

Comparison of direct medical cost between ramipril and candesartan in hospitalized acute decompensated heart failure at West Nusa Tenggara Regional Hospital



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ABSTRACT

Introduction: Pharmacoeconomy is the field of study regarding costs analysis associated with the use of drugs in health care. The purpose of pharmacoeconomics is to compare a different drug used in the treatment with the same condition or can be the opposite, i.e. comparing different treatments in different circumstances. The purpose of this study is to determine and compare the average efficiency of direct medical costs between ramipril and candesartan combination drug in hospitalized heart failure patients with a payer perspective at the West Nusa Tenggara Regional General Hospital, Mataram, Indonesia.

Method: This study is part of an economic evaluation of direct medical cost analysis research in hospitalized heart failure patients with a payer perspective. Study design using a retrospective approach involving 45 patients with heart failure who met the study inclusion criteria and

exclusion criteria. Independent t-test was used to compare the direct medical cost between ramipril and candesartan.

Results: The average gross total cost of using ramipril combination was Rp. 4,197,011 while the average total cost of using candesartan combination was Rp. 3,099,088. These results indicate there are savings in the average total cost of treatment for heart failure using candesartan that is Rp. 1,097,923. Candesartan combination provides the lowest value and is a more efficient choice compared to ramipril combination. Meanwhile, after t-test comparison reveal no significant different average direct medical costs in patients using the ramipril combination compared with the candesartan combination ($p > 0.05$).

Conclusion: The results of this study indicate that there is no significant difference between the average direct medical costs in patients using ramipril compared with candesartan combination.

Keywords: heart failure, ramipril, candesartan, cost analysis, direct medical costs.

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INTRODUCTION

The heart is the most important organ in circulation. The heart works to pump blood throughout the body to meet the body's metabolic needs at all times, both at rest and work. Most sufferers live after having a heart attack but then suffer heart failure.^{1,2} Heart failure is a clinical syndrome caused by structural and/or functional abnormalities. Heart failure is a growing problem throughout the world, with more than 20 million people affected by heart failure.³⁻⁵ In developed countries the prevalence of heart failure in the adult age group reaches 2% of the population.⁶ The prevalence of heart failure increases with age and affects 6-10% of people over 65 years.⁷⁻⁹

The World Health Organization (WHO) notes that 17.9 million people worldwide die from cardiovascular disorders with a percentage of 31% of deaths worldwide. More than 75% of cardiovascular sufferers occur in low and middle-income countries, and 80% of cardiovascular deaths are

caused by heart attacks and strokes.¹⁰ In Indonesia, as many as 13,395 people with heart failure undergoing hospitalization, while as many as 16,431 people were undergoing outpatient treatment in all hospitals around Indonesia. In 2018 the results of Basic Health Research showed that the incidence of heart failure increased by 1.5% in Indonesia. While in the West Nusa Tenggara region the prevalence is 0.8%.¹¹

The additional cost-effectiveness ratio to expand the coverage of all heart failure patients is \$ 9,700 per life-year gained obtained in the base case. An analysis of the worst case of heart failure assuming simultaneous conservative results in an additional cost-effective ratio of \$ 110,000 per life-year gained. In a probabilistic sensitivity analysis, 99.74% of the possible additional ratios of cost-effective heart failure that were <\$ 50,000 per life-year gained.^{12,13} The cost of treatment is a very important issue for developing countries like Indonesia. One that

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affects the amount of the cost of handling heart failure is the type of drug used. Therefore in the treatment of heart failure a rational and comprehensive treatment is needed to achieve optimal medical service.¹⁴⁻¹⁶

Pharmacoeconomics is the field of study regarding costs analysis associated with the use of drugs in health care. The purpose of pharmacoeconomics is to compare a different drug used in the treatment with the same condition or can be the opposite, ie comparing different treatments in different conditions.¹⁷ The results of the pharmacoeconomics can be used as a reference or assist policymakers in determining choices for available treatment alternatives so that health services become more efficient and economical. The study aims to determine and compare the average efficiency of direct medical costs between ramipril and candesartan combination drug in hospitalized heart failure patients with a payer perspective at the West Nusa Tenggara Regional General Hospital, Mataram, Indonesia.

METHOD

This study is part of a hospital economic evaluation of direct medical cost analysis in acute decompensated heart failure hospitalization. Study design using a retrospective approach with a payer's perspective.¹⁸ The inclusion criteria in this study were patients with main diagnoses of acute decompensated heart failure who were hospitalized in West Nusa Tenggara Regional Hospital who were seeking treatment in the period 2018.

The type of data in this study is secondary data from hospital information system (SIRS), where the data obtained was the primary diagnosed heart failure patient data that met the patient criteria in the study which included age, sex, concomitant diseases and use of combination of ramipril (furosemide 40 mg, spironolactone 25 mg, bisoprolol 5 mg, ramipril 5 mg) or using a combination of candesartan (furosemide 40 mg, spironolactone 25 mg, bisoprolol 5 mg, candesartan 16 mg) West Nusa Tenggara Regional Hospital 2018. The criteria used in assessing costs is the comparison between heart failure patients using the combination of ramipril compared to candesartan combination. A total of 240 patients diagnosed with heart failure who received treatment at West Nusa Tenggara Regional Hospital in 2018, 45 samples were obtained that met the inclusion criteria, 33 patients were using the Ramipril combination and 12 patients using the candesartan combination.

Statistical analysis in this study using SPSS version 21.0 (IBM Corporation, Armonk, NY, USA). Independent t-test was used to compare

direct medical cost between ramipril and candesartan combination. All value considered significant if $p < 0.05$.

RESULT

Characteristics of the study

Based on the results of this study indicate that inpatient heart failure patients in RSUDP NTB who received therapy with the combination of ramipril were 17 people (51.52%) were male and 16 people (48.48%) were female. While those who received candesartan therapy were 8 people (66.67%) who were male and 4 people (33.33%) were female. These results indicate that more heart failure patients are male than female. Meanwhile, in age characteristics shows, 18-65 years of age most diagnosed with heart failure by 81.82% and age ≥ 65 years by 18.18%. While the characteristics of age at Candesartan are age 35-65 years as much as 58.34% and age ≥ 65 years as much as 41.66%. Based on characteristics of concomitant diseases in the ramipril combination group of 90.9% had concomitant diseases and as many as 9.1% who did not have concomitant diseases. Whereas in the candesartan combination group all patients had concomitant disease (100%). In both groups it was seen that the majority of heart failure patients in the were mostly accompanied by concomitant diseases. Life status characteristics shows in the ramipril group patients mostly died (57.58%) compared to the number of living patients by 42.42%. Whereas in the candesartan group it was known that heart failure patients who died by 66.67% and patients living by 33.33% (Table 1).

Direct Medical Cost

The description of medical expenses at the hospital can be used as input in determining the planning and control of hospital services. Costs that will be calculated in this study are direct medical costs including ramipril and candesartan drugs, other drugs, medical equipment costs, doctor's fees, nurse fees, laboratory fees and accommodation costs.

Based on table 2, the average cost of drugs for heart failure patients using a combination of ramipril and candesartan combination has a different amount of costs. The difference in costs in each class is influenced by differences in length of stay, the number of drugs used and comorbidities besides heart failure and the types of drugs consumed so that it affects the costs that must be paid by the payer. The payer in this case is the Indonesian National Health Insurance Administering Agency (BPJS).

Table 1 Clinical characteristics

Characteristics	Drugs combination		Total (n=45)		Percentage (%)	
	Ramipril	Candesartan	Ramipril n=33	Candesartan n= 12	Ramipril	Candesartan
Sex	Male	Male	17	8	51.51%	66.66%
	Female	Perempuan	16	4	48.48%	33.33%
Age	18-65 years	36-65 tahun	27	7	81.81%	58.33%
	≥ 65 years	≥ 65 tahun	6	5	18.18%	41.66%
Comorbidities	With comorbidities	With comorbidities	3	0	90.9%	100%
	Without comorbidities	Without comorbidities	30	12	9.1%	0%
Status	Alive	Alive	14	4	42.42%	33.33%
	Death	Death	19	8	57.57%	66.66%

Tabel 2 Medication cost between ramipril and candesartan combination

Medication	Inpatient class	Number of patient	Item total cost (IDR)	Average medication cost (IDR)
Ramipril	VIP	5	71,773	14,355
	1	2	44,213	22,106
	2	7	77,017	11,002
	3	19	242,055	12,739
Candesartan	VIP	3	74,948	24,983
	1	1	26,964	26,964
	2	2	24,771	12,385
	3	6	123,401	20,566

Table 3 Others medication cost comparison between ramipril and candesartan combination

Medication	Inpatient class	Number of patient	Item total cost (IDR)	Average medication cost (IDR)
Ramipril	VIP	5	1,918,688	383,738
	1	2	5,497,997	2,748,998
	2	7	766,951	110,993
	3	19	19,897,806	1,047,252
Candesartan	VIP	3	1,849,651	616,550
	1	1	318,754	318,754
	2	2	148,499	74,249
	3	6	1,991,553	331,925

Tabel 4 Medical equipment cost comparison between ramipril and candesartan combination

Medication	Inpatient class	Number of patient	Item total cost (IDR)	Average equipment cost (IDR)
Ramipril	VIP	5	573,594	114,719
	1	2	643,676	321,838
	2	7	620,930	88,704
	3	19	26,330,366	1,385,808
Candesartan	VIP	3	845,265	281,755
	1	1	219,409	219,409
	2	2	54,062	27,031
	3	6	1,140,748	190,124

Tabel 5 Average doctor visit and hospitalization cost comparison between ramipril and candesartan combination

Medication	Inpatient class	Number of patient	Item total cost (IDR)	Average fee cost (IDR)
Doctor visit fee				
Ramipril	VIP	5	2,625,000	525,000
	1	2	1,020,000	510,000
	2	7	1,000,000	142,857
	3	19	3,620,000	190,526
Candesartan	VIP	3	3,875,000	1,291,667
	1	1	180,000	180,000
	2	2	220,000	110,000
	3	6	1,200,000	200,000
Hospitalization cost				
Ramipril	VIP	5	5,695,350	1,139,070
	1	2	5,898,600	2,949,300
	2	7	3,579,200	511,314
	3	19	17,974,973	946,051
Candesartan	VIP	3	3,647,133	1,215,711
	1	1	394,600	394,600
	2	2	741,223	370,616
	3	6	5,030,075	838,345

Tabel 6 Average laboratory cost comparison between ramipril and candesartan combination

Medication	Inpatient class	Number of patient	Item total cost (IDR)	Average cost (IDR)
Laboratory cost				
Kombinasi Ramipril	VIP	5	4.707.050	941.410
	1	2	1,645,000	822,500
	2	7	2,389,783	341,397
	3	19	8,306,340	422,965
Kombinasi Candesartan	VIP	3	1.749.000	583.000
	1	1	205,000	205,000
	2	2	389,000	194,500
	3	6	1,690,000	281,666
Accommodation cost				
Ramipril	VIP	5	6.500.000	1.300.000
	1	2	2,550,000	1,275,000
	2	7	1,875,000	267,857
	3	19	6,300,000	331,578
Candesartan	VIP	3	8.150.000	2.716.667
	1	1	300,000	300,000
	2	2	450,000	225,000
	3	6	1,450,000	241,666

Based on [table 3](#), the average cost of other drugs for heart failure patients using the combination of ramipril and candesartan combination has a different amount of costs. Costs for drugs other

than heart failure include medications used to treat comorbidities in addition to heart failure. Common comorbidities in heart failure patients are hypertension, diabetes mellitus, and myocardial infarction.

Non-cardiovascular drugs used include ranitidine, lansoprazole, metformin, simvastatin, clopidogrel, and ceftriaxone.

Based on [table 4](#), the average cost of medical devices for heart failure patients using a combination of ramipril and candesartan has a different amount of costs. The difference in the cost of medical equipment in each class is influenced by differences in length of stay and the number of equipment used, so that it affects the cost that must be paid by the payer.

Based on [table 5](#), the average cost of doctors fee and hospitalization cost using a combination of ramipril and candesartan combination has a different amount of costs. The difference in costs in each class is influenced by differences in length of stay, number of drugs, medical equipment and service (oxygen installation, blood sampling, adult infusion set), and comorbidities in addition to heart failure and types of drugs used, so that influenced the costs to be paid by the National Health Insurance (BPJS).

Based on [table 6](#), there is a difference in the cost of the laboratory and accommodation between ramipril and candesartan combination. Laboratory examination costs are preoperative and postoperative preparations, for patients who will undergo surgery required an individual examination based

on the patient's condition. Differences in patient conditions cause different types, amounts and laboratory costs that must be incurred during treatment. Meanwhile, difference in accommodation cost due to class difference that affects the costs borne by patients. The cost for each class is different because the facilities of each room class are different. The cost of the VIP class is greater because the number of beds in the room has complete facilities compared to other treatment classes.

Based on [table 7](#), the average cost of emergency room much higher in the ramipril combination Rp. 241,667 compared to the candesartan combination of Rp. 142,857. This is because the actual number of patients who get the ramipril combination more than patients who get the candesartan combination. Meanwhile, the average cost of the intensive cardiac care unit on the ramipril combination is Rp. 700,000, while for candesartan combinations Rp. 0. This happens due to samples in studies that received candesartan combination therapy none were treated in the intensive ward.

Direct medical cost analysis

Based on [table 8](#), the average direct medical costs of patients using the Ramipril combination amounted to IDR 4,197,011 while the average direct medical

Table 7 Average emergency and intensive cardiac care unit cost comparison between ramipril and candesartan combination

Medication	Item total cost (IDR)	Average cost (IDR)
Emergency department cost		
Kombinasi Ramipril	2,900,000	241,667
Kombinasi Candesartan	1,000,000	142,857
Intensive cardiac care unit cost		
Kombinasi Ramipril	3,500,000	700,000
Kombinasi Candesartan	0	0

Table 8 Direct medical cost comparison between ramipril and candesartan

Medication	Inpatient class	Number of patient	Total direct medical cost (IDR)	Average direct medical cost (IDR)	p
Ramipril	VIP	5	22,591,455	4,518,291	0.570
	1	2	19,049,486	9,524,743	
	2	7	11,908,881	1,701,269	
	3	19	84,951,540	4,471,134	
Total			138,501,362	4,197,011	
Candesartan	VIP	3	20,290,997	6,763,666	
	1	1	1,744,727	1,744,727	
	2	2	2,027,555	1,013,778	
	3	6	13,125,777	2,187,630	
Total			37,189,056	3,099,088	
Mean difference of direct medical cost				IDR 1,097,923	

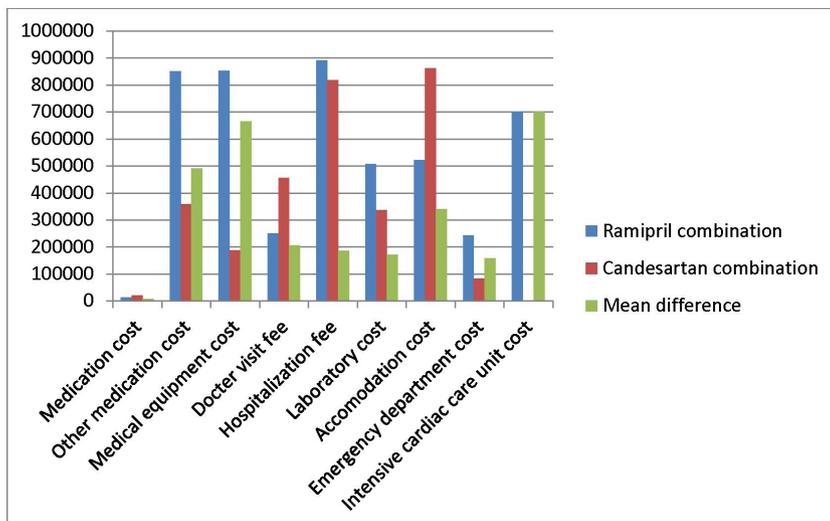


Figure 1 Comparison graph between all study parameter between ramipril and candesartan combination

costs of patients using the candesartan combination amounted to IDR 3,099,088. The difference between the average direct medical costs between a combination of ramipril and candesartan is Rp. 1,097,088. These results can illustrate that candesartan drugs are more cost-effective than ramipril drugs. Candesartan can provide lower economic value in the treatment of heart failure compared with ramipril. Meanwhile, after t-test comparison we found $p=0.570$ ($p<0.05$) which means there is no significant difference between the average direct medical costs in patients using the ramipril combination compared with the candesartan combination. However, mathematically the cost of candesartan is more efficient compared to ramipril. Graph comparison between all cost parameter can be seen in [figure 1](#).

DISCUSSION

According to Choi et al. the incidence of heart failure is more common in men than women, this is related to lifestyle and other risk factor such as smoking and alcohol consumption.¹⁹ Study by Mosterd et al. age is one of the factors that influence the incidence of heart failure, older age contribute as a factor for developing heart failure by 10% if it is not matched by a healthy lifestyle.⁷ Lawson et al. study >85% of patients with heart failure have comorbidities or comorbidities.²⁰ The World Health Organization (WHO) notes that 17.9 million people worldwide die from cardiovascular disorders with a percentage of 31% of deaths worldwide.¹⁰

The cost of each patient varies due to the length of time the patient has been inpatient and treatment. The results obtained are similar to Rahmawati et al.

research which states that the use of candesartan drugs is more efficient than the use of other medications for treatment in patients with heart failure.²¹

Another study conducted by Schadlich et al. Regarding cost effectiveness of ramipril in patients with heart failure in myocardial infarction in Germany, there is a variation in the value of ramipril that is 2500 to 8300 deutschemarks (DM) per life-year gained and ramipril shows a favourable cost incremental cost-effectiveness ratio in heart failure treatment compared to placebo.²²

Another study conducted in Indonesia by Baroroh et al. Regarding the cost-effectiveness of candesartan compared to the combination of candesartan amlodipine in patients with hypertension in the setting of an outpatient clinic, it shows that candesartan alone has a better cost-effectiveness of IDR 580,993 in one month of treatment.²³

CONCLUSION

We concluded there was no significant difference between the average direct medical costs in patients using the ramipril combination compared with the candesartan combination. Economically the candesartan combination drug saves more costs (IDR 3,099,088) compared to the ramipril combination (IDR 4,197,011) with an average difference in cost of Rp. 1,097,923.

CONFLICT OF INTEREST

The authors declare there is no conflict of interest regarding publication of current study.

FUNDING

The current study doesn't receive any specific grant from government or any private sectors.

ETHICAL STATEMENT

This study was conducted after obtaining ethical clearance from director of West Nusa Tenggara Regional Hospital, with ethical clearance reference number number 070/2037/RSUDP NTB.

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