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Analysis Of Technical Efficiency Of Health Function Expenditure In Indonesia 2020-2024

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Abstract

This study analyzes the level of technical efficiency of health function expenditure in 34 provincial governments in Indonesia during the 2020-2024 period. Using the Data Envelopment Analysis (DEA) method with an input-oriented BCC model and the Variable Return to Scale (VRS) assumption, this study measures relative efficiency using one input variable (realized health expenditure per capita) and four output variables (life expectancy, maternal mortality rate, infant mortality rate, and stunting prevalence). The results show that the average technical efficiency is still relatively low, ranging from 0.460 to 0.547, with significant disparities between provinces. DI Yogyakarta, East Kalimantan, and West Sulawesi consistently achieved perfect efficiency (TE=1), making them benchmark. In contrast, DKI Jakarta, East Java, and West Java were the provinces with the highest levels of inefficiency, with potential budget savings (radial movement) exceeding IDR 10,000 billion. A comparison between the COVID-19 pandemic phase (2020-2021) and the recovery phase (2022-2024) shows an average efficiency increase of 6.20 percent, although some provinces experienced a drastic decline. These findings indicate that the size of the budget does not guarantee efficiency; the effectiveness of governance and the quality of program implementation are the main determining factors.

Keywords: Technical Efficiency, Health Expenditure, *Data Envelopment Analysis*, COVID-19 Pandemic, Fiscal Decentralization.

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INTRODUCTION

Health expenditure is a key foundation for creating an effective and equitable health system, particularly in supporting the achievement of *Universal Health Coverage* (UHC) (WHO, 2010; Pribadi & Setijaningrum, 2023). Investment in health, as explained in *Human Capital Theory* (Becker, 1962), is not merely consumptive spending but a productive investment to improve the quality of human resources and economic productivity (Adriani, 2019). Regional autonomy and fiscal decentralization policies in Indonesia give provincial governments the authority to manage health budgets (Rahmawati & Muhsyaf, 2025). However, the realization of health function expenditure in 34 provinces during the 2020-2024 period shows a mismatch with the mandate of Minister of Home Affairs Regulation No. 84 of 2022, where the average allocation is only about 3-4 percent of the total regional budget (APBD), far below the minimum target of 10 percent.

The COVID-19 pandemic (2020-2021) worsened this condition, forcing the government to *refocusing* the budget and disrupting maternal and child health services (Sani et al., 2022). Previous studies (Utami et al., 2021; Radityo & Arianti, 2023; Rahmawati & Muhsyaf, 2025) show that the efficiency of health expenditure in Indonesia is still low and uneven. Sihaloho et al. (2019) found that regions with the largest budgets, such as Central Maluku Regency, actually had the lowest efficiency scores, indicating that the size of funds is not always in line with the effectiveness of their utilization.

This study aims to: (1) analyze the level of technical efficiency of provincial governments' health function expenditure in Indonesia during the 2020-2024 period using an input-oriented BCC DEA model; (2) identify *benchmark* provinces that can serve as examples of expenditure management for other regions; and (3) compare the level of technical efficiency between the COVID-19 pandemic phase and the post-pandemic recovery phase.

RESEARCH METHOD

This study uses a non-parametric quantitative approach with secondary numerical data from official publications of the Central Statistics Agency (BPS), the Ministry of Health, and the Directorate General of Fiscal Balance (DJPK) of the Ministry of Finance for the 2020-2024 period. The unit of analysis (*Decision Making Unit*/DMU) consists of 34 provinces in Indonesia. The input variable is realized health function expenditure per capita (in billions of rupiah). The output variables consist of: (1) life expectancy (in years) as a *desirable output*); (2) maternal mortality rate per 100,000 live births as an *undesirable output*); (3) infant mortality rate per 1,000 live births as an *undesirable output*); and (4) stunting prevalence in percent as an *undesirable output*).

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The analytical method uses *Data Envelopment Analysis* (DEA), first introduced by Charnes, Cooper, and Rhodes (1978). DEA is a linear-programming-based non-parametric approach for measuring relative efficiency among DMUs. This study uses the BCC model (Banker, Charnes, & Cooper, 1984), which assumes *Variable Return to Scale* (VRS) because provincial governments in Indonesia operate at non-uniform scales. The orientation used is *input-oriented*, aiming to minimize input use (expenditure) without reducing the output produced. Calculations were performed using Win4Deap2 software. Provinces were grouped into four categories: (1) high efficiency (TE = 1); (2) good efficiency (0.8 ≤ TE ≤ 1); (3) fairly good efficiency; and (4) low efficiency (TE ≤ 0.4992) (Maimunah, 2015).

In general, the input-oriented BCC model used is as follows (Maimunah, 2015):

Max: θ_{B}

Subject to: $\theta_{\mathrm{B}} x_{\mathrm{o}} - \mathrm{Y}\lambda \geq 0$

$Y\lambda \geq y_0$

$e\lambda = 1$

$\lambda \geq 0$

Where:

η_B : input efficiency score in the BCC model

Y : input matrix of all comparator DMUs (units of analysis)

X : output matrix of all comparator DMUs

y_0 : input vector of the DMU being evaluated

x_0 : output vector of the DMU being evaluated

λ : weight of the comparator combination among DMUs (decision variable)

e : unit vector (for the VRS condition, the sum $\lambda = 1$)

RESULTS AND DISCUSSION

The average technical efficiency score for all provinces from 2020 to 2024 ranges from 0.460 to 0.547. This result confirms the findings of Utami et al. (2021), Radityo & Arianti (2023), and Rahmawati & Muhsyaf (2025), which state that the level of health expenditure efficiency in Indonesia is still relatively low and uneven.

Table 1. Technical Efficiency Scores of Health Function Expenditure in Indonesia, 2020-2024

No.	Province	Efficiency Score					Average
		2020	2021	2022	2023	2024	
1	Aceh	0.201	1.000	1.000	0.188	0.148	0.507
2	Sumatera Utara	0.299	0.213	0.209	0.253	0.261	0.247

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No.	Province	Efficiency Score					Average
		2020	2021	2022	2023	2024	
3	Sumatera Barat	0.241	0.314	0.228	0.241	0.193	0.243
4	Riau	0.169	0.200	0.159	0.221	0.178	0.185
5	Jambi	0.344	0.353	0.301	0.362	0.315	0.335
6	Sumatera Selatan	0.447	0.361	0.245	0.25	0.457	0.352
7	Bengkulu	0.459	0.542	0.686	0.468	0.439	0.519
8	Lampung	0.216	0.231	0.209	0.281	0.18	0.223
9	Bangka Belitung	0.634	0.760	1.000	0.7	0.771	0.773
10	Kepulauan Riau	0.370	0.498	0.435	0.432	0.364	0.420
11	DKI Jakarta	0.017	0.020	0.02	0.024	0.024	0.021
12	Jawa Barat	0.203	0.114	0.192	0.16	0.114	0.157
13	Jawa Tengah	0.542	1.000	0.266	0.268	0.247	0.465
14	DI Yogyakarta	1.000	1.000	1.000	1.000	1.000	1.000
15	Jawa Timur	0.039	0.040	0.036	0.042	0.029	0.037
16	Banten	0.207	0.214	0.137	0.175	0.234	0.193
17	Bali	0.373	0.341	1.000	0.439	1.000	0.631
18	Nusa Tenggara Barat	0.281	0.205	0.2	0.189	0.119	0.199
19	Nusa Tenggara Timur	1.000	1.000	0.332	1.000	1.000	0.866
20	Kalimantan Barat	0.499	0.486	0.479	0.354	0.747	0.513
21	Kalimantan Tengah	0.347	0.469	0.822	0.335	0.23	0.441
22	Kalimantan Selatan	0.153	0.225	0.383	0.214	0.128	0.221
23	Kalimantan Timur	1.000	1.000	1.000	1.000	1.000	1.000
24	Kalimantan Utara	1.000	1.000	0.602	0.649	1.000	0.85
25	Sulawesi Utara	0.218	0.373	0.352	0.647	0.59	0.436
26	Sulawesi Tengah	0.311	0.440	0.316	0.441	0.295	0.361
27	Sulawesi Selatan	0.192	0.362	1.000	0.443	0.325	0.464
28	Sulawesi Tenggara	0.663	1.000	1.000	1.000	1.000	0.933
29	Gorontalo	1.000	1.000	0.828	1.000	1.000	0.966
30	Sulawesi Barat	1.000	1.000	1.000	1.000	1.000	1.000
31	Maluku	0.514	0.635	0.537	0.932	1.000	0.724
32	Maluku Utara	0.555	1.000	0.611	0.805	1.000	0.794
33	Papua Barat	1.000	0.692	1.000	1.000	1.000	0.938
34	Papua	0.139	0.154	1.000	0.485	0.994	0.554
National Average		**0.460**	**0.537**	**0.547**	**0.5**	**0.541**	**0.517**

Source: Win4DEAP2 Data Processing Results, 2020-2024

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DI Yogyakarta, East Kalimantan, and West Sulawesi consistently achieved perfect technical efficiency (TE = 1) throughout the entire 2020-2024 period, making them a *benchmark* for other provinces. This success shows that proportional health expenditure, good governance, and effective cross-sector coordination matter more than the size of the budget.

Provinces with high fiscal capacity, such as DKI Jakarta and East Java, consistently recorded very low levels of efficiency. The efficiency scores of these provinces were within an extremely small range, averaging between 0.019 and 0.040. On the other hand, several regions with relatively more limited health expenditure allocations, such as DI Yogyakarta, Gorontalo, and West Sulawesi, actually managed to achieve perfect technical efficiency (TE = 1) in a number of observation periods. This pattern is consistent with the findings of Sihaloho et al. (2019), who reported that regions with the largest health budgets tend to have the lowest efficiency scores. Thus, the amount of funds allocated does not automatically guarantee effective utilization.

Table 2. Comparison of Average Technical Efficiency of Health Function Expenditure Between the Pandemic and Post-Pandemic COVID-19 Recovery Phases in Indonesia, 2020-2024

No.	Province	Pandemic (2020-2021)	Recovery (2022-2024)
1	Aceh	0.601	0.445
2	Sumatera Utara	0.256	0.241
3	Sumatera Barat	0.278	0.221
4	Riau	0.185	0.186
5	Jambi	0.349	0.326
6	Sumatera Selatan	0.404	0.317
7	Bengkulu	0.501	0.531
8	Lampung	0.224	0.223
9	Bangka Belitung	0.697	0.824
10	Kepulauan Riau	0.434	0.410
11	DKI Jakarta	0.019	0.023
12	Jawa Barat	0.159	0.155
13	Jawa Tengah	0.771	0.260
14	DI Yogyakarta	1.000	1.000
15	Jawa Timur	0.040	0.036
16	Banten	0.211	0.182
17	Bali	0.357	0.813

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No.	Province	Pandemic (2020-2021)	Recovery (2022-2024)
18	Nusa Tenggara Barat	0.243	0.169
19	Nusa Tenggara Timur	1.000	0.777
20	Kalimantan Barat	0.493	0.527
21	Kalimantan Tengah	0.408	0.462
22	Kalimantan Selatan	0.189	0.242
23	Kalimantan Timur	1.000	1.000
24	Kalimantan Utara	1.000	0.750
25	Sulawesi Utara	0.296	0.530
26	Sulawesi Tengah	0.376	0.351
27	Sulawesi Selatan	0.277	0.589
28	Sulawesi Tenggara	0.832	1.000
29	Gorontalo	1.000	0.943
30	Sulawesi Barat	1.000	1.000
31	Maluku	0.575	0.823
32	Maluku Utara	0.778	0.805
33	Papua Barat	0.846	1.000
34	Papua	0.147	0.826
	Average of 34 Provinces	0.498	0.529

Source: Win4DEAP2 Data Processing Results, 2020-2024

The national average efficiency increased from 0.498 during the pandemic phase (2020-2021) to 0.529 during the recovery phase (2022-2024), an increase of 6.20 percent. The largest increases occurred in Papua (464.1%), Bali (127.7%), and South Sulawesi (112.8%). Papua, which had previously always been among the bottom five, managed to achieve full efficiency in 2022 and maintained it through 2024. This shows that appropriate policy interventions, such as expanding access to health services in remote areas, can produce significant results in a relatively short time (Gupta & Verhoeven, 2001).

In contrast, the sharpest declines in efficiency occurred in Central Java (66.2%), West Nusa Tenggara (30.3%), and Aceh (25.8%). Central Java, which previously had an average TE of 0.771, plummeted to 0.260 during the recovery phase. The simultaneous decline in budget allocation in 2024 across almost all provinces, Central Java falling from 3.50% to 0.54%, and DKI Jakarta from 17.81% to 8.74%,

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indicates the presence of national structural factors such as the end of COVID-19 funding and shifting budget priorities after the 2024 election.

Health function expenditure realization data also show that in 2024 there was a decline in allocation across almost all provinces, with some regions experiencing quite sharp declines. Central Java fell from 3.50 percent to 0.54 percent, South Sumatra from 2.06 percent to 0.55 percent, and DKI Jakarta from 17.81 percent to 8.74 percent. This simultaneous decline points to the presence of national-level structural factors, such as the end of COVID-19 handling funds, changes in transfer-to-region policy through the Special Allocation Fund (DAK), or a readjustment of budget priorities following the 2024 election. This phenomenon is also consistent with the findings of Rambe et al. (2022), who showed that efficiency scores during the pandemic varied by region: Kalimantan was relatively stable, Java-Bali and Sumatra tended to increase, while Nusa Tenggara, Maluku, and Papua actually experienced declines. These findings reinforce the view that adequate fiscal capacity and health infrastructure are highly determinative of a region's health system resilience in facing external pressures.

High fluctuations in maternal and infant mortality rates, such as the increase in maternal mortality in DI Yogyakarta from 40 (2020) to 162 cases (2021) before falling to 26 (2023), and the surge in infant mortality in West Java from 3,331 (2022) to 5,533 cases (2024), indicate the vulnerability of the maternal and neonatal health service system. This is consistent with Karlina and Rosyadi (2025), who stated that infant mortality reflects the effectiveness of basic health services. From a *good governance* perspective, this inefficiency reflects weak accountability and transparency in the management of health budgets (Riwukore et al., 2022).

The still-high prevalence of stunting in East Nusa Tenggara (37%) and West Sulawesi (35.4%) in 2024 shows that reducing stunting cannot rely on health expenditure alone. A more comprehensive multisectoral approach is needed, in line with the UNICEF (2021) framework, which states that stunting is a multidimensional problem influenced by food security, parenting practices, sanitation, and the environment. Provinces with high efficiency tend to have better cross-sector coordination, reflected in a more consistent decline in stunting.

CONCLUSION

This study concludes that the level of technical efficiency of health function expenditure in Indonesia during 2020-2024 is still in the low category (average 0.460-0.547) and highly uneven across provinces. DI Yogyakarta, East Kalimantan, and West Sulawesi were identified as *benchmark* with consistently perfect efficiency (TE = 1). In contrast, DKI Jakarta, East Java, and West Java were the provinces with the highest levels of inefficiency and require intensive policy intervention.

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The comparison between the pandemic and recovery phases shows an average efficiency increase of 6.20 percent, driven by adaptive policies in several regions such as Papua. However, a number of large provinces experienced sharp declines, indicating the vulnerability of the health system to external shocks. A *slack* value of zero confirms that the inefficiency is systemic, calling for a thorough reform of budget governance.

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