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Cost Effectiveness Analysis (CEA) of Antihypertensives Use in Inpatient Hemodialysis Patients at Abdoel Wahab Sjahranie Hospital Samarinda

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ABSTRACT

Hypertension is the first comorbid disease that can occur in patients with damaged kidney function. Apart from that, hypertension is a complicating disease that often occurs during the hemodialysis process. The large variations in the use of antihypertensives in patients with chronic renal failure on hemodialysis therapy can affect the cost incurred by these patients. The purpose of this study was to optimize the use of the most cost-effective and pharmacological antihypertensive drugs in patients undergoing hemodialysis therapy. This research is a descriptive study with a pharmacoeconomic approach using the Cost Effectiveness Analysis (CEA) method. The measurement indices used to analyze the data are ACER and ICER. Data collection was conducted retrospectively, taken from the medical records of inpatient hemodialysis patients by reviewing the inclusion data of patients who were eligible to be research objects. Direct medical costs were taken from the average cost of hemodialysis, other procedures, room costs and drug costs. The effectiveness of drug therapy was determined based on the Mean Arterial Pressure (MAP) value that met the normal value. Research data is grouped based on therapy patterns and then analyzed to obtain cost – effective therapy. The results of the study showed that the percentage effectiveness of antihypertensive therapy with Furosemide was 46%, the combination of Amlodipine and Candesartan was 69% and the combination of Furosemide, Amlodipine, and Candesartan was 56%. Based on the ACER value of Rp. 1,726,133.4, the combination of antihypertensive Amlodipine and Candesartan is the most cost-effective therapy option and based on the ICER value of Rp. -6,697,330.3, the combination of antihypertensive Amlodipine and Candesartan is also the most cost-effective therapy option.

1. Introduction

Hemodialysis is a kidney replacement therapy that uses special equipment to treat symptoms and signs of low glomerular filtration rate, which is expected to prolong life and improve the quality of life of patients (PENEFRI, 2008). Hemodialysis is the most commonly used kidney replacement therapy for chronic kidney disease patients in Indonesia. The hemodialysis process is generally carried out around 2-3 times per week and takes 4-5 hours (Pasaribu et al., 2021).

Based on research entitled Epidemiology of hemodialysis outcomes, it shows that almost 4 million people in the world are living with renal replacement therapy, and hemodialysis remains the most commonly used form of renal replacement therapy, accounting for approximately 69% of all renal replacement therapy and 89% of all dialysis (Bello et al., 2022). Of the total population worldwide, the prevalence of chronic kidney disease is known to be >10% with the number of sufferers being around 843.6 million people (Kovesdy, 2022). Data from the World Health Organization (WHO)

shows that around 1.5 million people are undergoing hemodialysis therapy. In Indonesia, there was a decrease in the number of new patients and active patients undergoing hemodialysis in 2020 compared to the previous year. This data estimates that there were 61,786 new patients and 130,931 active patients (PERNEFRI, 2020). Based on the 2023 Indonesian Health Survey, in East Kalimantan, the prevalence of chronic kidney disease in the population aged ≥15 years was 8,929 (0.21%), and based on Basic Health Research in 2018, patients undergoing hemodialysis therapy in East Kalimantan were 15.20%. Based on data in the hemodialysis room at Abdoel Wahab Sjahranie Hospital, Samarinda in 2024, in June 2024, there were 185 people with chronic kidney disease undergoing hemodialysis therapy at Abdoel Wahab Sjahranie Hospital.

Hypertension is the most common comorbidity in end-stage chronic kidney disease, reaching 60% (PERNEFRI, 2020). During the hemodialysis process, patients can experience an increase or decrease in blood pressure (Omega et al., 2023). In previous research, it was found that the most common complicating hemodialysis disease was hypertension, namely 54.5% (Gusti et al., 2019). Apart from that, data in 2020 also states that the most common complication during hemodialysis is intradialytic hypertension, namely 30% (PERNEFRI, 2020). Chronic kidney disease patients with cases of intradialytic hypertension have a 59% risk of death compared to cases of intradialytic hypotension (Husna et al., 2024). Therefore, hemodialysis patients can be given or must take antihypertensives to manage or control the patient's high blood pressure (Tuladhar et al., 2023).

The National Kidney Foundation-Kidney Disease Outcomes Quality Initiative (NKF-KDOQI) recommends that the blood pressure in hemodialysis patients that must be achieved is <140/90 mmHg pre-dialysis and <130/80 mmHg post-dialysis. One strategy to control or achieve blood pressure targets in chronic kidney disease patients undergoing dialysis therapy is to use blood pressure-lowering or antihypertensive drugs. Based on previous research, of the 189 patients undergoing hemodialysis, they took at least one antihypertensive drug, and they took an average of 1.8 antihypertensive drugs (Haase et al., 2019). The antihypertensives commonly given to hemodialysis patients vary widely. Based on previous research, the use of single antihypertensive drugs as therapy for kidney failure patients undergoing hemodialysis therapy is amlodipine 38.7%, valsartan 32.7%, candesartan 16.3%, spironolactone 8.2% and furosemide 4.1%, while for combination therapy that is often used is amlodipine with valsartan 35.6% and amlodipine with candesartan 32.2% as well as triple therapy combinations. or more, the most common are amlodipine, bisoprolol, and valsartan 13.1% (Auliafendri & Khairiati, 2022).

The large variation in the use of antihypertensives in chronic kidney disease patients undergoing hemodialysis therapy can affect the costs incurred by these patients. The limited pharmacoeconomic studies on antihypertensives in hemodialysis patients make pharmacoeconomic knowledge very important to optimize the efficiency of the use of the most cost-effective and pharmacological antihypertensive drugs for patients undergoing hemodialysis therapy. This study can help identify cost-effective hypertension therapy options in hemodialysis patients, with accurate cost data, strong clinical outcome data, and careful analysis can produce relevant information for decision makers and consider patient treatment. Therefore, researchers want to conduct this study.

2. Materials and Methods

This study uses a retrospective analytical descriptive research design with a purposive sampling method, taking sources from medical records from January 2023 to July 2024. This research will be carried out at the Abdoel Wahab Sjahranie Samarinda Regional General Hospital. The total sample in this study was 85 patients, and only 42 patients met the inclusion and exclusion criteria. The inclusion criteria were inpatients undergoing hemodialysis therapy at the Abdoel Wahab Sjahranie Hospital who received antihypertensives, BPJS insurance patients, patients aged >17 years, patients who have medical record data including personal data, treatment history and blood pressure data, patients who have invoices or payment receipts, patients who use the same treatment regimen from the first day of treatment until discharge, then the exclusion criteria are patients who died and patients with incomplete or missing data. The materials used are medical record data of hemodialysis patients who use antihypertensives at the Abdoel Wahab Sjahranie Regional General Hospital in Samarinda and invoices and payment receipts listed in the hospital's financial data. The tools used in this research are data collection sheets, writing tools for taking notes, calculating tools, and computers for data processing, namely using the Microsoft Excel application. This research received approval from the

Health Research Ethics Committee of Abdoel Wahab Sjahranie Samarinda Regional General Hospital with Letter Number: 559/KEPK-AWS/X/2024.

2.1. Data Analizes

The first blood pressure data was recorded when the patient was first admitted to the hospital, and the last blood pressure was recorded when the patient was discharged. The first and last blood pressure data are calculated using the MAP (Mean Arterial Pressure) formula to see if there is a decrease in blood pressure. The results of this calculation are used to determine whether or not the treatment has been achieved. MAP is the average blood pressure during one cardiac cycle, which is calculated based on systolic and diastolic blood pressure. The normal range for MAP is between 70-100 mmHg (Masruroh & Santoso, 2020). The MAP value can be calculated using the following formula **MAP = (2(DBP) + SBP)/3**, with DBP = Diastolic Blood Pressure, and SBP = Systolic Blood Pressure.

Then to find out the effectiveness of antihypertensive drugs, either individually or in combination, used by patients, the following formula is used: Effectiveness = Number of Patients Who Reach the Target/Number of Patients Using the Drug x 100%.

The data was taken based on the analysis method of the use of antihypertensive drugs used in hemodialysis patients at RSUD Abdoel Wahab Sjahranie Samarinda, namely the achievement of therapy targets and total direct costs to be analyzed using the Average Cost Effectiveness Ratio (ACER) and Incremental Cost Effectiveness Ratio (ICER) values. The ACER and ICER values can be calculated using the formula:. ACER and ICER values can be calculated with the formula:

$$\text{ACER} = \frac{(\text{Cost of Treatment (Rp)})}{(\text{Effectiveness of Treatment (\%)})} \text{ and ICER} = \frac{\text{Cost of A (Rp)} - \text{Cost of B (Rp)}}{\text{Effect of A (\%)} - \text{Effect of B(\%)}}$$

3. Results and Discussion

This research was conducted at Abdoel Wahab Sjahranie Hospital Samarinda in November 2024. This research was conducted using a purposive sampling method, data were taken from patient medical records at the inpatient installation of Abdoel Wahab Sjahranie Hospital Samarinda. Patient selection was carried out retrospectively, from a total population of 85 patients who met the inclusion criteria, 42 patients were selected. The Health Research Ethics Committee of the Abdoel Wahab Sjahranie Regional General Hospital of Samarinda has approval for this research with Letter Number: 559/KEPK-AWS/X/2024.

3.1. Patient Caracteristic

The results of data on the characteristics of hemodialysis inpatients at Abdoel Wahab Sjahranie Hospital were grouped by gender. In Table 1, data obtained from 42 patients shows that on average, the greater number of patients were women, namely 23 patients (55%). The results of this study are in line with the research of Ariyani et al (2019) with 55% female patients and Karwiti and Umizah (2023) research with 66% female patients, where both studies found that the majority of hemodialysis patients were women. Gender does not have a significant relationship with hemodialysis (Baroleh et al., 2019). Men and women have the same risk; only lifestyle can cause someone to suffer from kidney disease and have to undergo hemodialysis (Agustani et al., 2021).

Patient characteristics based on age in Table 1 show that the patients who underwent hemodialysis more often in this study were adult patients based on the Indonesian Ministry of Health (2009), namely 56-65 years, namely 13 patients (31%), followed by those aged 46-55, namely 10 patients (24%). This is according to research by Haiya et al (2024), namely 36.6%. Age is one of the factors that influences kidney function, where there will be a decrease in kidney function, a decrease in glomerular excretion rate, physiological changes such as increased response to vasoconstriction and impaired response to vasodilation, and worsening tubular function occur with increasing age (Ray & Reddy, 2023).

Patient characteristics based on comorbidities in Table 1 found that 29 patients had hypertension alone (69%), while the others had hypertension with comorbidities (31%). Hypertension is the most common comorbidity (60%) and a complicating disease in hemodialysis patients (30%) (PERNEFRI, 2020. This is because hypertension is closely related to kidney health, where hypertension is the main factor that can trigger the development of kidney failure, and conversely, kidney conditions that are not functioning normally can cause an increase in blood pressure, which leads to hypertension.

Hypertension can worsen kidney damage by increasing intraglomerular pressure, which then triggers both structural and functional disorders of the glomerulus. Apart from that, hypertension can increase the workload of the heart, damage kidney blood vessels, disrupt the filtration process, and worsen the severity of hypertension itself (Artiany et al., 2021).

Patient characteristics are based on Table 1. Patients with the highest length of stay were <6 days (58%). Based on research from Ferdianto and Rizaldy (2023), a smaller aLOS (Advanced Length Of Stay) value indicates that the better the quality of service provided to patients, when viewed from an economic perspective, this results in lower costs incurred by patients (Ferdianto & Rizaldy, 2023).

Table 1. Caracteristic Patient in Inpatient Hemodialysis Patients at Abdoel Wahab Sjahranie Hospital Samarinda

Characteristics	Frequency (N=42)	Percentage (%)
Gender		
Male	19	45
Female	23	55
Age		
17-25 (Late Teens)	3	7
26-35 (Early Adulthood)	3	7
36-45 (Late Adulthood)	9	21
46-55 (Early Seniors)	10	24
56-65 (Late Seniors)	13	31
≥66 (Seniors)	4	10
Comorbid		
Hypertension without other comorbidities	29	69
Hypertension with other comorbidities	13	31
Length of Stay (LOS)		
<6	24	57
6-9	14	34
>9	4	9

3.2. Effectiveness of Therapy

The results of the analysis of the effectiveness of antihypertensive use using data from medical records of hemodialysis patients at Abdoel Wahab Sjahranie Regional Hospital are presented in Table 2. Based on the achievement of the antihypertensive target in Table 2 with the single administration of Furosemide, out of a total of 13 patients, there were 6 patients (46%) who achieved the target, for the combination therapy of Amlodipine and Candesartan which was given to 13 patients there were 9 patients (69%) who achieved the target. Meanwhile, for the combination therapy of Furosemide, Amlodipine, and Candesartan given to 16 patients, 9 patients (56%) achieved the target. Based on these results, it can be seen that the combination therapy of Amlodipine and Candesartan has higher effectiveness than single Furosemide therapy and combination therapy of Furosemide, Amlodipine, and Candesartan. The results of this study are in line with the results of previous research, Made Maharianingsih & Putri (2024), which stated that as many as 20% of patients with chronic kidney failure with hypertension received antihypertensive drugs with two types of drugs, namely Amlodipine and Candesartan. Candesartan and Amlodipine are known to reduce cardiovascular events and prevent the onset of diabetes in the long-term management of kidney disease (Wulandari et al., 2023).

3.3. Cost Effective Analysis

Treatment costs are calculated to determine cost effectiveness based on analysis of the Average Cost-Effectiveness Ratio (ACER) as shown in Table 3 and Incremental Cost-Effectiveness Ratio (ICER) calculation indices as shown in Table 4. Total costs are the accumulation of direct cost components and the total costs of antihypertensive drugs used by the patient. To strengthen the results of calculating the ACER values obtained, a comparison was made in the form of a therapy cost-effectiveness quadrant, which is presented in Figure 1.

Table 2. Effectiveness of antihypertensive in hemodialysis patients

Combination therapy	Frequency (N=42)	Percentage (%)	Effectiveness			
			Yes	Percentage (%)	No	Percentage (%)
Furosemide	13	31	6	46	7	54
Amlodipine + Candesartan	13	31	9	69	4	31
Furosemide + Amlodipine + Candesartan	16	38	9	56	6	44

Table 3. ACER value calculation

Combination therapy	Total Cost (IDR)	Effectiveness (%)	ACER
Furosemide	104.768.566	46	2.277.577.5
Amlodipine + Candesartan	119.103.205	69	1.726.133.4
Furosemide + Amlodipine + Candesartan	206.168.500	56	3.681.580.3

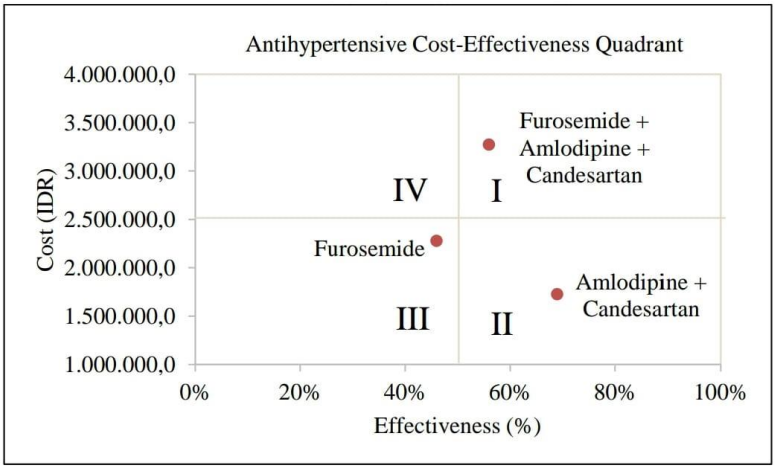

Fig. 1. Antihypertensive cost – effectiveness quadrant

Table 4. ACER value calculation

Combination therapy	Cost (IDR) (C)	Effectiveness (%) (E)	ΔC	ΔE	ICER ΔC/ΔE
Amlodipine + Candesartan	119.103.205	69	-87.065.295	13	-6.697.330.3
Furosemide + Amlodipine + Candesartan	206.168.500	56			

Based on Table 3 in the combination group of Furosemide, Amlodipine, and Candesartan is greater, which is IDR 3,681,580.3 compared to single Furosemide, which is IDR 2,277,577.5, and the combination of Amlodipine and Candesartan, which is IDR 1,922,504.1. In line with previous studies, the costs incurred for the combination therapy of the Amlodipine (CCB), Candesartan (ARB), and Furosemide (Diuretic) groups are the highest, thus affecting the ACER value (Zulfah, 2019). Based on the ACER value of the three therapy groups, the combination therapy group of Amlodipine and Candesartan is a cost-effective therapy option, because it has the lowest ACER value (Yanti et al., 2022). This is reinforced by Figure 1, namely that the combination of Amlodipine and Candesartan is in quadrant II, which means it is a therapy group with high effectiveness at a low price, while the combination of Furosemide, Amlodipine and Candesartan is in quadrant I, which means it is a therapy group with high effectiveness at a high price and Furosemide alone is in quadrant III, which means a therapy group with low effectiveness and low price.

Calculation of the Incremental Cost Effectiveness Ratio (ICER) value by looking at the ACER values in Table 3. The combination therapy group of Amlodipine and Candesartan is IDR 1,922,504.1 lower than the combination therapy group of Furosemide, Amlodipine, and Candesartan, namely IDR 3,681,580.3, but both of them have almost the same effectiveness. So, the ICER value can be calculated. The ICER (Incremental Cost-Effectiveness Ratio) value describes the additional costs required to achieve a one-unit change in effectiveness in patients. If the ICER calculation produces a negative value or is getting smaller, this indicates that the alternative drug is more effective and more economical, so that therapy can be considered the best choice (Wulandari et al., 2023). Based on the ICER value in Table 4, the comparison group between Amlodipine and Candesartan combination therapy and Furosemide, Amlodipine and Candesartan combination therapy gives an ICER value of IDR -6,697,330.3. In this research, the negative results were shown in the combination therapy group of Amlodipine and Candesartan. These results can conclude that this therapy group is the most cost-effective therapy for antihypertensives in inpatient hemodialysis patients at Abdoel Wahab Sjahranie Samarinda Regional Hospital. Based on the ICER value in Table 4, the comparison group between combination therapy of Amlodipine and Candesartan with combination therapy of Furosemide, Amlodipine and Candesartan gave an ICER value of IDR -6,697,330.3. The treatment of hypertension in hemodialysis patients using the combination therapy group of Amlodipine and Candesartan showed negative results, so it can be concluded that the combination therapy group of Amlodipine and Candesartan is the most cost-effective therapy group for antihypertensive treatment therapy in inpatient hemodialysis patients at RSUD Abdoel Wahab Sjahranie Samarinda. This study is in accordance with previous studies where the effectiveness of treatment with amlodipine-candesartan has a greater therapeutic effectiveness with a smaller average direct medical cost. So that the combination of amlodipine-candesartan is in quadrant II (figure 1) which is dominant and worthy of being chosen (Erfika et al., 2024).

4. Conclusion

The research that has been conducted on the cost-effectiveness analysis of antihypertensives in inpatient hemodialysis patients at the Abdoel Wahab Sjahranie Regional General Hospital, Samarinda, can conclude that the cost-effectiveness value of the use of antihypertensives at the Abdoel Wahab Sjahranie Regional General Hospital, Samarinda, is a combination of Amlodipine and Candesartan with an ACER value of IDR 1,726,133.4 and an ICER value of IDR -6,697,330.3..

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Competing Interests

The author declares that this research has no conflict of interest with any party.

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References

Ariyani, H., Hilmawan, R. G., S., B. L., Nurdianti, R., Hidayat, R., & Puspitasari, P. (2019). Gambaran karakteristik pasien gagal ginjal kronis di unit Hemodialisa Rumah Sakit Umum Dr. Soekardjo kota Tasikmalaya. *Keperawatan & Kebidanan*, *3 No 2*(November), 1–6.

Artiany, S., Gamayana Trimawang Aji, Y., & Yenny. (2021). Gambaran Komorbid pada Pasien Hemodialisis di Rumah Sakit Angkatan Udara (RSAU) drEsnawan Antariksa. *Jurnal Keperawatan Cikini*, *2*(2), 1–6. https://doi.org/10.55644/jkc.v2i2.57

Auliafendri, N., & Khairiati, R. (2022). Evaluasi penggunaan obat antihipertensi pada pasien Gagal Ginjal Kronik (GGK) Di Unit Hemodialisa RSU Imelda Pekerja Indonesia Medan. *JIFI (Jurnal Ilmiah Farmasi Imelda)*, *6*(1), 22–29. https://doi.org/10.52943/jifarmasi.v6i1.1116

Baroleh, J. M., Ratag, T. B., G, F. L. F., & Langi. (2019). Faktor-faktor yang berhubungan dengan penyakit ginjal kronis pada pasien di instalasi rawat jalan RSU Pancaran Kasih Manado. *Kesmas*, *8*(7), 8. https://ejournal.unsrat.ac.id/index.php/kesmas/article/view/27233

Bello, A. K., Okpechi, I. G., Osman, M. A., Cho, Y., Htay, H., Jha, V., Wainstein, M., & Johnson, D. W. (2022). Epidemiology Of Haemodialysis Outcomes. *Nature Reviews Nephrology*, *18*(6), 378–395. https://doi.org/10.1038/s41581-022-00542-7

Erfika, L. L., Kaaffah, S., & Kurniasih, K. I. (2024). Cost effectiveness analysis kombinasi amlodipin-kandesartan dibandingkan amlodipin-irbesartan pada hipertensi komorbid Diabetes Mellitus Tipe 2 Di RSUD Goeteng Taroenadibrata. *Journal Syntax Idea*, *6*.

Ferdianto, A., & Rizaldy, I. (2023). Efisiensi Penggunaan tempat tidur di unit rawat inap berdasarkan grafik Barber Johnson Di RSU Anna Medika Madura. *Jurnal Keperawatan Muhammadiyah*, 93. https://doi.org/10.30651/jkm.v0i0.17881

Gusti, I., Puja, A., Dewi, A., Parut, A. A., Institut, D., Dan, T., Bali, K., Tukad Balian, J., & 180 Renon, N. (2019). Penyulit dominan yang dialami selama intradialisis pada pasien yang menjalani terapi hemodialisis Di BRSU Tabanan-Bali dominant complications that occur during intradialisis on patients undergoing hemodialysis therapy in BRSU Tabanan-Bali. *Jurnal Riset Kesehatan Nasional , Vol.3 No.2*, 56–61.

Haase, S. B., Chang, S., Brigitte Schiller, M., Glenn M. Chertow, MD, M., & Tara I. Chang, MD, M. (2019). Antihypertensive medication withholding practices in hemodialysis: a survey study of patients and providers. *Physiology & Behavior*, *176*(5), 139–148. https://doi.org/10.1111/hdi.12640.Antihypertensive

Haiya, N. N., Ardian, I., Azizah, I. R., & Marfu'ah, S. (2024). Investigasi kualitas hidup pasien hemodialisa berdasarkan aspek dukungan keluarga. *Jurnal Gema Keperawatan*, *17*(1), 162–178. https://doi.org/10.33992/jgk.v17i1.3310

Husna, U. Y., Setyowati, E., Retnowati, E., Trinovitawati, Y., & Wahidah, N. (2024). *Studi Evaluasi Efektivitas Penggunaan Antihipertensi Terhadap Tekanan Darah Pasien Hemodialisa Di RSI Sunan Kudus*. *9*, 2014.

Karwiti, W., & Umizah, L. P. (2023). Gambaran kadar ureum pada pasien gagal ginjal kronik yang menjalani hemodialisa description of ureum levels in chronic renal disease patients with Hemodialysis. *JMLS) Journal of Medical Laboratory and Science*, *3*(2), 2023. https://doi.org/10.36086/medlabscience.v3i2

Kovesdy, C. P. (2022). Epidemiology of chronic kidney disease: an update 2022. *Kidney International Supplements*, *12*(1), 7–11. https://doi.org/10.1016/j.kisu.2021.11.003

Lina, L. F., & Wahyu, H. (2019). Efektivitas inovasi intervensi keperawatan mengulum es batu terhadap penurunan skala haus pasien gagal ginjal kronik yang menjalani Hemodialisis Di RSUD dr. M. Yunus Bengkulu. *Jurnal Ilmiah*, *10*(2), 1–94.

Made Maharianingsih, N., Windidaca, D., Putri, B., Made, N., Jurusan, M., Klinis, F., Ilmu, F., & Kesehatan, I. (2024). Studi penggunaan obat antihipertensi pada pasien chronic renal failure. *Indonesian Journal of Pharmaceutical Education (e-Journal)*, *4*(1), 2775–3670. https://doi.org/10.37311/ijpe.v4i1.25489

Masruroh, N., & Santoso, A. P. R. (2020). Pemeriksaan mean arteri pressure dan protein urine sebagai prediksi hipertensi pada ibu hamil trimester III Di RS Prima Husada Sidoarjo. *Jurnal Midwifery*, *2*(2), 52–59. https://doi.org/10.24252/jm.v2i2a1

Murdeshwar, H. N., & Anjum, F. (2023). *Hemodialysis*. StatPearls Publishing.

Nusantara, D. T. H., Irawiraman, H., & Devianto, N. (2021). Perbandingan kualitas hidup antara

pasien penyakit ginjal kronik yang menjalani terapi CAPD dengan Hemodialisis di RSUD Abdul Wahab Sjahranie Samarinda. *Jurnal Sains Dan Kesehatan*, *3*(3), 365–369. https://doi.org/10.25026/jsk.v3i3.299

Omega, K. D., Putri, K. P. A., Marcory, Y. S., Juhdeliena, & Wikliv, S. (2023). Perbedaan Tekanan Darah Intradialisis Pada Pasien Gagal Ginjal Kronik yang Menjalani Hemodialisis. *Jurnal Keperawatan Cikini*, *4*(1), 87–93.

PENEFRI. (2008). Pedoman pelayanan hemodialisis di sarana pelayanan kesehatan. *DirDepkes RI. (2008). Pedoman Pelayanan Hemodialisis Di Sarana Pelayanan Kesehatan. Direktorat Bina Pelayanan Medik Spesialistik Direktorat Jenderal Bina Pelayanan Medik Departemen Kesehatan Republik Indonesia*, *8–9. Https://Www.Pernefri.Org/Konsensus/PEDO*, 8–9. https://www.pernefri.org/konsensus/PEDOMAN Pelayanan HD.pdf

PERNEFRI. (2020). 13th Annual Report of Indonesian Renal Registry 2020. *Indonesian Renal Registry (IRR)*, *13*, 11. https://www.indonesianrenalregistry.org/data/IRR 2018.pdf

Ray, N., & Reddy, P. H. (2023). Structural and physiological changes of the kidney with age and its impact on chronic conditions and COVID-19. *Ageing Research Reviews*, *88*(April), 101932. https://doi.org/10.1016/j.arr.2023.101932

Sarman Agustani, Suparman, R., Setianingsih, T., & Mamlukah. (2021). Analisis faktor-faktor yang berhubungan dengan kepatuhan pasien penderita gagal ginjal kronik dalam menjalani terapi. *Jurnal Ilmiah*, *2*(02), 113–122. https://ejournal.stikku.ac.id/index.php/jphi/article/view/411%0Ahttp://ojs.poltekkes-medan.ac.id/pannmed/article/view/298

Tuladhar, L. R., Manandhar, D., Ansari, S., Khadka, N., Regmi, D., & Shrestha, B. L. (2023). Antihypertensive medications use among chronic hemodialysis patients visiting the outpatient department of nephrology of a tertiary care centre: a descriptive cross-sectional study. *Journal of the Nepal Medical Association*, *61*(259), 255–258. https://doi.org/10.31729/jnma.8095

Wulandari, C., Setiani, L. A., Zunnita, O., & Ikramin, M. (2023). Cost effectiveness analysis kombinasi obat anhipertensi pada pasien hipertensi rawat jalan Di RSUP Fatmawati Jakarta Periode 2020. *Jurnal Farmamedika (Pharmamedica Journal)*, *8*(2), 200–208. https://doi.org/10.47219/ath.v8i2.293

Wulandari, W., Suwantika, A. A., Zakiyah, N., Rahayu, C., & Ramadhani, S. F. (2023). *Perbandingan Pemilihan Obat Antihipertensi pada Pasien Penyakit Ginjal Tahap Akhir yang Melakukan Hemodialisis dan Continuous Ambulatory Peritoneal Dialysis Comparison of Antihypertensive Drug Selection in End-Stage Renal Disease Patients Undergoing Hemod*. *12*(2). https://doi.org/10.15416/ijcp.2023.12.2.98

Yanti Rosalina Pasaribu, Sefti S.J. Rompas, & Rina Margaretha Kundre. (2021). Perbedaan tekanan darah pada pasien CKD sebelum dan setelah hemodialisis di ruang Hemodialisa RS swasta Di Sulawesi Utara. *Jurnal Keperawatan*, *Volume 9*,(1).

Yanti, W. V., Warnida, H., Sentat, T., & Janan, P. L. (2022). Analisis Efektivitas biaya metode KB dan kualitas hidup akseptor di puskesmas Loa Janan. *Jurnal Riset Kefarmasian Indonesia*, *4*(2), 230–246. http://jurnalfarmasi.or.id/index.php/jrki/article/view/237/150

Yaqoob, S., Yaseen, M., Abdullah, H., Jarullah, F. A., & Khawaja, U. A. (2020). Sexual dysfunction and associated anxiety and depression in female hemodialysis patients: a cross-sectional study at karachi institute of kidney diseases. *Cureus*, *12*(8). https://doi.org/10.7759/cureus.10148

Zulfah, M. (2019). Analisis efektivitas biaya kombinasi obat antihipertensi pada pasien rawat Inap Di RSUD Dr. Soekardjo Tasikmalaya. *Journal of Pharmacopolium*, *2*(1), 53–62. https://doi.org/10.36465/jop.v2i1.472