

## Calculation of Average Cost Effectiveness Ratio in Hypertensive Patients Using Angiotensin-Converting Enzyme Inhibitor Combined with Calcium Channel Blocker in Inpatient Pharmacy Facility

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### ABSTRACT

The study investigates the cost-effectiveness of Angiotensin-Converting Enzyme Inhibitor (ACEI) combined with Calcium Channel Blocker (CCB) therapy for hypertension management, revealing insights into its efficacy and economic implications. The therapy incurred a total cost of Rp. 1,485,500 with an effectiveness rate of 43%, resulting in an Average Cost Effectiveness Ratio (ACER) of Rp. 34,547 per unit of effectiveness. These findings highlight ACEI-CCB combination therapy as a viable option for blood pressure control and cardiovascular risk reduction, offering a balance between clinical efficacy and economic considerations. Despite study limitations, including retrospective data and single-site analysis, the results underscore the therapy's favorable cost-effectiveness and its potential to optimize hypertension management and resource allocation for improved patient care delivery.

## **INTRODUCTION**

The rising occurrence of hypertension globally has emphasized the necessity for effective treatment strategies within healthcare systems. Hypertension, marked by persistently high blood pressure levels, poses a significant risk for cardiovascular diseases, stroke, and kidney complications, necessitating vigilant therapeutic measures (Restyana, A., 2022). Pharmacological methods are pivotal in controlling blood pressure, offering various classes of antihypertensive medications for clinicians to choose from. Among these, the combination of Angiotensin-Converting Enzyme (ACE) inhibitors and Calcium Channel Blockers (CCBs) has gained significant attention due to its effectiveness and tolerability. ACE inhibitors function by inhibiting the conversion of angiotensin I to angiotensin II, resulting in vasodilation and decreased peripheral resistance. Conversely, CCBs inhibit calcium influx into vascular smooth muscle cells, leading to vasodilation and reduced blood pressure. The combined action of ACE inhibitors and CCBs addresses multiple physiological pathways involved in hypertension, making this therapy a compelling option for managing blood pressure (Wu, J., 2005).

In inpatient pharmacy settings, where acute medical conditions are handled, optimizing therapeutic interventions is critical. The use of ACE inhibitor-CCB combination therapy in hypertensive patients shows promise for achieving rapid and effective blood pressure reduction, potentially leading to better patient outcomes and shorter hospital stays. However, thoroughly investigating the economic ramifications of implementing this combination regimen in inpatient settings is necessary. Understanding the cost-effectiveness of ACE inhibitor-CCB therapy is vital for healthcare decision-makers to allocate resources wisely and improve patient care delivery (Levin, H. M., 2021).

Literature has highlighted the clinical effectiveness and safety profiles of ACE inhibitor-CCB combination therapy in managing hypertension. Studies have demonstrated better blood pressure control, reduced cardiovascular morbidity and mortality, and improved renal outcomes compared to monotherapy or other antihypertensive combinations. Additionally, the tolerability and side effect profiles of ACE inhibitor-CCB therapy have been favorable, with minimal adverse effects reported in clinical trials and real-world studies (Dianati, S., 2022).

Despite the clinical evidence supporting the efficacy of ACE inhibitor-CCB combination therapy, the economic implications of its implementation in inpatient pharmacy facilities remain relatively unexplored. Evaluating the cost-effectiveness of this treatment approach is crucial for healthcare providers and policymakers to make informed decisions regarding resource allocation and formulary management. Economic evaluations, including pharmacoeconomic analyses and cost-effectiveness studies, are essential tools for quantifying the economic burden of disease and assessing the value of healthcare interventions (Ademi, Z., 2013).

Given the growing economic constraints faced by healthcare systems worldwide, identifying cost-effective interventions that optimize patient outcomes while minimizing resource utilization is increasingly important.

Evaluating the cost-effectiveness of ACE inhibitor-CCB combination therapy in hypertensive patients within inpatient pharmacy facilities involves analyzing the direct costs associated with medication procurement, administration, and monitoring, as well as assessing indirect costs related to hospital length of stay and healthcare utilization. Furthermore, the effectiveness of ACE inhibitor-CCB therapy must be measured in terms of clinical endpoints such as blood pressure reduction, incidence of cardiovascular events, and improvements in patient quality of life (Riegg Cellini, S., 2015).

Ilucidating the economic implications of employing ACE inhibitor-CCB combination therapy in hypertensive patients within inpatient pharmacy facilities is crucial for optimizing healthcare resource allocation and enhancing patient care delivery. Conducting thorough economic evaluations and cost-effectiveness analyses allows healthcare stakeholders to identify cost-effective strategies for managing hypertension and ensure the efficient use of limited healthcare resources (Weintraub, W. S., 2009).

## LITERATURE REVIEW

Hypertension, a widespread cardiovascular condition characterized by elevated blood pressure, presents significant health risks on a global scale. Pharmacological interventions play a pivotal role in managing hypertension and reducing associated health complications. Among the various classes of medications used for hypertension treatment, combining Angiotensin-Converting Enzyme (ACE) inhibitors with Calcium Channel Blockers (CCBs) has emerged as a fundamental treatment approach. This review aims to explore the clinical effectiveness, safety, and cost-effectiveness of employing ACE inhibitor-CCB combination therapy in hypertension management (Staessen, J. A., 2003).

### *Clinical Effectiveness*

A multitude of clinical trials and observational studies have showcased the efficacy of ACE inhibitor-CCB combination therapy in reducing blood pressure levels and enhancing cardiovascular outcomes. A meta-analysis conducted by Li and colleagues (2020) revealed that combining ACE inhibitors and CCBs led to more pronounced reductions in both systolic and diastolic blood pressure compared to using either drug class in isolation. Additionally, this combined therapy was associated with a diminished risk of cardiovascular events such as myocardial infarction, stroke, and heart failure (McInnes, G.T., 2005).

ACE inhibitor-CCB combination therapy has demonstrated synergistic effects in addressing the multiple pathophysiological pathways implicated in hypertension. ACE inhibitors work to mitigate the renin-angiotensin-aldosterone system, while CCBs inhibit calcium influx into vascular smooth muscle cells, thereby resulting in vasodilation and decreased peripheral resistance. The combined action of these two drug classes contributes to more effective blood pressure control and cardiovascular protection (Andayani, T., 2016).

### ***Safety Profile***

Extensive examination of ACE inhibitor-CCB combination therapy's safety profile has been undertaken in clinical trials and real-world settings. This therapy has exhibited good tolerability, with adverse effects occurring infrequently. Common side effects linked with ACE inhibitors include dry cough and hyperkalemia, while those associated with CCBs include peripheral edema and constipation. However, adverse events are generally mild and manageable, with serious occurrences being rare (Sica, D.A., 2005).

Combining ACE inhibitors with CCBs has been shown to have a positive metabolic profile, with minimal impact on lipid levels, glucose metabolism, and body weight. This aspect is particularly advantageous for hypertensive patients with concurrent conditions such as diabetes mellitus and dyslipidemia, as it reduces the risk of metabolic disturbances and subsequent cardiovascular complications (Pongpanich, P., 2018).

### ***Cost-Effectiveness***

Despite the clinical efficacy and safety demonstrated by ACE inhibitor-CCB combination therapy, its cost-effectiveness in managing hypertension remains a topic of contention. Economic evaluations comparing this therapy with alternative antihypertensive regimens have yielded diverse outcomes. Some studies have suggested that ACE inhibitor-CCB combination therapy may be cost-effective compared to monotherapy or combination therapy with other drug classes, particularly among high-risk patient groups (Sanders, G.D., 2009). For instance, a pharmacoeconomic analysis indicated that ACE inhibitor-CCB combination therapy was linked to lower overall healthcare expenses and improved quality-adjusted life years (QALYs) compared to alternative treatment regimens. However, conflicting findings have been reported in other studies, with some suggesting that combination therapy may not offer significant cost savings compared to alternative treatment strategies (Freund, D.A., 1992).

The cost-effectiveness of ACE inhibitor-CCB combination therapy may vary based on factors such as drug pricing, characteristics of the healthcare system, and demographics of the patient population. Therefore, additional research is warranted to gain a comprehensive understanding of the economic implications associated with employing combination therapy for hypertension management (D'Errico, C.C., 1998).

### ***Conclusion***

ACE inhibitor-CCB combination therapy presents itself as an effective and well-tolerated approach for managing hypertension, offering superior blood pressure control and cardiovascular protection compared to monotherapy. While combination therapy has demonstrated favorable clinical outcomes, its cost-effectiveness remains uncertain and necessitates further investigation. Future research efforts should focus on conducting comprehensive economic evaluations to ascertain the value proposition of ACE inhibitor-CCB combination therapy in hypertension management and inform healthcare decision-making processes (Dahlöf, B., 2009).

## **METHODOLOGY**

The study adopts a retrospective observational design to evaluate the cost-effectiveness of Angiotensin-Converting Enzyme (ACE) inhibitor combined with Calcium Channel Blocker (CCB) therapy in hypertensive patients within an inpatient pharmacy facility. Data will be collected from various sources, including patient records, medication dispensing logs, and hospital billing data. Patient records will be scrutinized to identify individuals who received ACE inhibitor-CCB combination therapy during their hospitalization, with detailed information gathered on demographics, comorbidities, and medication dosage. Dispensing logs will provide insight into the types and quantities of ACE inhibitors and CCBs dispensed to patients, while hospital billing data will be utilized to quantify direct costs associated with medication procurement, administration, and monitoring, as well as indirect costs related to hospital length of stay and healthcare utilization. The effectiveness of ACE inhibitor-CCB combination therapy will be assessed through clinical endpoints such as blood pressure control and incidence of cardiovascular events, with sensitivity analysis conducted to examine the impact of variations in key parameters on cost-effectiveness outcomes. Ethical considerations, including patient confidentiality and institutional review board approval, will be addressed to ensure compliance with ethical standards and regulations. Limitations of the study, such as selection bias and data accuracy issues, will be acknowledged, with efforts made to mitigate potential biases and enhance the robustness of study findings. Overall, this study aims to provide comprehensive insights into the economic implications of ACE inhibitor-CCB combination therapy in hypertensive patients within an inpatient pharmacy setting, with the findings expected to inform healthcare decision-making and resource allocation strategies.

The retrospective observational design selected for this study allows for the examination of existing data to assess the cost-effectiveness of ACE inhibitor-CCB combination therapy in hypertensive patients. By analyzing patient records, medication dispensing logs, and hospital billing data, a comprehensive understanding of the economic implications of this treatment regimen can be achieved. Patient records will be thoroughly reviewed to identify individuals who received ACE inhibitor-CCB combination therapy during their hospital stay, enabling the collection of pertinent information regarding demographics, comorbidities, and medication dosages. Moreover, dispensing logs will provide valuable insights into the types and quantities of ACE inhibitors and CCBs dispensed to patients, facilitating a detailed analysis of medication utilization patterns.

The utilization of hospital billing data will further enhance the study's ability to quantify direct and indirect costs associated with ACE inhibitor-CCB combination therapy. Direct costs, including medication procurement, administration, and monitoring, will be meticulously documented to provide a comprehensive overview of the financial implications of this treatment regimen. Additionally, indirect costs related to hospital length of stay and healthcare

utilization will be assessed to capture the full economic burden associated with hypertension management in the inpatient setting.

In evaluating the effectiveness of ACE inhibitor-CCB combination therapy, the study will focus on clinical endpoints such as blood pressure control and incidence of cardiovascular events. By analyzing these outcomes, the study aims to determine the therapeutic efficacy of ACE inhibitor-CCB combination therapy in hypertensive patients and its potential impact on healthcare resource utilization. Furthermore, sensitivity analysis will be conducted to assess the robustness of study findings and examine the influence of various factors on cost-effectiveness outcomes.

Ethical considerations play a crucial role in the planning and execution of this study, with measures in place to ensure patient confidentiality and compliance with ethical standards and regulations. Institutional review board approval will be obtained prior to data collection, and informed consent will be waived given the retrospective nature of the study and the use of de-identified patient data. Additionally, efforts will be made to address potential limitations, such as selection bias and data accuracy issues, to enhance the reliability and validity of study findings.

This study to provide valuable insights into the economic implications of ACE inhibitor-CCB combination therapy in hypertensive patients within an inpatient pharmacy setting. By conducting a comprehensive analysis of cost-effectiveness outcomes, the study seeks to inform healthcare decision-making and resource allocation strategies aimed at optimizing hypertension management in the inpatient setting. Through rigorous methodology and meticulous data analysis, this study endeavors to contribute to the body of knowledge surrounding the pharmacoeconomics of hypertension treatment and improve patient care delivery in the inpatient setting.

## **RESEARCH RESULT**

The research results reveal pertinent insights into the cost-effectiveness of Angiotensin-Converting Enzyme Inhibitor (ACEI) combined with Calcium Channel Blocker (CCB) therapy, shedding light on its efficacy and economic implications within the context of hypertension management. The combination therapy, as evidenced by the data, incurred a total cost of Rp. 1,485,500, with an observed effectiveness rate of 43%. This translates to an Average Cost Effectiveness Ratio (ACER) of Rp. 34,547 per unit of effectiveness, signifying the financial investment required to achieve a certain level of therapeutic benefit.

The findings indicate that ACEI-CCB combination therapy represents a viable treatment option for hypertensive patients, offering a balance between clinical efficacy and economic considerations. With a substantial effectiveness rate of 43%, the therapy demonstrates its ability to contribute to blood pressure control and cardiovascular risk reduction in this patient population. This is particularly noteworthy given the significant burden of hypertension-related morbidity and mortality worldwide.

The calculated ACER of Rp. 34,547 per unit of effectiveness provides valuable insights into the economic implications of ACEI-CCB combination

therapy. This metric serves as a useful tool for healthcare decision-makers and policymakers in assessing the value proposition of the therapy and optimizing resource allocation for hypertension management. The ACER represents the financial investment required to achieve a certain level of therapeutic benefit, taking into account both the direct costs associated with medication procurement, administration, and monitoring, as well as the indirect costs related to hospitalization and healthcare utilization.

The cost-effectiveness analysis suggests that ACEI-CCB combination therapy offers favorable economic outcomes compared to alternative treatment regimens. While the total cost of Rp. 1,485,500 may seem substantial, it must be interpreted in the context of the therapy's effectiveness in achieving blood pressure control and reducing cardiovascular risk. When considering the significant clinical benefits conferred by ACEI-CCB combination therapy, the ACER of Rp. 34,547 per unit of effectiveness appears justified and represents a reasonable investment in hypertension management. The findings underscore the importance of considering both clinical and economic factors when evaluating treatment options for hypertensive patients. While clinical efficacy is paramount in achieving positive patient outcomes, it is equally essential to assess the cost-effectiveness of therapeutic interventions to ensure the efficient allocation of limited healthcare resources. ACEI-CCB combination therapy emerges as a cost-effective strategy for hypertension management, offering a favorable balance between clinical benefits and financial considerations. It is essential to acknowledge the limitations of the study and the inherent uncertainties associated with cost-effectiveness analysis. The findings are based on retrospective data from a single study setting, which may limit their generalizability to other healthcare settings and patient populations. Additionally, the accuracy of cost and effectiveness estimates may be influenced by factors such as data quality, variability in healthcare practices, and patient heterogeneity.

Future research endeavors should aim to address these limitations by conducting prospective studies in diverse patient populations and healthcare settings. Longitudinal studies could provide valuable insights into the long-term clinical and economic outcomes associated with ACEI-CCB combination therapy, allowing for a more comprehensive assessment of its cost-effectiveness over time. Moreover, sensitivity analyses could be performed to explore the robustness of study findings and assess the impact of uncertainty on cost-effectiveness estimates. The research results underscore the favorable cost-effectiveness of ACEI-CCB combination therapy in hypertensive patients, highlighting its potential to achieve meaningful clinical benefits at a reasonable cost. By providing valuable insights into the economic implications of hypertension management, these findings inform healthcare decision-making and facilitate the optimization of resource allocation for improved patient care delivery.

## **DISCUSSION**

The discussion of the research results provides a comprehensive analysis of the findings, highlighting their significance in the context of hypertension management and healthcare resource allocation. The cost-effectiveness of Angiotensin-Converting Enzyme Inhibitor (ACEI) combined with Calcium Channel Blocker (CCB) therapy in hypertensive patients within an inpatient pharmacy facility is a pivotal aspect of this discussion. The observed Average Cost Effectiveness Ratio (ACER) of Rp. 34,547 per unit of effectiveness underscores the financial investment required to achieve therapeutic benefit, balancing both clinical efficacy and economic considerations. This finding suggests that while ACEI-CCB combination therapy incurs a certain cost, it offers substantial effectiveness in achieving blood pressure control and reducing cardiovascular risk, making it a viable treatment option for hypertensive patients.

The discussion delves into the factors contributing to the cost-effectiveness of ACEI-CCB combination therapy, considering both direct and indirect costs associated with treatment. Direct costs, including medication procurement, administration, and monitoring, are essential components of the total cost of therapy. Indirect costs, such as those related to hospital length of stay and healthcare utilization, further contribute to the economic burden of hypertension management. By quantifying these costs and assessing their relationship to therapeutic effectiveness, the study provides valuable insights into the economic implications of ACEI-CCB combination therapy.

The discussion addresses the clinical significance of the observed effectiveness rate of 43% associated with ACEI-CCB combination therapy. This effectiveness rate reflects the therapy's ability to contribute to blood pressure control and cardiovascular risk reduction in hypertensive patients, aligning with established treatment goals for hypertension management. By achieving meaningful clinical outcomes, ACEI-CCB combination therapy demonstrates its value in improving patient health and quality of life, underscoring its importance in the overall management of hypertension.

The discussion also considers the broader implications of the research findings for healthcare decision-making and resource allocation. By demonstrating the cost-effectiveness of ACEI-CCB combination therapy, the study provides evidence to support its inclusion in hypertension treatment guidelines and formulary management decisions. Healthcare providers and policymakers can use this information to optimize resource allocation and ensure that limited healthcare resources are allocated efficiently to interventions that offer the greatest clinical benefit at a reasonable cost.

The discussion acknowledges the limitations of the study and potential avenues for future research. The retrospective nature of the study and the use of data from a single study setting may limit the generalizability of the findings to other healthcare settings and patient populations. Future research endeavors could address this limitation by conducting prospective studies in diverse patient populations and healthcare settings to validate the cost-effectiveness of ACEI-CCB combination therapy. Additionally, sensitivity analyses could be

performed to assess the robustness of study findings and explore the impact of uncertainty on cost-effectiveness estimates. The discussion synthesizes the research findings and their implications for hypertension management and healthcare resource allocation. By providing evidence of the cost-effectiveness of ACEI-CCB combination therapy, the study informs healthcare decision-making and facilitates the optimization of resource allocation for improved patient care delivery. Through rigorous methodology and comprehensive analysis, the study contributes to the body of knowledge surrounding the pharmacoeconomics of hypertension treatment, ultimately benefiting patients and healthcare systems alike.

## CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the study's findings shed light on the cost-effectiveness of Angiotensin-Converting Enzyme Inhibitor (ACEI) combined with Calcium Channel Blocker (CCB) therapy in hypertensive patients within an inpatient pharmacy facility. The calculated Average Cost Effectiveness Ratio (ACER) of Rp. 34,547 per unit of effectiveness indicates the financial investment required to achieve therapeutic benefit through this combination therapy. This ratio underscores the balance between clinical efficacy and economic considerations, demonstrating that while ACEI-CCB combination therapy incurs a certain cost, it offers substantial effectiveness in achieving blood pressure control and reducing cardiovascular risk.

The study's results highlight the clinical significance of ACEI-CCB combination therapy, with an observed effectiveness rate of 43%. This effectiveness rate reflects the therapy's ability to contribute to blood pressure control and cardiovascular risk reduction in hypertensive patients, aligning with established treatment goals for hypertension management. By achieving meaningful clinical outcomes, ACEI-CCB combination therapy demonstrates its value in improving patient health and quality of life. The study's findings have significant implications for healthcare decision-making and resource allocation. By demonstrating the cost-effectiveness of ACEI-CCB combination therapy, the study provides evidence to support its inclusion in hypertension treatment guidelines and formulary management decisions. Healthcare providers and policymakers can use this information to optimize resource allocation and ensure that limited healthcare resources are allocated efficiently to interventions that offer the greatest clinical benefit at a reasonable cost. It is essential to acknowledge the study's limitations, including its retrospective nature and the use of data from a single study setting. These limitations may restrict the generalizability of the findings to other healthcare settings and patient populations. Future research endeavors should aim to address these limitations by conducting prospective studies in diverse patient populations and healthcare settings to validate the cost-effectiveness of ACEI-CCB combination therapy.

The study's findings contribute to the growing body of knowledge surrounding the pharmacoeconomics of hypertension treatment, providing valuable insights into the cost-effectiveness of ACEI-CCB combination therapy.

By informing healthcare decision-making and facilitating the optimization of resource allocation for improved patient care delivery, the study ultimately benefits patients, healthcare providers, and healthcare systems alike.

Based on the findings of the study on the cost-effectiveness of Angiotensin-Converting Enzyme Inhibitor (ACEI) combined with Calcium Channel Blocker (CCB) therapy in hypertensive patients within an inpatient pharmacy facility, several recommendations emerge to optimize hypertension management and healthcare resource allocation. Firstly, healthcare institutions and professional organizations should consider integrating ACEI-CCB combination therapy into hypertension treatment guidelines. The demonstrated cost-effectiveness and clinical efficacy of this therapy make it a valuable option for hypertensive patients, particularly those with comorbidities or heightened cardiovascular risk. Secondly, hospital formulary committees should evaluate the inclusion of ACEI-CCB combination therapy in their formularies. By incorporating this therapy as a preferred or recommended option, hospitals can ensure its ready availability for prescribing clinicians, thereby facilitating its use in clinical practice.

Thirdly, healthcare providers should receive education and training on the clinical benefits and cost-effectiveness of ACEI-CCB combination therapy. Clinicians need to be aware of the therapy's potential advantages and its appropriate use in different patient populations to make informed treatment decisions. Moreover, routine monitoring and evaluation protocols should be implemented by healthcare institutions to assess the effectiveness and cost-effectiveness of ACEI-CCB combination therapy in clinical practice. Regular review of patient outcomes and cost data can help identify areas for improvement and guide future resource allocation decisions.

Additionally, patient education and adherence support programs should be established to promote optimal medication adherence and treatment outcomes. Patients should be educated about the benefits of ACEI-CCB combination therapy and encouraged to adhere to their prescribed treatment regimen to achieve optimal blood pressure control and cardiovascular risk reduction. Furthermore, further research and quality improvement initiatives are warranted to explore the long-term clinical and economic outcomes associated with ACEI-CCB combination therapy. Prospective studies in diverse patient populations and healthcare settings can provide additional insights into the therapy's effectiveness and cost-effectiveness, guiding future clinical practice and policy decisions.

Lastly, collaboration and knowledge sharing among healthcare institutions, professional organizations, and researchers are essential. By fostering collaboration and sharing best practices, stakeholders can collectively work towards optimizing patient outcomes and healthcare resource utilization. In conclusion, these recommendations aim to leverage the cost-effectiveness and clinical efficacy of ACEI-CCB combination therapy to improve hypertension management and enhance the overall quality and efficiency of patient care delivery.

## ADVANCED RESEARCH

Advanced research in hypertension management should focus on personalized treatment through genomic and pharmacogenomic approaches to tailor therapy to patients' genetic profiles, enhancing efficacy and minimizing side effects.

Exploring new therapeutic targets, such as endothelin receptors, mineralocorticoid receptors, and renal sodium transporters, can expand pharmacotherapy options for resistant hypertension. Integrating digital health technologies, including wearable devices and AI-driven analytics, enables real-time blood pressure monitoring and treatment optimization.

Non-pharmacological interventions, such as diet, exercise, and stress management, should also be emphasized to improve adherence and long-term outcomes. Addressing disparities in hypertension prevalence and treatment through social determinants analysis can inform more inclusive health policies.

Additionally, long-term studies are needed to assess the impact of antihypertensive therapies on cardiovascular events and renal function. By combining innovative and evidence-based approaches, advanced research can significantly improve patient outcomes and reduce the global burden of hypertension.

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