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REVIEW ARTICLE

THE IMPACT OF COLLABORATIVE CARE ON COST OF TREATMENT FOR THE MANAGEMENT OF HYPERTENSION- A SYSTEMATIC REVIEW

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Abstract

Introduction: For evaluation of the long term costs and benefits of physician-pharmacist collaboration associated with physician management for the treatment of essential hypertension. Around the world the major cause of death is hypertension. It is an incurable condition that requires proper therapeutic regimens for its life-long management. Due to this, hypertension therapy can be financially burdensome to the patient, and the rates of non-compliance are increased.
Aims and Objectives: To observe the results of collaborative, clinical, and interventive approaches to hypertension management, on the cost-effectiveness of therapy, this study aimed to collect and compare cost information on hypertension management, mortality, and morbidity across different countries and cost groups. Using this information, future healthcare expenses can be better planned; for example, by initial emergency response or by changing the way money is distributed. This will lead to more high-pressure jobs. Therefore, it will be more costly to control blood pressure.
Method: A systematic review was conducted using 6 major electronic databases that investigated the influence of collaborative care upon healthcare expenses in hypertensive patients and hypertension therapy costs, before and after the intervention of medical personnel, was observed.
Conclusions: It was concluded that interventions provided by the collaboration of medical personnel, in the management of hypertension, made the therapy more cost-effective and hence the rate of patient compliance and adherence to the therapy were increased.
Keywords: Collaborative care, cost-effectiveness, cost of hypertension therapy, Hypertension management, interventions.

INTRODUCTION

Systemic arterial hypertension termed: high-blood-pressure, represents the physiological state in which arterial blood-pressure is persistently high. The definition of high blood pressure varies depending on how it is measured[1]. Most patients (90-95%) have primary or essential hypertension with genetic and environmental causes and a good family history[2]. Genome wide relation studies have presented >120 genetic-loci associated with blood-pressure control, which together explain 3.5% of the variance in quality. In the time of precision medicine, these findings have important implications for finding new diagnoses and treatments for hypertension[2]. Hypertension is often considered asymptomatic that's why it is called 'Silent Killer', but noted that studies have reported many symptoms, including cognitive changes, mood swings, and general symptoms that can lead to high blood pressure, such as dizziness and headache[3]. Additionally, some of these symptoms may also be due to elevated antibodies identified or attributed to the disease itself, which often overlap with symptoms seen in primary care. They believe that these symptoms, such as headache, dizziness, weakness, fatigue, irritability, and anxiety, should not be considered "early symptoms" of high blood pressure because blood pressure is often referred to as a symptom or sign of

heart disease and there is no direct evidence that blood pressure will rise to cause these symptoms. Instead, researchers proposed calling these symptoms "early symptoms associated with essential hypertension[4]. The Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7) has defined categories for normal blood pressure, prehypertension, and stages 1 and stage 2 hypertension. In contrast, the European Society of Hypertension/European Society of Cardiology (ESH/ ESC) guidelines categorize hypertension differently. ESH/ESC guidelines have removed the "pre-hypertension" category, as they believe the majority of the population is "sick" and may lead to unnecessary physician visits. Instead, they consider the population to be too risk-averse to provide treatment recommendations for the entire group[5].

To evaluate patients with high blood pressure, doctors need to consider not only high blood-pressure but heart diseases as well, target organ damage, and co-morbidities that affect blood pressure or target damage. This requires a comprehensive approach that includes routine examination and a focused examination based upon history of patient, physical examination along with preoperative diagnosis[6].

Many risk factors for high blood pressure have been identified, such as high cholesterol, obesity, smoking, and stress. In addition, a diet high in salt and calories is also considered a risk factor. Drinking alcohol and coffee is associated with the risk of developing hypertension. Furthermore, participants acknowledged that a sedentary lifestyle is a risk factor; the study found that oral contraceptives and a family history of heart disease were also significant disease factors for hypertension[7]. Prehypertension is not a diagnosis or disease in itself; It is a category used to define an individual's blood pressure that is above-normal but not high-enough to be considered hypertension[8]. Essential hypertension is regarded as the most common type of high-blood-pressure, affecting most adults. However, dietary and life style modifications could assist in reducing blood pressure and its associated risk of complications from high blood pressure[8,9]. Secondary hypertension is a type of high blood pressure that can be identified and reversed and accounts for only 5%–10%. It is more common among young people, approximately 30% of people aged 18–40 suffer from high blood pressure[10]. Resistant-hypertension is high blood-pressure that is resistant to treatment with medication or requires the use of more than one medication to control and is defined as blood pressure remaining above the target range despite taking three or more antihypertensive medications, often including diuretics[11]. Malignant-hypertension is rare and severe form of hypertension that requires immediate medical attention. High blood pressure, characterized by extremely high, typically with systolic blood-pressure of 180 mmHg or above and diastolic blood-pressure of 120 mmHg, can cause damage to many organs and cause a serious crisis that must be treated quickly to prevent further complications and body failure[12]. The Joint National Committee (JNC) recommends lifestyle changes for people with blood pressure (BP) of 120/80 mmHg or higher. Preventing hypertension demonstrates the ability of medications to treat prehypertension and reduce cardiovascular events[13]. Lifestyle changes are the cornerstone of preventive treatment for individuals at risk of cardiovascular disease, including hypertension, obesity, dyslipidemia, and diabetes[16]. It can be used as a first-line treatment before taking medication, as an adjunct to medication in previously treated patients, or even to support medication adherence and tolerance to achieve and manage lifestyle changes in patients with high blood pressure[14]. Cardiovascular-diseases (CVD) is major source of mortality in diabetic patients. Whereas, hypertension is considered a major risk for CVD[15].

Additionally, diabetes and high blood pressure are closely related and higher the risk of atherosclerotic cardiac disease, so both need to be controlled to reduce the risk of complications. Obesity is one of the leading risk factors for increased risk of developing heart disease as well as metabolic diseases specifically type II diabetes. Obesity give rise to high blood pressure which is a leading risk factor for cardiovascular and kidney diseases through multiple mechanisms, including hypertension, hyperglycemia, dyslipidemia, inflammation, and atherosclerosis[16].

Between 1990 and 2015 approximately 3.5 billion adults worldwide had ideal systolic blood pressure. The number of healthy years lost due to high blood pressure has increased by 43% due to population growth, aging, and a 10% increase in high blood-pressure events. According to the WHO, hypertension is a significant threat to global health as it is a major risk factor for various diseases and deaths worldwide; It causes 9.4 million deaths and 212 million deaths every year, accounting for 8.5% of the world's total[1]. From 1990 to 2019, the number of patients aged 30-79 years with high blood pressure has doubled, and the age standard expansion in the world has remained stable. While the lowest prevalence of hypertension in 2019 was observed in Canada and Peru, 9 countries had a prevalence of more than 50% in men and 2 countries had a prevalence of more than 50% in women. Only 47% of women and 38% of men worldwide have high blood pressure, and control is as low as 10-50% depending on the country. Treatment and management costs vary between countries.

The highest treatment costs are in South Korea, Canada, and Iceland, and the lowest in countries such as Nepal, Indonesia, and some sub-Saharan African countries[17]. The overall age-adjusted prevalence of hypertension remained unchanged from 2017 to 2021 at approximately 30%. Additionally, the prevalence of hypertension varies from state to state; they range from 24.6% in Colorado to 40.6% in Mississippi. During this time, high blood pressure cases have risen in some states and declined in others[18]. The age-standardized prevalence of hypertension was 45.4% and was greater in men than women in the 2017-2018 study. With age, the prevalence of high blood pressure increases and is observed in people aged 60 and over (74.5%). The reported prevalence of hypertension is comparatively higher in non-Hispanic black-adults in comparison to white non-Hispanic and Hispanic-adults[19].

Global warming is increasing and its prevalence is more significant in developing countries (31.5%) than in developed countries (28.5%). The cases of hypertensive adults has also risen worldwide; it grew from 1.39 billion in 2010 to an estimated 1.04 billion in developing countries alone[20]. When studies on hypertension in Nigeria over the last 50 years were examined, the prevalence of a certain condition varied significantly across different populations, with rates ranging from 8-46.4%, depending on the measurement approach and criteria used. Prevalence is equal in men and women, in urban and rural areas. Aggregate prevalence increased from 8.6% in 1970 to 22.5% in 2000-2011[21] by the year 2025, Targets to have a 25% decrease in hypertension prevalence worldwide by WHO[22]. Because of rapid increase in the prevalence of hypertension, the enhanced cost of treatment greatly effects the economic status of the individuals as well as families, that could be controlled through the collaborative care involving multiple healthcare professionals specifically pharmacists who are at the ideal position to face patients for dispensing of the medications[9].

METHODS

Study Design: By using PRISMA guidelines all parameters were observed during this study. To find the research relevant to the study topic the keywords included "Management of Hypertension", "collaborative care", "cost of treatment" and "interventions". Various electronic databases and manual searches on Google Scholar were used for study searches. The search was limited to English language and should be published from January 2000-2023.

Inclusion Criteria: The inclusion criteria were as follows; the studies must be in the English language, must be published in journals, must be about making hypertension management more economically stable through collaboration and interventions, and the results of the studies showed some impact on the cost-effectiveness of the treatment or therapy.

Exclusion Criteria: The exclusion criteria include; the studies were published in other languages than English, not published in a journal, the studies were reviews of other studies, and the studies had no relation to the topic under study.

Data Categories: The data on cost is derived from first-hand research studies that examine the trend for a country or region within a country (for example Canada or particular states in the USA). Hypertension therapy costs were categorized into the following classes: total costs – direct + indirect costs, direct costs related to hypertension therapy (diagnostics, drugs, hospitalization, medical equipment, consultations, medical transport, nursing, etc.), indirect costs (economic losses due to decrease in employee's productivity (presenteeism), their absence due to sickness and death (absenteeism), hospital costs (specifically related to hospitalization), drug expenses (the price of buying and administering prescription drugs), pharmaceutical care costs (costs that are related to participation of pharmacist in treatment), out-of-pocket expenses(the costs directly paid by the patient), and lastly, the expenses related to stroke constitute a distinct category of direct costs.

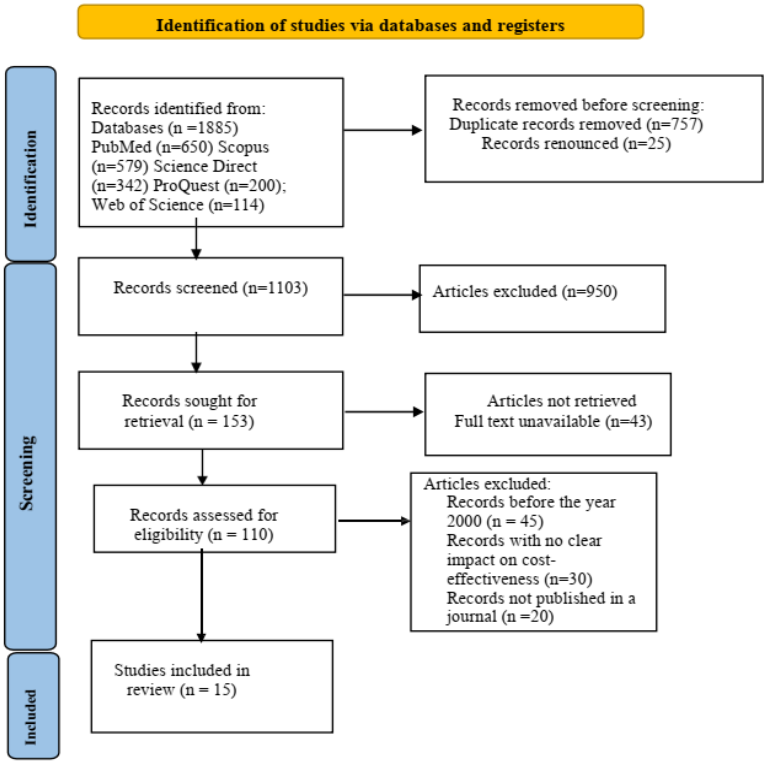

Figure 1: PRISMA flow chart representation for systematic review.
The PRISMA 2020 statement: general guidelines for publication of systematic reviews.
http://www.prisma-statement.org/

Pharmacoeconomic assessments frequently make use of these cost categories and criteria.

Data Extraction

The extracted data from the included studies contains the author's name, study year, time duration of the study, the country where the study was conducted, sample size of the population under observation, mean age of the sample population, provider of interventions, the impact of the interventions on cost-effectiveness of therapy and conclusions.

Data Synthesis and Analysis

The impacts of the interventions provided by a medical practitioner or through the collaboration of various qualified personnel, on the cost of therapy, were studied. The rate of compliance and adherence among the sample population was also taken into consideration. The differences in the cost of treatment of hypertension, before and after the intervention, were observed.

Ethical approval

The present research project was approved by the institutional ethical review board, ensuring that the study was conducted by the highest ethical standards and guidelines with approval number: ERB-PHRMD-DPP/4530-A.

RESULTS

In this systematic review, through an electronic database search, a total of original research articles from 1885 were identified, and 1,103 studies were reviewed after duplicates were removed. Of the 1103 studies reviewed, 950 articles that did not meet the main criteria were excluded and 153 studies were selected. During the full-text search, 43 of 153 abstracts were found as abstracts only. They were issued in the special edition/issue as abstracts and were not available as full texts of the journals. After exclusion, a total of 110 studies were available for further analysis. Of the 110 short-term studies, studies were excluded because they were published before 2000. Afterward, a total of 30 studies with no clear impact on cost-effectiveness were also excluded and 20 studies that were not published in an authentic article were also excluded. In the end, 15 cross sectional studies that were in line with the inclusion criteria were selected, reviewed, and evaluated.

Study characteristics are presented in PRISMA flowchart. AXIS 20-point device was used to control quality of included studies. The AXIS-tool is an important tool for evaluating instruments that address issues in cross-sectional studies and highlight their quality and risk of bias. The AXIS instrument (developed in 2016), also called "AXIS-20", is a 20 points based questionnaire for addressing important aspects of the "cross-sectional" research studies, such as study-design, sample-size, target-population, sampling-technique, validity as well as reliability using content as a study method. Table 1 represents the evaluation of qualitative analysis of included-studies using AXIS-20. Included studies had clearly defined aims and objectives. Most included-studies had appropriate study designs and samples. The presented results of studies included were clear and showed consistent. Additionally, the included studies possessed no conflict of interest. Among the total 15 included studies, 1 study was published in 2001, 2 studies were published in 2002, 1 study in 2010, 2 studies in 2011,3 studies in 2015, 3 studies in 2017, 2 studies in 2018, and 1 study was published in 2022. Characteristics of included studies are shown in Table 2. Among the added research studies the majority of the studies had clear objectives. On the other hand, there was no conflict of interest in any of the included studies that would affect the author's interpretation of the results. The target/user group and appropriate sample were clearly defined in all included studies. Similarly, all studies received ethical approval and informed consent from study participants. Most of the included studies received funding. The majority of the 15 studies found 9 original studies were from the USA, 3 original studies were from Canada, 1 study was from Australia, 1 study was from Portugal, and 1 study was from the Netherlands. All of the new research focuses on the impact of pharmacist collaboration on the cost of treating high blood pressure. The study duration of most studies is approximately 6-12 months.

DISCUSSION

This systematic review reclaims 15 articles from 6 major electronic databases to investigate the impact of collaboration on hypertension care costs. The study mainly focused on the effect of collaborative intervention on cost-effectiveness and adherence to medication therapy. Most of the data suggests that interventions enhanced the medical objectives of the treatment which led to a reduced financial cost related to hypertension therapy. Although the location, size, and methodology of these studies vary there was a correlation between collaborative care and improved blood pressure patients. In most cases under study, the pharmacist was seen as the main intervention provider. In some cases, pharmacists worked with physicians to provide pharmaceutical care plans for the effective management of hypertension in patients. Pharmacists, nurses, and general practitioners worked together to give intervention which resulted in an overall increase in quality of life and blood pressure improvement. These studies show that intervention given by a pharmacist or the addition of a pharmacist in the intervention group has a significant effect on blood pressure management. Given the high risk and heavy health burden of hypertension, this highlights the importance of cost awareness in the assessment and treatment of hypertension. The resources should be prioritized on managing and treating patients with high blood pressure rather than investigating rare cases. This describes ways to treat high blood pressure, including using diuretics as the first line of treatment because they are often effective, simple, and inexpensive. Additionally, beta blockers are recommended as alternative medications in cases where diuretics are contraindicated.

Table 2: Cross-Sectional Studies Appraisal tool (AXI Stool).

	Study 1 [13]	Study 2 [14]	Study 3 [15]	Study 4 [16]	Study 5 [17]	Study 6 [18]	Study 7 [19]	Study 8 [20]	Study 9 [21]	Study 10 [22]	Study 11 [23]	Study 12 [24]	Study 13 [25]	Study 14 [26]	Study 15 [27]
Introduction															
Were the aims/objectives of the study clear?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Methods															
Was the study design appropriate for the stated aim(s)?	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Was the sample size justified ?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Was the target/reference population clearly defined?	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Were measures undertaken to address and categorize non-responders?	✓	✓	×	✓	✓	✓	×	✓	×	×	×	✓	×	✓	✓
Were the risk factors and outcome variables measured appropriate to the aims of the study?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Were the risk factor and outcome variables measured correctly using instruments/measurements that had Been trialed, piloted, or published previously?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Is it clear what was used to determine statistical significance and/or precision estimates?(e.g. p-values, confidence intervals)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓
Results															
Were the basic data adequately described?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Does the response rate raise concerns about non-response bias?	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
If appropriate, was information about non-responders described?	×	✓	×	×	×	×	×	×	×	×	×	×	×	✓	×
Were the results internally consistent?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Were the results presented for all the analyses described in the methods?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Discussion															
Were the authors' discussions and conclusions justified by the results?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Were the limitations of the study discussed?	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓
Others															
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	✓	✓	✓	×	✓	×	✓	✓	×	×	✓	✓	×	×	×
Was ethical approval or consent of participants attained?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Overall, this article offers doctors tips on how to manage high blood pressure[23]. Similarly, a prospective randomized controlled trial was conducted in Portugal in which a pharmacist was employed as the intervention provider. As a result of the pharmacist program designed for this 9 months trial, SBP and DBP were reduced and the percentage of patients meeting JNC-7 criteria increased. Adding a clinical pharmacist to the hypertension care team is therefore one potential tactic to deal with this significant public health concern[24]. On the other hand, a randomized controlled trial was conducted on hypertensive Filipino Americans in New York City (NYC) utilizing community health workers instead of pharmacists to give behavioral interventions. Over the course of four months, clinical participants attended 4 training workshops and 4 one-on-one meetings with community health workers using research techniques in the community. Participants in the control group only attended 1 training workshop. At 8 months, a considerably higher proportion of individuals had their blood pressure under control in the treatment group (83.3 than in the control group (42.7%)[25].

Similarly, over the course of 9 months, a randomized and interventional study was carried out in an Indian rural community. In this study, clinical pharmacists were employed to provide counseling to the test population. Systolic and diastolic blood pressure (SBP and DBP), sociodemographic information (e.g., family history, occupation, habits, allergies, and previous medication, etc.), and body mass index BMI of patients in the control and intervention groups is collected during interviews and entered into a pre-designed data collection form. This study indicates that clinical pharmacists in the treatment of hypertension in rural areas improved public knowledge of the condition, the medications used to treat it, and how it affects the well-being of patients[26].

On the other hand, an unmasked randomized controlled trial was conducted in the UK which utilized an e-intervention system to control and manage blood pressure. The HOME BP (Home and Online Management and Evaluation of Blood Pressure) trials combine self-management with self-monitoring to evaluate online intervention for managing hypertension in the first line perspective[27]. The increase in the management of B.P and patient compliance with an apparent decrease in the overall cost of treatment of hypertension due to in-person counseling sessions is the authentic data gathered by the pharmacist himself from the patient during the session also pharmacist can measure the blood pressure of the patient and note it down which reduces the chances of error in monitoring by the patient. Most of the cases resulted in favor of the debate stating there is a significant reduction in the cost of therapy by the intervention of either a pharmacist or physician or collaborative intervention. The intervention through collaborative care increases the adherence of patients to medicines and at the same time affects the cost of therapy. There should be a defined policy about the intervention of healthcare providers in managing patients with targeted diseases. Similarly, research was conducted in the USA that used an intervention group and a regular group. A 30-year study period was used in this research and after the defined time results were obtained that stated there was a considerable variation in the expenses of medication in the patients where the intervention was used. While there was a change in the cost of medication health outcomes were also enhanced. The result points out those governments must devise policies to address interventions by pharmacists, nurses, or other healthcare providers in the treatment of chronic diseases like hypertension[28].

Contrary to this a study conducted in Thailand resulted in an increased cost of therapy. The increased cost may include the need for additional consultations or higher-cost alternatives recommended by the pharmacist. Also implementing changes to medication schedules by pharmacist intervention might result in an increased cost to adjust treatment plans[29]. This study examined a group of 120 patients, 38 of whom were excluded due to a history of cardiovascular disease (CVD). The results showed that patients who received medical treatment (MTM) had a lower systolic blood pressure (8.21 mm Hg) compared to patients who did not receive medical treatment (MTM). Lowering blood pressure reduced the 10 years risk of cardiovascular disease by 3.3%, from 42.9% to 39.6%. Additionally, the annual risk of heart disease is reduced by 0.46%. The results were further analyzed by analyzing the need to avoid convergence of predictive validity. This study demonstrates that pharmacist-led medication management (MTM) clinics for hypertension patients are cost-effective for payers, provide cost savings, and improve health. These models demonstrate that pharmacists can provide significant benefits to healthcare by minimizing the chances of cardiovascular disease and enhancing patients' well-being. The research suggests that pharmacists should be paid to provide medical services; this allows them to expand their practices and provide more care to patients with long-term illnesses such as high blood pressure[30].

Improved blood pressure now CAPTION study, a randomized trial of 625 patients in 32 practices, found that pharmacist medication management produced notable improvements in blood pressure control (BP) and expense savings by pharmacists and physicians' collaboration. Compared with the control group, the intervention group had a 6.1 mmHg reduction in systolic blood pressure, a 2.9 mmHg reduction in diastolic blood pressure, and hypertension control (43% versus 34%). The total cost of the intervention was lower than the control group, with a 1 mmHg reduction in systolic blood pressure and a 1% increase in blood pressure control[31]. This study, involving 197 patients with uncontrolled blood pressure, showed that physician-pharmacist collaborative practice improved BP control and reduced cost rates with usual care (UC). In comparison, the patient receiving pharmacist and physician collaborative management (PPCM) shows a reduction in BP compared (-22 mmHg) with the UC group (-11 mmHg). Additionally, a higher proportion of patients in the PPCM group achieved blood pressure control, with 60% of patients achieving target levels versus 43% in the usual care group.

Table 3: Study details of the included studies.

S.N.	Study	Country	Study Design	Study Duration	Sample Size	Mean Age + Gender	Interven-tion Provider	Mode of Intervention	Impact on cost of treatment	Conclusion
1	Linnea A. Polgreen *et. al.*, 2015[13]	USA	Randomized trials	9 months	Control group =224 Investigation group=401 Total patients =625	61 years Majority of participants were women	Pharmacist	Recommendation to the physician regarding therapy	There was a decrease in the cost of treatment	A collaborative approach, between pharmacist and physician, toward hypertension control provides cost-effective therapy
2	Isabelle cote *et al.*, 2002[14]	Canada	Case-control studies	9 months	Total participants= 100	Age of participants= 34-80 years	Pharmacist	Through the implementation of a health promotion program	Significant decrease in mean direct costs of medication	Hypertension control was improved, by the implementation of a health promotion program, in cost and gained benefits.
3	Janice PL. *et al.*, 2010[15]	USA	Case-control study	2 years	Intervention group=29,042 Control group=30,454 Total participants =59,496	Age of participants= 18 years and older	Pharmacist	Providing counselling to patients at risk of non-adherence	Significant decrease in annual health care spending for hypertension and diabetes patients	Interventions provided by Pharmacist are cost-effective and decrease chances of non–adherence
4	Jessica S Jay *et al.*, 2017[16]	USA	Decision analysis model	3 years	Total patients=10,000	Adult age	Physician-pharmacist	Direct counselling of patients from pharmacist and physician when required	There was a significant change in cost for patients with a difference of at least 162$ in 3 years	By using collaborative interventions there was a decrease in cost while an increase in the effectiveness of therapy
5	Puttarinkulchaitan aroaj *et al.*, 2011[17]	USA	Cluster randomized control study	6 months on average	Control group=244 Intervention group=252 Total patients=496	21 years and older	Physician-pharmacist	Direct interaction between patients and physicians with the collaboration of pharmacist	There was a significant increase in the cost of therapy	By collaborative interaction, Blood pressure was controlled while there was an increase in cost.
6	Rachele L *et al.*, 2018[18]	Australia	Retrospective observational study	12 months	20,335 Patients	60 years	Pharmacist	Counselling	Participation in the pharmacist-led intervention, to reduce the cost of $95 per adult in medication non adherence cost, yielding an annual saving of $1.9 billion a year	Patient adherence was increasing and the financial burden was decreased

7	Helen T *et al.*, 2017[19]	Canada	Randomized control trial	12 months	Total participants=684 Male=392 Female=292	62 years old	Community pharmacist	Through cost-analysis	Overall, there were no significant differences in healthcare costs. There was an incremental cost saving of 4770 per patient	Clinical–pathway–based pharmacist interventions were found to be associated with health care cost.
8	Suzetecosta *et al.*, 2022[20]	Portugal	Pragmatic quasi experimental controlled trials	6 months	Ig group =206, cg group=96 Total=302	FOR Control=64years old FOR Intervention=66 years old Most Patients were Females.	General Practitioners Nurses Community pharmacist	Collaborative care between intervention pharmacies and primary care.	Not shown to have a reasonable level of cost-effectiveness compared to usual care	Due to the limitation of economic outcomes, results are not generalizable but strategies and methods can be used in future studies.
9	Carlo Marra *et al.*, 2017[21]	Canada	Markov model	30 years		Mean age-63.5 years. 49 percent were males	Pharmacist	Prescribing, patient education prescribing, patient education	The intervention is economically dominant and cost-saving makes it dominant in other options.	Pharmacist care for hypertension, including patient education and prescribing, has the potential to provide health benefits and cost savings to Canadians.
10	Puttarin K *et al.*, 2015[22]	USA	Cohort study	6 months	Total participants=399	56.7 years	Pharmacist Physician	Pharmacist counselling the patients and providing recommendations to the Physician	The intervention was 48.6% cost-effective if payers were willing to pay $50,000 per QALY gained.	Cost-effective in high-risk patients and least in low-risk patients.
11	Gary R. Matzke *et al.*, 2015[23]	USA	Retrospective Analysis	2 years and 6 months	Collaborative care=2480 Usual care=2480 Total=4960	65 years + The major population is female	Clinical Pharmacist	Clinical sessions with patients	An estimated cost savings of $2,619per patient.	The inclusion of clinical pharmacists was associated with a significant decrease in the cost of treatment and benefit in clinical outcomes.

12	Bosmans JE *et al.*, 2018[24]	Netherlands	Pragmatic randomized controlled trial	9 months	Intervention group = 85 Control group =85 Total=170	61 years + Half male and half female	pharmacist	Patient-tailored adherence program	Intervention program and usual Care shows no significant differences in costs.	pharmacist-led intervention program to enhance medication adherence was not considered cost-effective in patients with hypertension.
13	Bob G. Schultz*et al.*, 2011[25]	USA	Cohort study design Using Semi-Markov Model	11 years	MTM clinic patients=158 Control=158 Total=316	60 years + 70% female	Clinical pharmacist	Face-to-face sessions	MTM cohort incremental costs were $3214 compared to no MTM cohort.	Pharmacist led MTM clinic-provided service is cost-effective from a US-payer perspective for the management of hypertension.
14	Jeff E. Borenstein *et al.*, 2002[26]	USA	Randomized controlled Study	12 months	UC Group =99 PPCM Group=98 Total=197	61.5 years+ Majorly females	Clinical Pharmacist	Face-to-face sessions and recommendation to physicians	The cost of provider visit was higher in the UC than in the PPCM group($195vs $160, p=0.02).	A collaborative approach using physician-pharmacist co-management for patients leads to better blood pressure control and reduced average visit costs/patient.
15	Mark P. Okamoto *et al.*, 2001[27]	USA	Prospective, randomized, comparative study	6 months	Hypertension Clinic =164 Physician Clinic =166 Total =330	61.7 years	Pharmacist + Physician	In-person	Total costs for the hypertension clinic group were not different from the physician-managed clinic group ($242.46vs $233.20, *p*=0.71), but cost: effectiveness ratios were lower in the hypertension clinic group.	In a hypertension clinic, pharmacists can be a valuable cost-effective alternative to physicians in the management of patients, and they can provide better clinical outcomes and higher patient satisfaction.

Additionally, the average cost per visit was lower in the PPCM group. This study suggests that the use of evidence-based PPCM may be an effective way to treat hypertension[32].

The importance of community health workers is pivotal in primary care, particularly in underserved communities where they provide essential support to patients[33]. The authors suggest four principles for improving policy for these workers: encouraging their participation in policy development, reducing barriers to education and employment, allowing contracting with community organizations, and incorporating multiple responsibilities and talents. These employees are uniquely qualified to interact with patients and provide education, counseling, and health guidance, making them valuable members of the healthcare team[34,35,36].

Limitations of the study:

The present study comprised only 15 cross sectional studies for assessing the impact of collaborative care on cost of treatment for the management of hypertension. Most of the included studies are from United States of America and Canada that could be presented as the limitation of the present systematic review.

CONCLUSIONS

After conducting this study, it was found that a clinical and interventive approach to the management of hypertension provides cost-effective treatment for patients. The collaboration between physicians, pharmacists, and other medical professionals allows for the identification of cost-effective alternatives to costly medications and therapies and aids in the formation of a comprehensive therapy regimen that is individualized for each patient's need. This study shows that a cost-effective treatment of hypertension decreases the instances of non-compliance and the rate of patient adherence to therapy increases and as patient compliance increases, there is an improved control over hypertension. Evidence shows that collaborative care models can improve patient blood pressure control and outcomes while reducing hospitalizations, emergency room visits, and medication costs. The cost-effectiveness of care coordination has been demonstrated in many settings, including general medical care, specialist care, and emergency care. The outcomes of this review provide strong support for the use of collaborative care models in the management of hypertension, particularly in healthcare systems prioritizing cost-effectiveness. Future studies should prioritize identifying the best components and features of integrated care models in the most effective ways to reduce healthcare costs and improve patient outcomes.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The authors hereby confirm that no generative AI technologies, including Large Language Models (such as ChatGPT or COPILOT) and text-to-image generators, have been employed during the creation or editing of this manuscript.

CONSENT

As per international and institutional standards, the author(s) have obtained and preserved written informed consent from the patient(s) involved in this study.

AUTHOR'S CONTRIBUTION

Shahid S, Qamar A, Ali U: writing original draft, methodology, investigation. **Ali S, Hameed MS, Ashraf SM, Nasir A:** formal analysis, data curation, conceptualization. **Qamar A, Qamar M, Bajwa A:** writing, review and editing, methodology. **Shahid S, Iqbal MZ:** formal analysis, data curation, conceptualization. Final manuscript was checked and approved by all authors.

CONFLICT OF INTEREST

The authors hereby declare that they have no competing interests.

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