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Research Article

The Effect of Directly Observed Treatment Strategy on Cost Utility of Pulmonary Tuberculosis Patients at Banten Regional Public Hospital

Baha Udin [1,2]

Yusransyah [2]

Saepudin [3*]

[1] Master Program of Pharmacy, Universitas Islam Indonesia, Sleman, Special Region of Yogyakarta, Indonesia
[2] Department of Pharmacy, Sekolah Tinggi Ilmu Kesehatan Salsabila Serang, Serang, Banten, Indonesia
[3] Department of Pharmacy, Universitas Islam Indonesia, Sleman, Special Region of Yogyakarta, Indonesia

*email: saepudin@uii.ac.id; phone: +6281802759919

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Abstract

Pulmonary tuberculosis (TB) is one of the communicable diseases with high prevalence in some provinces in Indonesia, including the Province of Banten. Considering its high prevalence and the high cost of treatment resulting from multiple treatment components, research on the analysis of treatment costs of TB is very important. This study aimed to determine the effect of implementing the directly observed treatment (DOT) strategy on the cost-utility of pulmonary TB patients. The study was conducted at Banten Regional General Hospital using the perspective of the health provider and patients by involving 24 TB patients. Treatment cost was calculated by including direct medical costs, direct non-medical costs, and indirect costs, and then categorized into initial and final cost-utility. The average cost-effectiveness ratio (ACER) was then calculated by setting the patient's quality of life as the clinical outcome in this study. This study found that the average value of the average cost-utility ratio (ACUR) for the initial cost-utility and the final cost-utility were IDR 2,682,343.53 and IDR 2,402,153.15, respectively, and the difference was statistically significant (p=0.006). It indicates that the DOT strategy can potentially improve the utility costs of the treatment of TB patients at Banten Regional Hospital.

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INTRODUCTION

Pulmonary tuberculosis (TB) remains a significant global health burden, ranking as the 13th leading cause of mortality worldwide and the second most prevalent infectious disease after COVID-19[1]. In 2021 alone, an estimated 10.6 million individuals were diagnosed with TB globally[2]. Within Indonesia, the incidence of bacteriologically confirmed pulmonary TB reached 260,699 cases in 2019, representing a rate of 97.25 cases per 100,000 population[3].

The management of pulmonary TB presents a complex challenge, necessitating a comprehensive government-led program due to the extended treatment duration, high transmission risk, and the critical importance of patient adherence[4]. To address these complexities, the Indonesian government has implemented the Directly Observed Treatment (DOT) strategy[5]. This strategy encompasses five key components, with microscopic sputum examination and combination anti-tuberculosis drug therapy being pivotal elements[6].

The extended treatment regimen for pulmonary TB, lasting a minimum of six months, can significantly impact patients' overall health status[7]. This prolonged duration often leads to both physical and psychological changes, ultimately affecting their quality of life (QoL)[2]. A decline in QoL is strongly correlated with compromised health status, potentially resulting in treatment delays and disruptions, leading to incomplete or interrupted therapy[8]. Studies have consistently demonstrated a concerning trend of diminished QoL among pulmonary TB patients. For instance, Ita *et al.*[9] reported that the QoL in this

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population frequently falls within a low category. Similarly, Alfauzan and Lucya[10] found that TB patients across Asian countries experience a relatively low QoL. These findings underscore the critical need to address the multifaceted challenges posed by prolonged TB treatment and their impact on patient well-being.

The global economic burden of pulmonary TB is substantial, with estimated costs reaching approximately US$1 trillion. From 2000 to 2015 alone, the cumulative economic impact of TB was estimated at US$616 billion. In several African and Asian nations, including Indonesia, the economic losses attributable to TB exceed 1% of their Gross Domestic Product (GDP)[11]. Within Indonesia, the Ministry of Health allocates a significant annual budget of IDR 300 billion towards TB management. Of this, IDR 200 billion is designated for the procurement of anti-tuberculosis drugs, with the remaining funds supporting treatment initiatives. Furthermore, the Ministry of Health receives an additional IDR 100 billion in funding from the Global Fund consortium. Consequently, the total annual budget dedicated to TB control in Indonesia approximates IDR 400 billion[12]. These financial commitments underscore the significant economic strain imposed by TB and highlight the necessity for effective and cost-efficient interventions.

The escalating costs associated with drug utilization pose a significant burden on healthcare systems, with an average annual increase of 10% impacting governmental budgets[13]. Specifically, the economic implications of TB treatment, particularly within regional healthcare settings, necessitate careful evaluation. To date, no pharmacoeconomic studies have been conducted to assess the impact of the DOT strategy on cost-utility within the Banten Regional General Hospital. This hospital, serving as the sole provincial-level referral center for pulmonary TB patients in Banten Province, warrants a comprehensive analysis to inform policy decisions regarding the effectiveness and economic efficiency of DOT. Consequently, this study aims to analyze the influence of the DOT strategy on both the costs and utilities experienced by pulmonary TB patients undergoing treatment at the Banten Regional General Hospital.

MATERIALS AND METHODS

Materials

This study employed a multi-faceted data collection approach, utilizing medical record data, cost analyses, patient identity sheets, informed consent forms, and EQ-5D-5L questionnaires. Medical record data, encompassing patient diagnoses and treatment regimens, were extracted from the Banten Regional Hospital's medical records department, specifically focusing on pulmonary tuberculosis patients who met the predefined study criteria. Cost data, detailing the direct medical expenditures associated with patient care, were obtained from the hospital's insurance department. Patient identity sheets, developed by the researcher, facilitated the collection of indirect medical cost information and patient demographic characteristics. Informed consent was obtained directly from each participant, ensuring their voluntary participation throughout the study. The EQ-5D-5L questionnaire, adapted from the instrument validated by Purba *et al.*[14], was used to assess patient health-related QoL.

Methods

Research design

This study employed an observational, cross-sectional design to evaluate the QoL, associated costs, Average Cost-Utility Ratio (ACUR), and the impact of DOT on cost-utility among pulmonary TB patients at Banten Regional Hospital. A dual perspective, encompassing both the provider and the patient, was adopted. Cost analysis included direct medical costs, specifically those related to anti-tuberculosis medications, ancillary drug use, sputum examinations, laboratory procedures, and administrative fees. Additionally, direct non-medical costs, such as consumption and transportation expenses, and indirect costs, representing productivity losses, were assessed.

Subjects selection

This retrospective cohort study aimed to evaluate pulmonary TB treatment outcomes among patients at Banten Regional Hospital between January and May 2024. The target population comprised all patients with confirmed pulmonary TB during this period. A sample was selected from this population based on specific inclusion and exclusion criteria. Inclusion criteria were as follows: patients aged 18-64 years, undergoing outpatient DOT at Banten Regional Hospital, receiving Category 1 TB treatment, currently in the second or third month of the continuation phase, having complete treatment cost

data, and providing informed consent to participate. Exclusion criteria included patients who experienced changes in treatment strategies, were transferred to community health centers, or declined to provide informed consent or complete the study questionnaire.

Research instruments

Prior to participation, all pulmonary TB patients meeting the study's inclusion and exclusion criteria provided written informed consent. Patient demographic information, including gender, age, education level, employment status, income, consumption costs, transportation expenses, and productivity loss, was collected directly from participants using a structured questionnaire. Direct medical cost data was obtained from patient medical records, which also provided information on the specific TB therapies administered. Quality of life was assessed using the EQ-5D-5L questionnaire, a validated instrument for indirect measurement. Patient-reported data, including demographic information and QoL assessments, was collected through direct interaction with participants[14,15].

Data collection techniques

Data collection for this study employed a structured questionnaire, designed to elicit responses to specific questions and statements from participants. The questionnaire was administered to respondents who had completed one or two months of pulmonary TB treatment during the continuation phase of anti-tuberculosis drug therapy. To assess cost-utility and QoL, data were collected at two distinct time points: initial and final. The initial cost-utility data were obtained from patients in their second or third month of the continuation phase. Subsequently, the final cost-utility data were collected one month after the initial assessment, allowing for a longitudinal evaluation of treatment impact.

Pharmacoeconomic analysis

To evaluate changes in the QoL of pulmonary TB patients, a comprehensive assessment was conducted utilizing respondent data sheets in conjunction with the EQ-5D-5L questionnaire. The utility value, derived from the EQ-5D-5L responses, was subsequently employed to calculate the Quality-Adjusted Life Year (QALY) values. A cost-utility analysis was performed to determine the economic efficiency of the treatment, wherein the direct medical costs were compared against the treatment utility. The calculation of the cost-utility ratio was based on **Equation 1**[16].

$$ACUR = \frac{Treatment\ costs\ for\ pulmonary\ TB\ patients}{Therapeutic\ utilities} \quad [1]$$

Data analysis

Prior to statistical analysis, the normality of data distribution was assessed using the Kolmogorov-Smirnov test. Subsequently, an independent-samples t-test was employed to compare the mean utility costs between the initial and final time points. All statistical analyses were performed using a significance level (α) of 0.05.

RESULTS AND DISCUSSION

Patients characteristics

The demographic profile of the TB patient cohort revealed a predominance of male patients (**Table I**), consistent with findings from Sunarmi and Kurniawati[17]. This observation aligns with the established higher risk of pulmonary TB in men, potentially attributable to occupational exposures and lifestyle factors such as smoking and alcohol consumption, which are more prevalent in males. Conversely, women may exhibit greater health-seeking behaviors, leading to earlier diagnosis and intervention[18].

The study population was primarily composed of individuals aged 18-28 years, reflecting the vulnerability of the economically productive age group (15-49 years) to TB[19]. While TB can affect all age groups, its prevalence in this cohort suggests increased exposure during active work years. Elderly patients, though less represented, are at heightened risk of treatment failure due to age-related physiological changes impacting drug absorption[20].

A significant proportion of patients had low educational attainment (elementary and high school), which is consistent with Widiati and Majdi[21]. This finding underscores the potential impact of education on TB knowledge and treatment adherence.

Lower educational levels may hinder the comprehension of health information, thereby affecting treatment outcomes[22,23]. The majority of patients were employed, a factor that can influence TB risk through occupational exposures. Working environments with poor ventilation, lighting, and humidity can increase susceptibility to the disease[24].

While a larger number of patients reported no family history of TB, the potential for familial transmission remains significant. *Mycobacterium tuberculosis* can be transmitted through droplet infection, posing a high risk to close contacts within households. This contrasts with Akadji *et al*.[25] who found a higher incidence of TB with family history, highlighting the need for further investigation of regional differences.

Finally, the study found a higher proportion of non-smokers among TB patients, which contradicts findings from Katiandagho *et al*.[26]. Smoking is a recognized risk factor for TB, exacerbating disease severity and hindering treatment efficacy. The discrepancy between studies suggests potential variations in smoking prevalence and its association with TB across different populations. In summary, the demographic characteristics of TB patients in this study highlight the complex interplay of socio-economic factors, lifestyle, and biological susceptibility.

Table I. Demographic characteristics of outpatient pulmonary TB patients at Banten Regional Hospital.

Demographics	Frequency	Percentage (%)
Sex		
Male	14	58.3
Female	10	41.7
Total	24	100
Age (years old)		
18-28	9	37.5
29-39	5	20.8
40-50	1	4.2
51-60	5	20.8
>60	4	16.7
Total	24	100
Last education		
No school	2	8.3
Elementary school	9	37.5
Junior high school	3	12.5
Senior High school	9	37.5
Diploma/Bachelor	1	4.2
Total	24	100
Employment status		
Employed	16	66.7
Unemployed	8	33.3
Total	24	100
Family history of TB		
Yes	6	25
No	18	75
Total	24	100
Smoking history		
Yes	10	41.7
No	14	58.3
Total	24	100

Cost analysis of outpatient TB Treatment at Banten Regional Hospital

The cost-utility analysis in this study evaluated the economic impact of pulmonary TB outpatient care at the Banten Regional Hospital DOT Clinic by comparing total costs with quality-of-life outcomes. Total costs encompassed direct medical, direct non-medical, and indirect expenses. Direct medical costs, including doctor consultations, laboratory tests, and drug expenditures, were derived from hospital insurance records. Direct non-medical costs, such as transportation and consumption expenses per clinic visit, and indirect costs, representing lost monthly income due to treatment, were obtained through patient-completed identity sheets. Given the outpatient nature of TB treatment, adherence to scheduled monthly clinic visits is crucial for optimal patient recovery. This study specifically examined costs associated with the advanced phase of TB treatment, where patients typically attend the DOT Clinic once monthly. The economic evaluation highlights the comprehensive cost burden borne by patients undergoing outpatient TB therapy, underscoring the importance of considering both medical and non-medical factors in treatment planning and resource allocation[27].

Direct medical costs, representing expenditures for essential health services, were analyzed to assess the economic impact of pulmonary TB treatment. **Table II** details the specific cost components incurred by the Indonesian National Health Insurance (*Badan Penyelenggara Jaminan Sosial*; BPJS) for patients receiving DOT at the Banten Regional Hospital TB clinic in 2024. These data, collected during a single patient visit, provide a snapshot of the immediate financial burden associated with TB care. **Table III** further illustrates the initial and final costs borne by individual patients across these cost components. Notably, a significant reduction of IDR 132,506.2 was observed in the average overall patient costs between the initial and final assessments. This decrease suggests a correlation between patient adherence to treatment, consistent anti-tuberculosis drug usage, and a subsequent reduction in symptom severity, which in turn minimizes the need for additional costly therapeutic interventions. These findings underscore the potential for cost savings associated with effective TB management and patient compliance.

Table II. Total average of all types of costs components.

Types of fees	Initial average total (IDR)	Final average total (IDR)
Direct medical cost		
Doctor Consultation	119,006.25	106,064.58
Laboratory	19,666.71	3,750.00
Drug	31,690.71	27,482.38
Other Fees	60,044.67	53,555.50
Total	230,408.33	190,852.46
Direct non-medical cost		
Transportation costs	108,333.00	109,375.00
Consumption costs	92,292.00	53,333.00
Total	200,625.00	162,708.00
Indirect costs		
Monthly Income	1,824,883.50	1,824,883.50
Total	**2,255,916.83**	**2,178,444.29**

Table III. Costs for pulmonary TB patients at Banten Regional Hospital.

	Total initial cost (IDR)	Total final cost (IDR)	Difference (IDR)
Lowest	167,700.00	135,562.00	32,138.00
Highest	4,844,200.00	4,724,300.00	119,900.00
Median	2,206,010.00	2,160,920.00	45,090.00
Total	55,462,812.00	52,282,663.00	3,180,149.00
Average	2,310,950.50	2,178,444.29	132,506.20
Standard deviation	1,569,416.29	1,582,274.01	-12,857.70

Patients' quality of life

Quality of life, as defined by an individual's subjective perception within their cultural and value context, is intrinsically linked to both physical and mental health[28]. Optimal physical and mental well-being contributes to enhanced self-acceptance, positive body image, emotional stability, interpersonal harmony, and overall life satisfaction[29]. In this study, the EQ-5D-5L questionnaire, a validated generic instrument utilizing a value set utility, was employed to assess patient health status. Developed in Europe and widely adopted globally, including in Indonesia[30,31], the EQ-5D-5L comprises a visual analog scale and five domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Respondents selected from five possible answers within each domain, reflecting their experienced health conditions. Tondok *et al*.[32] validated the Indonesian version of the EQ-5D-5L for pulmonary tuberculosis patients, demonstrating significant Pearson correlation values ($p < 0.001$, $r \geq 0.60$-0.80) across all five domains and a Cronbach's α of 0.799, confirming its validity and reliability. In this study, "initial quality of life" refers to data collected at baseline, while "final quality of life" denotes data collected one-month post-baseline.

Table IV presents the initial and final QoL scores, as measured by the EQ-5D-5L, in pulmonary TB outpatients at Banten Regional Hospital. Initially, a majority of respondents reported no difficulties across all five dimensions. However, a subset experienced significant problem with mobility, self-care, pain, and anxiety. Notably, final QoL data indicated a reduction in severe problems, with pain and anxiety remaining the most prominent concerns.

Mobility limitations, ranging from moderate to severe, were observed in several patients, likely influenced by age-related musculoskeletal issues and TB-related symptoms such as weakness. This finding aligns with recommendations to assess functional limitations in TB patients using the 6-minute walk test, particularly those with residual pulmonary symptoms[33].

Similarly, difficulties with self-care, such as bathing and dressing, were frequently associated with mobility impairments, necessitating familial assistance. Patients also reported limitations in performing usual activities, directly correlating with their walking abilities.

Pain, primarily chest pain, was a common complaint among TB patients. This pain is likely attributed to pleuritic inflammation, a known complication of TB, and may persist even after recovery[34]. Additionally, factors such as age, occupation, and comorbidities may modulate pain perception. Anxiety and depression were also prevalent, with patient concerns regarding treatment duration and social stigma potentially contributing to these psychological burdens. As reported by Yudyarto *et al.*[35], the extended treatment regimen for TB can induce feelings of vulnerability and social isolation, thereby exacerbating anxiety. These findings underscore the importance of addressing both physical and psychological aspects of QoL in TB patients to optimize treatment outcomes.

Table IV. Quality of life of pulmonary TB patients at Banten Regional Hospital.

Dimensions	Level 1		Level 2		Level 3		Level 4		Level 5	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Ability to walk	17(71%)	21(88%)	1(4%)	3(13%)	5(21%)	0	1(4%)	0	0	0
Self care	18(75%)	22(92%)	2(8%)	1(4%)	2(8%)	1(4%)	2(8%)	0	0	0
Common activities	18(75%)	21(88%)	2(8%)	1(4%)	4(17%)	3(8%)	0	0	0	0
Pain	9(36%)	17(71%)	6(25%)	4(17%)	5(21%)	2(8%)	4(17%)	1(4%)	0	0
Feeling anxious	10(42%)	16(67%)	4(17%)	6(25%)	4(17%)	0	6(25%)	2(8%)	0	0

Table V presents the final health-related quality of life (HRQoL) data for the TB patients, categorized into 10 distinct Health States with corresponding utility values ranging from 1.000 to 0.533. Notably, a significant proportion of the cohort (n=13) reported being in Health State 11111, indicating an optimal level of HRQoL characterized by no difficulties in mobility, self-care, or usual activities, coupled with the absence of pain, discomfort, anxiety, or depression. Conversely, a smaller subset of patients experienced some degree of diminished HRQoL. Specifically, two patients were classified under Health State 11112, signifying no difficulties in the domains of mobility, self-care, and usual activities, and an absence of pain or discomfort, but reporting mild anxiety or depression. Similarly, two additional patients were categorized in Health State 11122, indicating no difficulties with mobility, self-care, or usual activities, but experiencing mild pain or discomfort alongside mild anxiety or depression.

Table V. Health State of Pulmonary TB Patients.

No	QoL Initial Utility			QoL Utility Final		
	Health state	Frequency	Utility	Health state	Frequency	Utility
1	11111	6	1.000	11111	13	1.000
2	11112	1	0.950	11112	2	0.950
3	11114	1	0.886	11121	1	0.919
4	11121	4	0.919	11122	2	0.869
5	11122	1	0.869	11132	1	0.938
6	11123	1	0.858	11134	1	0.874
7	11133	1	0.927	11321	1	0.868
8	11141	1	0.865	21114	1	0.747
9	13134	1	0.836	22242	1	0.533
10	22233	1	0.595	23322	1	0.641
11	31114	1	0.806			
12	31342	1	0.734			
13	32334	1	0.642			
14	33344	1	0.632			
15	34334	1	0.658			
16	44243	1	0.481			

Table VI presents the utility values for the initial and final QoL assessments in pulmonary TB patients participating in this study. These utility values, derived from questionnaire responses processed according to a standardized value set, provide a quantitative measure of health status. On this scale, a utility value of 1.000 represents perfect health, while a value of 0.000 indicates a severely compromised health state. The average utility values observed for both the initial and final QoL assessments fall within the "good" category, suggesting a generally positive perception of health among the study participants. Furthermore, the data reveal a range of utility values, with the highest reported value being 1.000 in both initial

and final assessments, indicating instances of perceived perfect health. Conversely, the lowest utility values recorded were 0.481 at baseline and 0.533 at the final assessment, reflecting individuals experiencing poorer health status.

These findings align with the understanding that TB induces multifaceted changes in individuals, impacting their mental, physical, and social well-being, consequently shaping their self-perception[36]. The observed improvement, albeit within the "good" category on average, may be attributed to factors such as the DOT strategy, which is known to positively influence patient adherence and treatment outcomes. As hypothesized by the researchers, the consistency of treatment patterns and the supportive attitude of healthcare workers likely play a crucial role in enhancing the QoL of TB patients. Adherence to the prescribed treatment regimen, facilitated by appropriate support, is expected to alleviate disease symptoms and improve both the physical and psychological state of individuals undergoing TB therapy. The range of utility values, however, highlights the heterogeneity in individual experiences and responses to TB and its treatment, warranting further investigation into factors influencing these variations.

Table VI. Utility value on QoL of pulmonary TB patients at Banten Regional Hospital.

	QoL Initial Utility	QoL Utility Final	Difference
Lowest	0.481	0.533	0.052
Highest	1.00	1.00	0
Median	0.9	1.00	-0.1
Total	20.42	22.21	1.79
Average	0.85	0.93	0.08
Standard deviation	0.149831	0.123289	-0.02654

Utilities of pulmonary TB patient costs at Banten Regional Hospital

Cost-utility analysis (CUA), a specialized form of economic evaluation, extends beyond traditional cost-effectiveness analysis by incorporating patient preferences and QoL outcomes. Unlike analyses that measure outcomes in natural units (e.g., years of life gained), CUA quantifies the "utility" or satisfaction associated with health states resulting from an intervention. This utility is typically expressed in QALYs, representing the number of years lived in perfect health, or in the Indonesian context, potentially as '*tahun kualitas disesuaikan*' (QTKD)[37]. The primary outcome of a CUA is often the Average Cost-Utility Ratio (ACUR), calculated by dividing the total cost of the intervention by the total utility gained. The ACUR serves as a crucial metric for determining the cost-utility implications of a specific health strategy. In this study, the cost-utility analysis revealed a notable decrease in the overall ACUR following the implementation of the DOT strategy (**Table VII**). Specifically, the difference in the total ACUR between the initial assessment and the final assessment post-DOT implementation was IDR 6,724,569.34. Furthermore, the average difference in ACUR per patient amounted to IDR 280,190.38. This reduction in ACUR suggests an improvement in cost-utility, indicating that the DOT strategy yielded a greater gain in quality-adjusted life years relative to the associated costs. This finding implies that the DOT intervention not only potentially improves health outcomes but also represents a more efficient allocation of healthcare resources in terms of patient well-being.

Table VII. Cost utilities for pulmonary TB patients at Banten Regional Hospital.

	ACUR Utility Initial Cost (IDR)	ACUR Final Cost Utility (IDR)	Difference (IDR)
Lowest	206,354.84	181,475.23	24,879.61
Highest	7,201,268.19	6,592,213.88	609,054.31
Median	2,476,574.68	2,444,953.99	31,620.69
Total	64,376,244.83	57,651,675.49	6,724,569.34
Average	2,682,343.53	2,402,153.15	280,190.38
Standard deviation	1,885,107.88	1,808,306.89	76,800.99

To further substantiate the findings from the ACUR calculation, a comparative analysis of cost-utility between the initial and final states was conducted and visualized using a cost-effectiveness quadrant. As depicted in **Figure 1**, the cost-utility of therapy shifted from the initial state to Quadrant II in the cost-effectiveness quadrant. This transition indicates that the final cost-utility outcome demonstrates higher effectiveness at a lower cost compared to the initial cost-utility. Specifically, the DOT treatment pattern for pulmonary tuberculosis patients at Banten Regional Hospital resulted in a cost-saving of IDR 280,190.38 per patient. This significant cost-saving, coupled with the enhanced effectiveness implied by the shift to Quadrant

II, suggests that the DOT strategy represents a more economically efficient and potentially more beneficial approach to managing pulmonary tuberculosis within this healthcare setting.

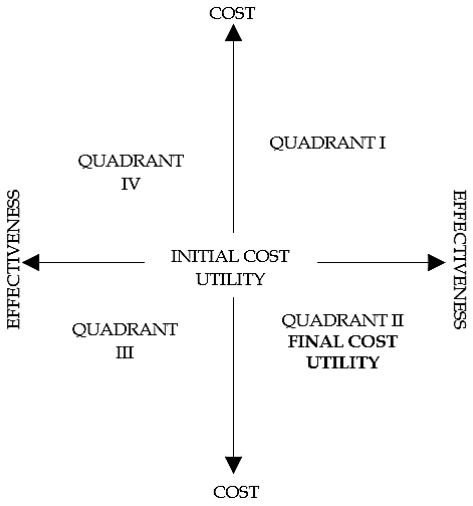

Figure 1. Cost effectiveness quadrant for pulmonary TB patients at Banten Regional Hospital.

The influence of DOT strategy on cost utility

To determine the impact of the DOT strategy on cost-utility, statistical analysis was conducted. Given that normality testing (Shapiro-Wilk, $p < 0.001$) indicated a non-normal distribution of the cost-utility data, the non-parametric Wilcoxon signed-rank test was employed. The results of the Wilcoxon test (**Table VIII**) revealed a significant trend towards improved cost-utility following the implementation of the DOT strategy. Specifically, the Negative Ranks indicated a reduction in cost-utility values from the initial assessment to the final assessment in 18 respondents (Mean rank = 11.72, Sum of ranks = 211.0). Conversely, Positive Ranks showed an increase in cost-utility values in 4 respondents (Mean rank = 10.50, Sum of ranks = 42.0), suggesting a less favorable outcome for this subgroup. Additionally, 2 respondents exhibited no change in cost-utility values (Ties). The predominance of Negative Ranks, with a higher mean rank compared to Positive Ranks, suggests that the DOT strategy was generally associated with a decrease in costs relative to the achieved health benefits within the study population.

Table VIII. Results of differences in initial cost and final cost utility values of pulmonary TB patients at Banten Regional Hospital.

	N	Mean rank	Sum of ranks
Negative ranks	18[a]	11.72	211.00
Positive ranks	4[b]	10.50	42.00
Ties	2[c]		
Total	**24**		

Note: a: the number experiencing a decrease in cost utility; b: the number experiencing an increase in cost utility; c: the number experiencing no increase.

Statistical analysis of the cost-utility data revealed a statistically significant difference ($p = 0.006$, which is less than the significance level of $\alpha = 0.05$), leading to the rejection of the null hypothesis (H_0). This finding indicates that the DOT strategy has a significant effect on the cost-utility outcomes of pulmonary TB patients at the Banten Regional Hospital (**Table IX**). However, when contextualizing these results with existing literature, a study by Sari *et al.*[38] comparing DOT and Self-Administered Treatment (SAT) strategies in pulmonary TB patients reported lower effectiveness, in terms of QoL, for the DOT group compared to the SAT group. This suggests that while DOT may influence cost-utility, its impact on patient-reported outcomes such as QoL warrants further consideration. Additionally, several other factors could have influenced the cost-utility outcomes observed in this study. These include prevailing government and hospital policies regarding pulmonary TB treatment protocols, patient adherence to the prescribed treatment regimen, and patient compliance with the utilization of anti-tuberculosis drugs. These contextual factors highlight the complex interplay of variables influencing the overall value of different TB treatment strategies.

Table IX. Statistical test results of the effect of DOT strategy on cost utility of pulmonary TB patients at Banten Regional Hospital.

ACUR Utility Initial Cost (IDR)	ACUR Final Cost Utility (IDR)	p-value
2,682,343.53	2,402,153.15	0.006

CONCLUSION

This study provides evidence suggesting that the DOT strategy has the potential to improve the cost-utility of pulmonary TB treatment within the specific context of Banten Regional Hospital. By ensuring adherence to the prescribed medication regimen, DOT may contribute to higher treatment success rates, reduced rates of drug resistance, and consequently, lower long-term healthcare costs associated with TB management. While this analysis focuses on the economic implications within a single regional hospital, the findings highlight the potential for DOT to optimize resource allocation and improve patient outcomes in the management of pulmonary TB. Further research, potentially involving multi-center studies and broader economic evaluations, could provide a more comprehensive understanding of the cost-utility of DOT across diverse healthcare settings and patient populations in Indonesia.

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AUTHORS' CONTRIBUTION

Conceptualization: Baha Udin, Yusransyah, Saepudin
Data curation: Baha Udin
Formal analysis: Baha Udin, Yusransyah
Funding acquisition: -
Investigation: Yusransyah, Saepudin
Methodology: Baha Udin, Yusransyah, Saepudin
Project administration: -
Resources: Baha Udin, Yusransyah, Saepudin
Software: -
Supervision: Yusransyah, Saepudin
Validation: Yusransyah, Saepudin
Visualization: Yusransyah, Saepudin
Writing - original draft: Baha Udin
Writing - review & editing: Yusransyah, Saepudin

DATA AVAILABILITY

None.

CONFLICT OF INTEREST

The authors declare no conflicts of interest related to this study.

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