo a clinical pharmacist-administered intervention that emphasizes behavioral and medication management. Considering the nationwide incidence of cardiovascular disease (CVD) and the inadequate management of risk factors, the suggested intervention might enhance secondary prevention of CVD within the Veterans Affairs (VA) system.

6. Regulated Studies of Nursing Interventions

A substantial and expanding amount of data indicates that nurses may significantly enhance hypertension outcomes. A recent analysis of research from 2005 to 2009 included 33 randomized controlled trials (RCTs) using interventions administered by nurses, nurse prescribers, or nurse practitioners aimed at enhancing blood pressure, in comparison to standard treatment. Interventions for hypertension had greater success in reaching blood pressure objectives when they included a stepped-treatment algorithm administered by a nurse, nurse prescription, or nurse-led telephone monitoring^[53-55].

Nurse-led case management has proven to be an effective approach for enhancing the management of cardiovascular risk factors, including hypertension, as evidenced by numerous studies. Nurses have successfully implemented strategies to improve blood pressure by facilitating communication with physicians and adhering rigorously to management protocols, incorporating counseling elements that may not be feasible within the time constraints of a busy physician's practice^[56].

7. Overview of Technological Challenges

Research employing health information technology (HIT) and high-speed communication technologies facilitates electronic sharing of blood pressure measurements, medications, and lifestyle behavior data between patients and their healthcare teams beyond office visits, enabling feedback and modifications to care plans. The integration of electronic technology with team-based treatment has yielded the most favorable outcomes, while the studies exhibit heterogeneity. There is less knowledge on the correct dosage of methods and their cost-effectiveness [57-60]. Furthermore, there is a lack of information regarding the long-term advantages of technology-enhanced team interventions, the extent to which blood pressure control is sustained over time, the necessity for continuous or booster interventions, and their enduring impact on cardiovascular outcomes, quality of life, and healthcare costs. Findings from current and forthcoming research will provide critical insights into the optimum effectiveness and worth of these tactics.

8. Conclusions

This study, albeit not comprehensive, presents substantial evidence that teams are useful in managing BP. Team-based care offers enhanced chances for hypertension management to become more patient-centered by delivering treatment that is individualized, responsive, collaborative, and empowering for patients, while affording doctors more time to address difficult and urgent matters as they emerge. There is an increasing emphasis on the Patient-Centered Medical Home (PCMH) and the use of technology to enhance access to healthcare.

The next challenges include not just increasing access but also guaranteeing that the access is of superior quality. Technology must undergo thorough assessment and should not be seen as a universal remedy. Additional research is required to enhance the comprehension and assessment of patients' and providers' communication preferences. The policy implications of team-based care must be addressed.

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