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Cost-Consequence Analysis of Multiple-Sourcing Procurement for Childhood Acute Lymphoblastic Leukemia Drugs in Indonesia

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Abstract

Background

Childhood acute lymphoblastic leukemia (ALL) remains a major contributor to pediatric cancer burden in Indonesia, with an estimated mortality rate of 0.44–5.3 per 100,000 children. Ensuring consistent drug availability remains a key challenge, particularly in procurement systems. This study aimed to evaluate the economic and operational implications of transitioning from single- to multiple-sourcing procurement mechanisms using childhood ALL drugs as a reference case.

Methods

A cross-sectional study was conducted using national e-catalog procurement data from 2021 to 2023. Healthcare facilities that transitioned from single-sourcing (2021) to multiple-sourcing (2022–2023) were included. Incremental costs were calculated as percentage changes in procurement expenditure, while outcomes were measured as percentage increases in drug quantities procured. A cost-consequence analysis framework was applied to assess changes in costs and procurement volumes.

Results

Multiple-sourcing procurement was associated with an average increase in procurement costs of 19.9%. However, substantial improvements in drug availability were observed, with an average increase in procured quantities of 6,516% across five drugs. The largest increase was observed for dexamethasone, which increased by 13,252%. These findings indicate that multiple-sourcing significantly expands procurement volumes despite higher costs.

Conclusions

Transitioning from single- to multiple-sourcing procurement mechanisms substantially improves drug availability, albeit with moderate increases in cost. This approach may be particularly valuable in low- and middle-income settings where ensuring continuous access to essential medicines is a priority.

1. Introduction

Interruptions in access to essential medicines remain a major barrier to effective treatment in low- and middle-income countries (LMICs), including Indonesia, even for conditions that are otherwise highly curable [1, 2]. This challenge is particularly critical in pediatric oncology, where treatment outcomes depend on uninterrupted access to complex, multi-drug regimens over extended periods [3]. Acute lymphoblastic leukemia (ALL), the most common childhood cancer, exemplifies this dependency [4]. Although survival rates exceed 80–90% in high-income countries, outcomes in resource-constrained

settings such as Indonesia remain substantially lower [5]. This disparity is driven not only by delays in diagnosis but also by inconsistent availability of essential chemotherapy agents, which can lead to treatment interruptions, protocol deviations, and ultimately poorer survival outcomes [6]. Ensuring continuous availability of ALL medicines therefore remains a critical health system challenge in Indonesia.

Pharmaceutical procurement systems play a central role in determining medicine availability [7]. In Indonesia, efforts to improve efficiency and transparency have led to the implementation of an electronic catalog (e-catalog) and e-purchasing system, which centralize information on drug specifications, suppliers, and prices [8]. Historically, procurement within this system relied on a single-sourcing mechanism, in which one supplier is selected for each product through tendering or negotiation processes. While this approach may support price standardization, it also increases vulnerability to supply disruptions when the selected supplier is unable to meet demand [9]. Previous evidence has highlighted gaps between procurement planning and actual purchasing under single-sourcing arrangements, contributing to medicine shortages [10].

To address these limitations, procurement policies in Indonesia have shifted toward a multiple-sourcing mechanism, allowing multiple suppliers to provide the same pharmaceutical products within the e-catalog system [11]. This approach is expected to enhance supply reliability and reduce the risk of stock shortages by diversifying sources of supply. However, expanding the number of suppliers may also lead to increased procurement costs due to price variability and reduced economies of scale [12]. As a result, policymakers face a fundamental trade-off between cost efficiency and ensuring adequate medicine availability.

Despite the growing adoption of multiple-sourcing strategies, empirical evidence on their real-world impact in Indonesia remains limited [13]. In particular, there is a lack of studies quantifying how increased procurement costs compare with improvements in medicine availability following procurement reform [14]. Understanding this trade-off is essential for informing policy decisions, especially in resource-constrained health systems where both efficiency and access are critical. Therefore, this study aimed to conduct a cost-consequence analysis (CCA) of the transition from single- to multiple-sourcing procurement mechanisms in Indonesia, using childhood ALL drugs as a reference case to evaluate changes in procurement costs and drug availability.

2. Methods

2.1. Study Design and Data Source

A cross-sectional analytical study was conducted using national pharmaceutical procurement data obtained from the e-catalog system. The dataset covered the period from 2021 to 2023 and included aggregated procurement data from healthcare facilities participating in the national e-purchasing system.

2.2. Study Population and Inclusion Criteria

The analysis focused on childhood ALL drugs listed in the national formulary. Healthcare facilities were included if they procured the selected drugs consistently through the e-catalog system during both procurement periods: single-sourcing (2021) and multiple-sourcing (2022–2023). Procurement data related to special access schemes or non-standard procurement pathways were excluded to ensure comparability.

2.3. Procurement Mechanisms

Two procurement mechanisms were evaluated:

- Single-sourcing (2021): Procurement from a single supplier selected through tender or negotiation processes.
- Multiple-sourcing (2022–2023): Procurement from multiple approved suppliers available within the e-catalog system.

The transition between these mechanisms reflects a national policy shift aimed at improving medicine availability.

2.4. Analytical Perspective

This study was conducted from the health system (payer) perspective, focusing on procurement expenditures and quantities of drugs procured through the national system.

2.5. Outcome Measures

Cost

Procurement cost was defined as the unit price of each drug as listed in the e-catalog. Incremental cost was calculated as the percentage change in procurement cost between multiple-sourcing and single-sourcing periods using the following formula:

$$\text{Incremental Cost } (\%) = \frac{\varvec{C}multi - \varvec{C}single}{\varvec{C}single} x100$$

Procurement Volume (Outcome)

Drug availability was proxied by the total quantity of drugs procured. Incremental change in procurement volume was calculated as:

$$\text{Incremental Volume } (\%) = \frac{\varvec{Q}multi - \varvec{Q}single}{\varvec{Q}single} x100$$

where C represents procurement cost and Q represents drug quantity, with subscripts indicating procurement mechanisms.

2.6. Analytical Approach

A CCA framework was applied, in which changes in costs and procurement volumes were reported separately without aggregating them into a single summary measure [15]. This approach was selected because outcomes (drug quantities) were not expressed in monetary units.

Average values for the multiple-sourcing period were calculated using data from 2022 and 2023, while 2021 data represented the single-sourcing baseline. Results were presented descriptively across selected ALL drugs to compare changes in procurement costs and volumes following the policy transition.

3. Results

3.1. Selection of Drugs

Based on the national formulary and treatment protocol for childhood ALL in Indonesia, twelve drugs were initially identified. After applying the inclusion and exclusion criteria, five drugs were included in the analysis: methotrexate intrathecal (IT), vincristine, prednisone, dexamethasone (oral), and cyclophosphamide.

3.2. Changes in Procurement Costs

Following the transition from single- to multiple-sourcing procurement, all five drugs showed increases in unit procurement costs. The average increase across drugs was 19.9% (Table 1). The largest increase was observed for dexamethasone (64.9%), followed by prednisone (32.3%). Smaller increases were observed for vincristine (1.3%), cyclophosphamide (0.7%), and methotrexate IT (0.3%).

Table 1
Unit procurement costs under single- and multiple-sourcing mechanisms

ALL drugs	Single-sourcing (IDR)	Multiple-sourcing (IDR)	Incremental cost
Methotrexate IT (25 mg/mL)	35,500	35,617	0.3%
Vincristine (1 mg/mL)	87,200	88,356	1.3%
Prednisone (5 mg)	70	93	32.3%
Dexamethasone (0.5 mg)	34	56	64.9%
Cyclophosphamide (500 mg)	95,480	96,177	0.7%
Average			19.9%

Under the multiple-sourcing mechanism, a wider range of prices was observed compared to single-sourcing, where only one supplier price was available. The variation between the lowest and highest prices was particularly notable for prednisone (IDR 68–389) and dexamethasone (IDR 34–270), indicating substantial price dispersion among suppliers (Table 2).

Table 2
Lowest and highest prices under multiple-sourcing procurement

ALL drugs	Multiple-sourcing	
	Lowest price (IDR)	Highest price (IDR)
Methotrexate IT (25 mg/mL)	33,562	54,168
Vincristine (1 mg/mL)	84,383	97,680
Prednisone (5 mg)	68	389
Dexamethasone (0.5 mg)	34	270
Cyclophosphamide (500 mg)	93,136	95,480

3.3. Changes in Procurement Volumes and Supplier Participation

The transition to multiple-sourcing was associated with substantial increases in procurement volumes across all analyzed drugs. The average increase in procured quantities was 6,516% (Table 3). The largest increase was observed for dexamethasone (13,252%), followed by prednisone (12,094%), cyclophosphamide (3,238%), vincristine (2,336%), and methotrexate IT (1,660%).

Table 3
Change in procurement volume following transition to multiple-sourcing

Drug	Quantity (Single-sourcing)	Quantity (Multiple-sourcing)	Number of providers	Incremental change (%)
Methotrexate IT (25 mg/mL)	4,682	82,412	33	1,660%
Vincristine (1 mg/mL)	977	23,809	29	2,336%
Prednisone (5 mg)	496,300	60,517,594	93	12,094%
Dexamethasone (0.5 mg)	723,600	96,615,866	78	13,252%
Cyclophosphamide (500 mg)	545	18,192	44	3,238%
Average				6,516%

In addition to increased procurement volumes, the number of suppliers expanded considerably under the multiple-sourcing mechanism. Prednisone had the highest number of suppliers (93), followed by dexamethasone (78), cyclophosphamide (44), methotrexate IT (33), and vincristine (29) (Table 3).

3.4. Summary of Cost and Procurement Changes

Overall, the shift from single- to multiple-sourcing procurement was associated with moderate increases in unit costs alongside substantial increases in procurement volumes and supplier participation. This pattern was consistent across all analyzed drugs, reflecting a trade-off between higher procurement costs and improved availability within the national procurement system.

4. Discussion

This study evaluated the impact of transitioning from single- to multiple-sourcing procurement mechanisms on drug availability and procurement costs for childhood ALL in Indonesia. The findings demonstrate that while multiple-sourcing is associated with moderate increases in procurement costs, it substantially improves procurement volumes and supplier participation across all analyzed drugs. These results highlight an important trade-off between cost efficiency and supply reliability within pharmaceutical procurement systems.

The substantial increase in procurement volumes observed in this study suggests that multiple-sourcing mechanisms can significantly enhance the availability of essential medicines [16]. In the context of childhood ALL, where treatment protocols require continuous and timely administration of multiple chemotherapy agents, improved availability is critical to preventing treatment interruptions and maintaining protocol adherence [17]. Previous studies have shown that disruptions in chemotherapy supply are associated with poorer clinical outcomes, reinforcing the importance of ensuring reliable access to these medicines, particularly in LMICs [18, 19].

The increase in the number of suppliers under the multiple-sourcing mechanism likely contributed to improved procurement volumes by reducing dependence on individual suppliers and enhancing supply flexibility. This finding is consistent with prior evidence indicating that supplier diversification can strengthen supply chain resilience and reduce the risk of stock shortages, particularly in settings where procurement systems are vulnerable to disruptions [20]. In Indonesia, where previous procurement practices under single-sourcing have been associated with gaps between procurement planning and actual purchasing, the shift toward multiple-sourcing appears to address key structural limitations in the system [21, 22].

However, these improvements in availability come with an increase in procurement costs. The observed rise in unit prices may be explained by greater price variability among suppliers and the reduced ability to leverage single-supplier negotiations for lower prices [23]. This reflects a common trade-off in procurement strategy; while single-sourcing may offer cost advantages through price consolidation, it may also increase vulnerability to supply disruptions [24]. In contrast, multiple-sourcing improves supply

security but may reduce price efficiency [25]. From a policy perspective, this trade-off suggests that procurement decisions should not be based solely on cost minimization but should also consider the critical importance of ensuring uninterrupted access to essential medicines [26].

In the context of childhood ALL treatment, the magnitude of the increase in procurement volumes relative to the increase in costs suggests that multiple-sourcing may represent a favorable strategy for improving access to essential medicines [27]. Although this study does not convert outcomes into monetary terms, the large improvements in availability indicate potential downstream benefits, including reduced treatment interruptions and improved clinical outcomes. These considerations are particularly important in resource-constrained settings, where supply disruptions can have significant implications for patient survival.

This study has several limitations. First, the analysis was limited to selected childhood ALL drugs and may not be generalizable to other therapeutic areas. Second, the use of aggregated procurement data does not capture variations at the facility level or account for differences in demand across regions. Third, this study did not evaluate clinical outcomes or downstream health impacts associated with improved drug availability. Finally, the analysis did not incorporate uncertainty or sensitivity analyses, and the results should therefore be interpreted as descriptive of observed trends rather than causal estimates.

Despite these limitations, this study provides empirical evidence on the real-world impact of procurement reform in Indonesia. The findings suggest that multiple-sourcing procurement mechanisms can play a critical role in improving medicine availability, albeit with modest increases in cost [28]. Future research should explore the broader health and economic implications of improved drug availability, including potential effects on treatment outcomes and long-term healthcare costs.

5. Conclusion

The transition from single- to multiple-sourcing procurement mechanisms in Indonesia was associated with substantial improvements in the availability of childhood ALL medicines, accompanied by moderate increases in procurement costs. These findings highlight a key trade-off between cost efficiency and supply reliability within pharmaceutical procurement systems. In the context of pediatric oncology, where uninterrupted access to essential medicines is critical for treatment continuity, the observed increases in procurement volumes suggest that multiple-sourcing may enhance access and strengthen supply resilience. Policymakers should therefore consider balancing cost containment with the need to ensure consistent medicine availability when designing procurement strategies. Further research is needed to assess the impact of improved drug availability on clinical outcomes and long-term health system costs, as well as to explore the applicability of multiple-sourcing mechanisms across other therapeutic areas.

Abbreviations

ALL Acute lymphoblastic leukemia

CCA Cost-consequence analysis

IDR Indonesian Rupiah

IT Intrathecal

LMICs Low- and middle-income countries

Declarations

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Authors' contributions

Dita N. S. Argadiredja and Mohammed Alfaqeeh contributed equally to this work and were primarily responsible for the study conception and design, data analysis, interpretation of results, and drafting of the manuscript. Yasmin Fatinah, Vesara Ardhe Gatera, Lucia R. Andalusia, Rano K. Sinuraya, and Dina Abushanab contributed to data validation and critically revised the manuscript for important intellectual content. Rizky Abdulah and Auliya A. Suwantika provided supervision, conceptual guidance, and review of the manuscript. All authors read and approved the final manuscript.

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Data Availability Statement

All data presented in the current work are available in the text and supplementary materials and available from the authors upon reasonable request.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Competing interests

The authors declare no competing interests.

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