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Pharmacoeconomic Evaluation and Clinical Outcomes of Channa as an Adjuvant to 20% Human Albumin Therapy in Patients with Chronic Kidney Disease: A Cost-Effectiveness Analysis (CEA) at Imelda Pekerja Indonesia General Hospital

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Hypoalbuminemia is a common complication in patients with Chronic Kidney Disease (CKD) and is associated with increased morbidity, mortality, and length of hospital stay. Human albumin therapy is effective but costly; therefore, pharmacoeconomic evaluation of alternative therapies based on snakehead fish (*Channa striata*) extract is warranted. This study aimed to evaluate the cost-effectiveness and clinical outcomes of Channa as an adjuvant to 20% Human Albumin therapy in CKD patients with hypoalbuminemia at Imelda Pekerja Indonesia General Hospital, Medan. A descriptive observational study with retrospective data collection was conducted involving 35 patients who were divided into three treatment groups: Channa product, 20% Human Albumin, and a combination of both therapies. Effectiveness was assessed based on the increase in serum albumin levels (Δ albumin, g/dL), while costs were calculated based on direct costs of albumin therapy. Cost-effectiveness analysis was performed by calculating the Average Cost-Effectiveness Ratio (ACER) and Incremental Cost-Effectiveness Ratio (ICER). The results showed that the total direct cost of albumin therapy was IDR 57,970,200, with the lowest cost observed in the Channa product group. The Channa product group had the lowest ACER (IDR 990,889 per g/dL), and the ICER analysis indicated that Channa was a dominant strategy, being both less costly and more effective. It was concluded that Channa therapy was the most cost-effective option for correcting hypoalbuminemia in CKD patients, while 20% Human Albumin remained important for severe conditions requiring rapid correction.
Keywords: Channa striata, chronic kidney disease; cost-effectiveness analysis; pharmacoeconomics; hypoalbuminemia; human albumin.

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1. Introduction

Albumin is the plasma protein with the highest concentration in the blood that plays a vital role in maintaining the body's homeostasis, starting from regulating the osmotic pressure of colloidal plasma, transporting hormones and drugs, to antioxidant functions. When albumin levels drop below 3.5 g/dL, the body experiences hypoalbuminemia which is not just a laboratory finding, but a clinical marker of metabolic disorders or underlying diseases [1]. Globally, the prevalence of hypoalbuminemia is quite high; one study of 1,071 patients in India found a prevalence of around 15%, while in Indonesia the number of patients or patients at risk reached 40–50% with 12% of them experiencing severe hypoalbuminemia [2].

Hypoalbuminemia often accompanies various chronic diseases, including postoperative disease, cirrhosis of the liver, chronic kidney disease, burns, neonatal sepsis, nephrotic syndrome, malnutrition, and hepatitis. Among these diseases, Chronic Kidney Disease (CKD) occupies the most prominent burden [3]. The results

of observation of medical record data at the Imelda Pekerja Indonesia Hospital in Medan recorded 233 patients with various diagnoses that have the potential to be accompanied by hypoalbuminemia, with CKD as one of the largest chronic disease groups. These findings are in line with the high prevalence of CKD nationally and make them the most relevant patient group to study.

In clinical practice, the most commonly used therapy to increase albumin levels quickly is the administration of human albumin. Although effective, human albumin is known to be high cost, so it is a consideration in health financing [4]. As an effort to complement therapy, snakehead fish extract (Channa striata) is often researched because it contains high protein, albumin fractions, and essential amino acids that play a role in protein synthesis and tissue regeneration, so it has the potential to be positioned as an adjuvant therapy that accompanies the administration of human albumin [5]. The research gap found is that there are still limited studies that directly compare the cost-effectiveness between human albumin alone and a combination of human albumin and Channa in CKD patients with hypoalbuminemia.

To answer this need, the pharmacoeconomic evaluation method chosen is Cost-Effectiveness Analysis (CEA), because the two therapies compared have the same therapeutic goal, namely increasing albumin levels, but with different costs and effectiveness [6]. The clinical outcome used was an increase in serum albumin (g/dL) levels, and CEA results were manifested in the form of ACER and ICER [7]. This study aims to evaluate the pharmacoeconomic aspects and clinical outcomes of the use of Channa products as an adjuvant in 20% Human Albumin therapy in CKD patients with hypoalbuminemia at the Imelda Pekerja Indonesia Hospital in Medan, so that rational, effective, and economical therapy options can be determined.

2. Literature Review and Problem Formulation

Chronic Kidney Disease (CKD) is a structural or functional disorder of the kidneys that lasts for at least three months and has an impact on health, classified based on cause, Glomerular Filtration Rate (GFR, G1–G5), and albuminuria category (A1–A3) [8]. In CKD patients, hypoalbuminemia occurs due to a combination of reduced albumin production, increased protein loss through urine (proteinuria), and chronic inflammation. Decreased albumin levels lower plasma oncotic pressure, triggering edema and ascites, increasing oxidative stress, and being a strong indicator of increased risk of death, especially in dialysis patients [1].

Management of hypoalbuminemia includes pharmacological and non-pharmacological therapies. Human Albumin 20% is a hyperoncotic colloidal solution administered intravenously for rapid correction, while Channa striata acts as an oral adjuvant therapy that increases endogenous albumin synthesis in the liver through the provision of amino acids as well as decreased inflammation [9]. Pharmacoeconomics is an important instrument in supporting quality control and control of medical costs in the era of National Health Insurance, with CEA as a method that compares the cost of an intervention with its health outcomes in non-monetary units [6].

Several previous studies have highlighted the pharmacoeconomic aspects of albumin therapy. Wahyuningtiyas (2020) analyzed the effectiveness and cost of pure snakehead fish extract compared to 20% Human Albumin in hypoalbuminemic patients, and concluded that pure snakehead fish extract is expected to have equivalent effectiveness at a lower cost [10]. Witha et al. (2024) compared 20% and 25% Human Albumin in postoperative patients and found that 25% albumin provided a higher average increase in albumin levels [2]. However, most studies still focus on comparisons between albumin products and not many have evaluated the cost-effectiveness of albumin when combined with Channa striata-based adjuvants in CKD patients.

Based on these gaps, three problems were formulated: (1) how to describe the characteristics of CKD patients with hypoalbuminemia who are undergoing albumin therapy; (2) how much is the direct medical cost of albumin therapy in each therapy group; and (3) what is the value of ACER and ICER for each therapy group so that the most cost-effective therapy for the correction of hypoalbuminemia in CKD patients can be determined at the Imelda Pekerja Indonesia Hospital in Medan.

3. Method

This study is a pharmacoeconomic study with an observational descriptive design and a Cost-Effectiveness Analysis (CEA) approach. Data were collected retrospectively from medical records and billing details of hospitalization of CKD patients with hypoalbuminemia at Imelda Pekerja Indonesia Hospital Medan [11]. The study subjects were 35 patients who met the inclusion criteria, namely CKD patients with hypoalbuminemia aged ≥ 18 years, serum albumin levels below the normal threshold, receiving 20% Human Albumin therapy, snakehead fish extract (Channa striata), or a combination of both, and having complete medical record data. Patients who are pregnant, died during treatment, are less than 18 years old, or with incomplete data are excluded.

Patients were grouped into three therapy groups: (1) Channa Products (Herbal Nusantara, PT Mega Medica Pharmaceuticals), (2) Human Albumin 20%, and (3) Channa + Human Albumin combination 20%. The free variable is the direct cost component during treatment, while the bound variable is a type of therapy that is judged by its effectiveness in the form of increased serum albumin levels. Effectiveness was calculated as the difference in serum albumin levels before and after therapy (Δ albumin, g/dL). Cost effectiveness analysis was carried out by calculating the Average Cost-Effectiveness Ratio (ACER = average cost ÷ average effectiveness) and Incremental Cost-Effectiveness Ratio (ICER = cost difference ÷ difference in effectiveness between groups) [7]. The alternative therapy with the smallest ACER value was considered the most cost-effective, while ICER was used to determine the additional cost per additional one unit of effectiveness in more expensive therapies.

4. Results and Discussion

This study analyzed 35 CKD patients with hypoalbuminemia who underwent hospitalization. Patient characteristics, direct cost of therapy, length of hospitalization, stage of CKD, comorbidities, and the results of pharmacoeconomic analysis (ACER and ICER) are described as follows.

Patient Characteristics

Patient characteristics include gender, age, guarantor, length of hospitalization, stage of CKD, albumin levels, and therapy group. A summary of the distribution of characteristics is presented in Table 1.

Table 1. Distribution of Patient Characteristics

Characteristics	Category	Number	Percentage (%)
Gender	Male	19	54.3
	Female	16	45.7
Age	26–45 years (adults)	11	31.4
	46–55 years (pre-elderly)	3	8.6
	56–65 years (young-old)	8	22.9
	>65 years (older adults)	13	37.1
Therapy Group	Channa Product	11	31.4
	20% Human Albumin	9	25.7

Characteristics	Category	Number	Percentage (%)
	Channa + 20% Human Albumin	15	42.9
Insurance Provider	BPJS Kesehatan	34	97.1
	BPJS Continued Care	1	2.9

Based on Table 1, male patients were slightly more dominant (19 patients; 54.3%) than female patients (16 patients; 45.7%). This proportion is in line with the epidemiological pattern of CKD that is more commonly found in men, as shown in Figure 1.

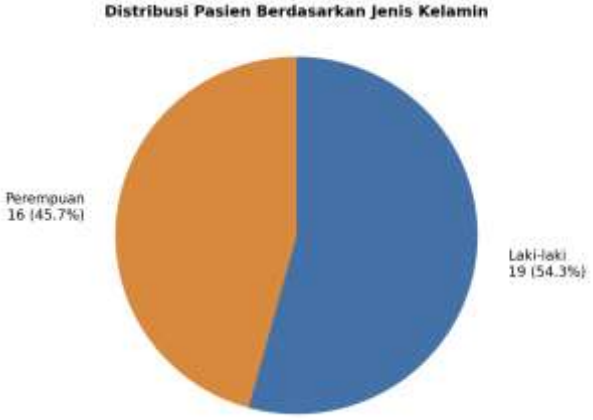

Figure 1. Distribution of Patients by Gender

A higher proportion of men is in line with Riskesdas data and the Alomedika review (2023) reporting that chronic kidney disease is more prevalent in men, even with ratios up to 3:1. This is associated with a high prevalence of systemic diseases such as diabetes mellitus and hypertension, higher serum creatinine levels, and an unhealthy lifestyle in men, while women are thought to have the protective effects of the hormone estrogen [12]. Based on age, the average age of patients was 58.9 years (range 41–79 years) with the largest group being over 65 years old (late elderly), as presented in Figure 2.

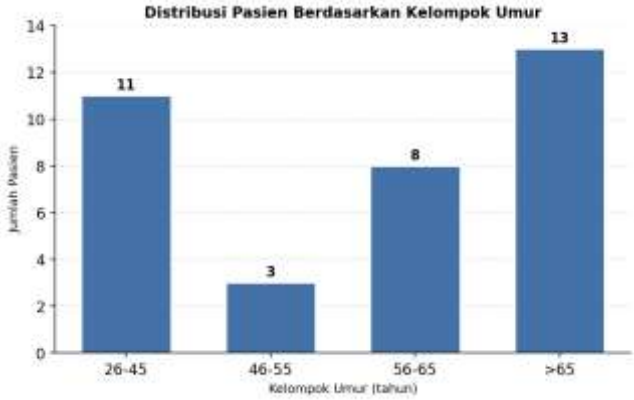

Figure 2. Distribution of Patients by Age Group

The dominance of this elderly patient is in accordance with the literature that states that the risk of CKD increases with age, especially in the age group ≥ 60 years. Decreased kidney function is part of the natural aging process that is aggravated by the accumulation of chronic diseases such as hypertension and diabetes.

Based on the therapy group, the majority of patients received a combination of Channa and Human Albumin 20% (15 patients; 42.9%), followed by Channa Products (11 patients; 31.4%) and Human Albumin 20% (9 patients; 25.7%), as shown in Figure 3.

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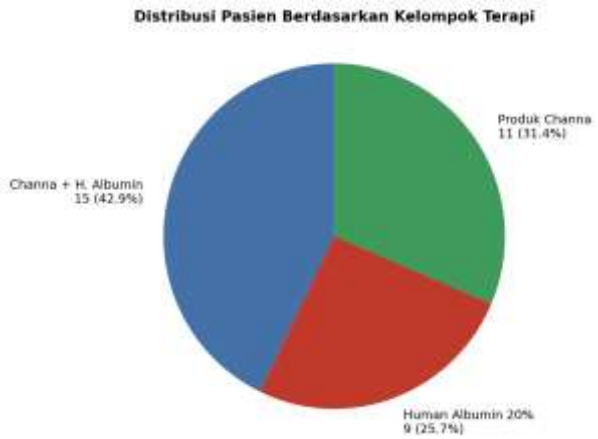

Figure 3. Distribution of Patients by Therapy Group

The large number of patients receiving the combination reflects a severe clinical condition, in which 20% intravenous Human Albumin is used for rapid correction of hypoalbuminemia while Channa is administered as an oral supplementation. Almost all patients (97.1%) are BPJS Kesehatan participants, so the aspect of therapy cost efficiency is very relevant in the context of national health insurance financing.

Analysis of the Direct Cost of Albumin Therapy

The direct costs analyzed were the cost of albumin-increasing therapy drugs on billing, namely Channa 500 mg capsules (IDR 9,100/capsule) and Human Albumin 20% – Albuman 20% 100 mL (IDR 1,965,000/bottle). The results of the cost calculation per group are presented in Table 2.

Table 2. Total Direct Cost of Albumin Therapy per Group

NO	Therapy Groups	Patients	Channa Cost	Albumin Cost	Total Therapy
1	Channa Products	11	IDR 2,411,500	Rp 0	IDR 2,411,500
2	Human Albumin 20%	9	Rp 0	IDR 17,685,000	IDR 17,685,000
3	Channa + Human Albumin 20%	15	IDR 6,433,700	IDR 31,440,000	IDR 37.873.700
	TOTAL	35	IDR 8,845,200	IDR 49.125.000	IDR 57.970.200

Source: Billing of RSU Imelda Kerja Indonesia (processed, 2026).

The Channa Product Group charged the lowest cost (IDR 2,411,500 for 11 patients), while the combination group recorded the highest total cost (IDR 37,873,700 for 15 patients). Overall, the total direct cost of albumin therapy reached IDR 57,970,200, with the Human Albumin component (IDR 49,125,000) much greater than the Channa component (IDR 8,845,200). The comparison of costs between groups is visualized in Figure 4.

Figure 4. Total Direct Cost of Albumin Therapy per Group

This difference is striking because the price of Human Albumin 20% is much more expensive than Channa. These results confirm that in terms of drug procurement costs, therapy based on snakehead fish extract is much more economical. Similar findings were put forward by Nugroho (2016) who stated that albumin therapy from snakehead fish extract can be a more economical alternative to Human Albumin 20%, with a comparable albumin-increasing effectiveness [13]. As an illustration of the overall cost burden, the average total cost of hospitalization is also compared between groups in Figure 5.

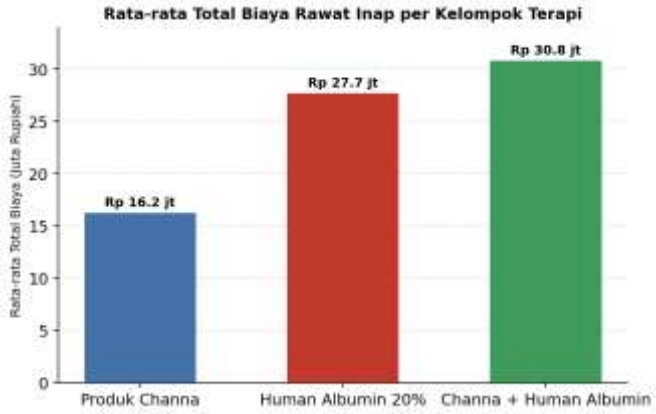

Figure 5. Average Total Cost of Hospitalization per Therapy Group

The average total hospitalization cost was the lowest in the Channa Product group (IDR 16,226,196) and the highest in the combination group (IDR 30,825,961). This pattern is natural because patients who require a combination of therapies generally have a higher level of severity and comorbidities, so they require more intensive and prolonged treatment.

Length of Stay Analysis

Length of stay (LOS) was compared between the three therapy groups to see the relationship between the type of therapy and the duration of treatment, as presented in Figure 6.

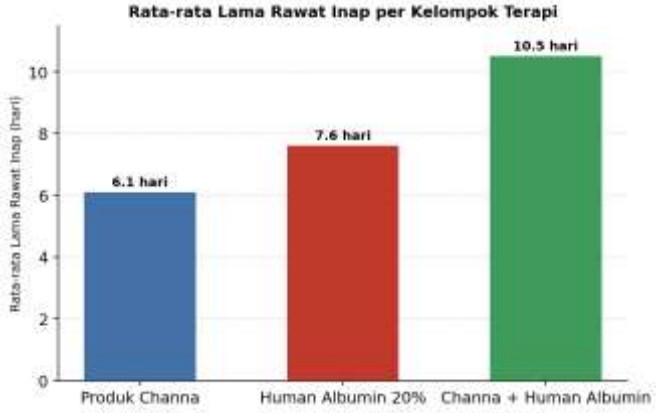

Figure 6. Average Length of Stay per Therapy Group

The average length of hospitalization of the Channa Product group was 6.1 days, Human Albumin 20% 7.6 days, and a combination of 10.5 days. The combination group had the longest averages reflecting the patient's more complex condition. The relationship between albumin levels and length of treatment is supported by Muryawan et al. (2019) who stated that every decrease in albumin by 1 g/dL is associated with an increase in length of treatment by up to 71% as well as an increase in the risk of morbidity and mortality [14]. Thus, effective hypoalbuminemia correction has the potential to shorten the length of treatment and reduce treatment costs.

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Analysis of CKD Stages and Comorbidities

The distribution of patients by stage of CKD is presented in Figure 7.

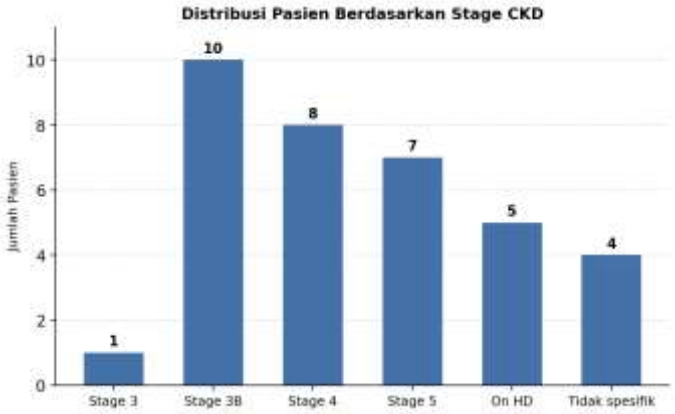

Figure 7. Distribution of Patients by CKD Stage

The most CKD stages are CKD Stage 3B (10 patients), and cumulatively advanced stage patients (Stage 4, Stage 5, and on HD) reach 20 patients. The high proportion of advanced stages confirms that hypoalbuminemia is common in severe CKD, in line with the mechanism of protein loss through urine, decreased albumin synthesis, and chronic inflammatory status and malnutrition that accompany decreased kidney function. Comorbidities beyond hypoalbuminemia were analyzed to describe the clinical complexity of the patient, as presented in Figure 8.

Figure 8. Frequency of Comorbidities in CKD Patients with Hypoalbuminemia

The most frequent comorbidities were anemia and hypertension/HHD (15 patients each), followed by gangrene/ulcers/osteomyelitis (13 patients) and pneumonia (12 patients). High anemia is a typical finding in CKD due to decreased erythropoietin production by the kidneys, while hypertension is a risk factor as well as a complication of CKD [15]. The large number of comorbidities of infection and gastrointestinal bleeding also aggravates the inflammatory status and accelerates the decline in albumin levels, thus confirming the patient's character as a multicomplex population.

Pharmacoeconomic Analysis (ACER and ICER)

A cost-effectiveness analysis was performed to determine the most cost-effective therapy group. The effectiveness of therapy was measured based on the average increase in albumin levels (Δ albumin, g/dL), while the cost used was the direct cost of albumin therapy. The effectiveness calculation only involved

patients with serial albumin level data (at least two measurements), namely 18 patients (2 in the Channa group, 4 in Human Albumin, and 12 in combination). The ACER values of each group are presented in Table 3.

Table 3. Therapy Effectiveness and ACER Value per Group

No	Therapy Groups	n*	Orbit-orbit Δ Albumin (g/dL)	Average Cost of Therapy	ACER (Rp/g/dL)
1	Channa Products	2	+0,450	IDR 445.900	IDR 990,889
2	Human Albumin 20%	4	+0,200	IDR 1,965,000	IDR 9,825,000
3	Channa + Human Albumin 20%	12	+0,442	IDR 2,539,767	IDR 5,750,415

Remarks: n = number of patients with paired albumin data (≥ 2 measurements). Source: Data processed, 2026.*

Based on Table 3, the lowest ACER value is owned by the Channa Product group (Rp 990,889 per g/dL), followed by a combination (Rp 5,750,415 per g/dL) and Human Albumin 20% (Rp 9,825,000 per g/dL). This means that for every increase in albumin levels of 1 g/dL, Channa therapy requires the least cost and is the most cost-effective option based on ACER parameters. These results are in line with pharmacoeconomic principles in the research of Refasi et al. (2018) and Heroweti & Rokhmawati (2023), where the therapy with the lowest ACER value was considered the most cost-efficient [16]. Furthermore, ICER was calculated to compare the difference in cost and difference in effectiveness between the two groups in pairs. The results of the calculation are presented in Table 4.

Table 4. ICER Calculation Between Therapy Groups

NO	Group Comparison	Δ Cost	Δ Effectiveness	ICER (Rp/g/dL)
1	Channa vs Human Albumin Products 20%	IDR -1.519.100	+0,250	IDR -6,076,400
2	Channa vs Channa + Human Albumin Products 20%	IDR -2.093.867	+0,008	IDR -251.264.000
3	Human Albumin 20% vs Channa + Human Albumin 20%	IDR -574.767	-0,242	IDR 2,378,345

Note: A negative ICER value indicates that the first comparison group is cheaper and at the same time more (or equally) effective (dominant position). Source: Data processed, 2026.

The results of the ICER calculation show that the Channa Product group is dominant over the other two groups, which is cheaper and at the same time the effectiveness is equal or higher. In the comparison of Channa vs Human Albumin 20% is obtained a negative cost difference with a positive effectiveness difference, so that ICER has a negative value which means Channa dominates. The comparison of Channa vs combination results in a very small difference in effectiveness (close to zero), so the addition of Human Albumin to Channa does not provide an increase in effectiveness commensurate with the additional cost.

Overall, both ACER and ICER parameters show a unidirectional conclusion, namely that Channa Product therapy is the most cost-effective option for the correction of hypoalbuminemia in CKD patients at the study site [16]. However, these findings need to be addressed with caution because the number of patients with paired albumin data in the Channa group is relatively small (n=2), and the choice of therapy in the field is strongly influenced by clinical severity. In severe hypoalbuminemia conditions that require rapid correction, Human Albumin 20% remains an important role that cannot be completely replaced [4].

5. Conclusion

Based on the results of the study, the characteristics of CKD patients with hypoalbuminemia at Imelda Pekerja Indonesia Hospital in Medan were dominated by men (54.3%), the final elderly age group (> 65 years), and BPJS Kesehatan participants (97.1%), with the most CKD stages being Stage 3B and the most frequent comorbidities in the form of anemia and hypertension/HHD. The total direct cost of albumin therapy for all patients is IDR 57,970,200, with the lowest cost in the Channa Product group and the highest in the combination group, where Human Albumin 20% is the largest cost contributor due to its high unit price.

Based on pharmacoeconomic analysis, the Channa Product group has the lowest ACER value (Rp 990,889 per g/dL) and is dominant in the ICER calculation, making it the most cost-effective therapy for the correction of hypoalbuminemia in CKD patients at the study site. Snakehead fish extract therapy can be considered as an economical albumin supplementation option in mild–moderate hypoalbuminemia, while Human Albumin 20% remains preferred for severe conditions that require quick correction. Further research is recommended to use a prospective design with uniform recording of albumin levels, a larger and balanced sample count, and the inclusion of comparative statistical tests and sensitivity analysis to make pharmacoeconomic results more robust and generalizable.

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