Evaluating Cost Effectiveness

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Evaluating the cost-effectiveness of diabetic foot ulcer management by wound care specialists in Indonesia

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Abstract

Diabetic foot ulcers affect quality of life and economically burden patients and the Indonesian healthcare system. The comparative cost-effectiveness of wound care specialists in private practices (e.g., wound clinics) and wound care nurses in national hospitals remains unknown. Thus, we used a decision tree to compare the cost and healing rates for patients after 12 weeks of wound care. Uncertainty was addressed using one-way and probabilistic sensitivity analyses. Among 89 participants (42 in the national hospital and 47 in the private practice), no significant differences were observed between the two groups in terms of sex, age, education level, smoking status, duration of diabetes, Wagner wound classification, glycated haemoglobin levels, neuropathy status, ankle-brachial index, baseline characteristics, quality of life, DMIST (depth, maceration, inflammation/infection, size, tissue type of the wound bed, type of wound edge, and tunnelling/undermining) score and wound location ($p > 0.05$). However, significant differences were observed for days from first visit/assessment until complete healing, mean quality of life ($p \leq 0.001$) and wound size ($p = 0.047$). Wound care specialists in private practices had a significantly lower cost of 2,804,423.3 Indonesian rupiah compared to 6,483,493.4 Indonesian rupiah for wound care nurses in national hospitals. The incremental cost-effectiveness ratio was −165,723.9. Therefore, wound care specialists in private practices are more cost-effective for managing diabetic foot ulcers. Probability sensitivity analysis confirmed that 80%–90% of the scenarios were cost-effective. These findings may inform healthcare resource allocation in Indonesia. Additionally, evidence-based cost-effectiveness measures were strengthened in private practices and national hospitals.

KEYWORDS
cost-effectiveness, diabetic, foot ulcer, nurse specialist

1 | INTRODUCTION

Diabetes was estimated to affect 463 million people, or 9.3% of the world's adult population (aged 20–79 years), in 2019. This number is predicted to reach 578 million (10.2% of the global adult population) by 2030.[1] Based on the Indonesian National Basic Health Research (RISKESDAS), the prevalence of Type 2 diabetes mellitus (DM) among

Abbreviations: ACER, average cost-effectiveness ratio; DFU, diabetic foot ulcer; HbA1c, glycated haemoglobin levels; ICER, incremental cost-effectiveness ratio; IDR, Indonesian rupiah; QALY, quality-adjusted life year; QOL, quality of life; SD, standard deviation; WCNs, wound care nurse; WCS, wound care specialist; WTP, willingness-to-pay.

people aged more than 15 years increased from 5.7% in 2007, to 6.9% in 2013, and 10.9% in 2018.[2] The number of individuals with DM increased 0.8% over 3 years, from 10.7 million[3] in 2019 to 19.5 million in 2021.[4] The increasing morbidity rate in patients with diabetes is a serious health problem and major concern. Around 15%–25% of patients with DM will develop a diabetic foot ulcer (DFU) during their lifetime.[5] DFU, a chronic ulcer, is defined as the presence of tissue infection, ulceration and destruction of the foot related to peripheral neuropathy and/or peripheral artery disease in the lower extremities of patients with diabetes.[6] DFU can lead to serious problems for both patients and their family and the healthcare system owing to the high treatment cost, high amputation risk and complications such as sepsis and death.[2,7,8] The incidence of DFU remains high in Indonesia. One study reported that 33.9% of patients with diabetes in a national referral hospital had DFUs. Among them, 14.3% died and 34.7% had major or minor amputations.[2] Diabetes treatment is a costly health issue for which the Indonesian government is responsible. The total direct medical cost in Indonesia is US$ 576 million, with 56% spent on hospitalisation, 38% on specialist visits, 4% on unbundled non-diabetes-related medications and 2% on unbundled anti-hyperglycaemic medications.[9] Patients with wound complications are handled improperly or by unqualified healthcare professionals and face severe complications, which can lead to longer treatment and result in higher medical costs.[7,8] DFUs not only impose a heavy financial burden on patients and the healthcare system, but also significantly decrease quality of life (QOL), and increase morbidity and mortality.[10]

In Indonesia, patients with diabetes can access healthcare services at community health centres (puskesmas), hospitals of varying levels, private clinics (with specialists and non-specialists) and independent facilities such as doctors' and nurses' offices. However, the Social Health Insurance Administrative Body (BPJS) does not cover all patient health services such as treatments administered by physicians, nurses and private clinics. In addition to the government health insurance, some people use private health insurance. Although Indonesia has numerous diabetic wound care facilities, many patients with DFUs do not receive evidence-based care. A lack of knowledge among healthcare providers and decision makers, low patient compliance, high costs and lack of reimbursement for recommended interventions may contribute to this problem. Even though the Indonesian government offers health insurance, such as the BPJS, many people continue to use private health services. It is possible that the community views private health services as superior to those covered by governmental health insurance.

No study has compared national hospital-based outpatient wound care clinics with independent private clinics staffed by wound care specialists (WCS) and/or wound care nurses (WCNs). It is important to include independent private practices in clinics in cost-effectiveness analyses of wound care. The cost of wound care per patient is higher because such clinics or private practices are often located in many areas of Indonesia and serve populations that cannot afford the recommended frequency and duration of wound care to prevent conditions, such as non-healing wounds, that lead to higher wound care cost per patient. Patients with wound healing durations longer than 12 weeks are the costliest to treat.[11,12] This study aimed to assess the cost-effectiveness of diabetic wound care services provided by WCNs at a national hospital covered by national health insurance in comparison to that of services provided by WCS in private practices. Our study focused on the cost-effectiveness of diabetic wound care delivered by WCNs at national hospitals and WCS in private practices.

2 | MATERIALS AND METHODS

Two national hospitals (Dr Soedarso Hospital Polyclinic and Syarif Sultan Alkadri Pontianak Hospital Polyclinic) and one private health service (Kitamura Wound Clinic as private practice) provided outpatient data for this observational study between April 2022 and June 2023. These two hospitals were selected because the BPJS covers the cost of wound care at wound polyclinics/diabetic foot polyclinics. Two nurses in the National Hospital Polyclinic, one in the Syarif Sultan Alkadri Pontianak Hospital Polyclinic and one in the Dr Soedarso Hospital Wound Polyclinic received wound care training from non-formal education as WCNs. Two nurses worked in a private practice with a certified WCS through higher education and diabetic wound care from non-formal education as WCS. Four research assistant nurses (two WCNs and two WCS) participated in the study and collected the data. Private practices and hospitals treated diabetic wounds as outpatients using the same criteria. Patients seeking outpatient care are usually either alone or with their family members. Patients were chosen for sampling at each of the three health services, and data were collected during their initial outpatient visits.

Using the sample size and data from Pontianak, which has 5218 patients with DM and 6 regional divisions, each area was estimated to have 800 patients with diabetes.[13] Using the sample size table and a precision level of ±10%, 89 individuals were enrolled for the investigation.[14] The criteria included patients with diabetic wounds without complications (such as heart or kidney disease or stroke), as well as patients who did not have severe systemic infection wounds, and who did not have severe-to-moderate ischaemic and/or neuro-ischaemic wounds or an ankle-brachial index (ABI) > 0.7 (mild ischaemia).[15] Patients with first ulcers were not limited by age, had type I or II diabetes or were visiting the health service for the first time. Vascular Hand-held Doppler and 10-g monofilament tests were used to detect ischaemia[15] and neuropathy,[16] respectively. The inability to sense the monofilament at one or more points was defined as abnormal.[17] Patient data were collected and followed-up by research assistants until the wounds were healed. Nurses provided wound care services in accordance with the standards developed by each of the three health services. Every week, research assistants examined the patients and collected data using the DMIST wound assessment tool,[18] the Indonesian version of QOL[19] and wound photographs. The QOL data were collected through face-to-face interviews using the

EQ-5D-5L instrument questions. The EQ-5D-5L consists of questions on mobility, self-care, pain, usual activities and psychological status, with five possible answers for each item (1 = no problems, 2 = slight problems, 3 = moderate problems, 4 = severe problems and 5 = extreme problems).[19,20] For example, state '11111' indicates 'no problems on any of the five dimensions'[19]; the health state '11112' had a value of 0.921. The minimum value was −0.865 for the worst state ('55555'). Preference values were most affected by mobility and least by pain/discomfort.[19] The EQ-5D-5L values vary, usually from 0 (death) to 1 (perfect health).[19] The next step involved collecting information on medication costs, healthcare provider services, dressing, disposal and transportation. For currency conversion, we assume that an Indonesian rupiah (IDR) of 15.025 was equivalent to 1 USD on 21 July 2023.

2.1 | Decision tree

A decision tree is a suitable and accepted method for assessing cost-effectiveness in a given setting, because it reflects a relatively simple decision scenario in a short-term timeframe. The decision tree is illustrated in Figure 1. Square D1 represents the decision between healthcare services for wound care in private practices and national hospitals. Circles C1 and C2 show the chances of healing in private practice health services and national hospitals, respectively, and triangles t1–t4 are terminal nodes representing the outcomes. We considered two health states (wound healing time <12 weeks and healing time >12 weeks).[21]

2.2 | Ethical considerations

The Institute of Technology and Health Muhammadiyah Kalbar Review Board and Ethics Committee approved this study (No. 290/II. I.AU/KET.ETIK/II/2022). The participants were informed that their participation in the study was voluntary and that they could withdraw at any time without penalty. The study methodology protected patients' personal data, ensuring anonymous data analysis and reporting. The participants read and signed an informed consent form.

2.3 | Data analysis

Continuous variables were assessed using the median and mean as representative measures. Group comparisons were conducted using appropriate statistical tests, such as Student's *t*-test or non-parametric tests, based on the results of the Shapiro–Wilk normality test. Categorical variables were expressed as the number of patients (in percentage) and were compared using the Chi-square or Fisher's exact test. Baseline data for the DMIST and QOL scores and the mean score from each weekly evaluation were obtained initially. QOL scores were determined using the table provided by Purba et al.[19] The predetermined level of significance was set at $p < 0.05$. Exploratory statistical analyses were performed using the MedCalc Statistical Software version 22.009 (MedCalc Software bvba, Ostend, Belgium).

The cost-effectiveness analysis used the average cost-effectiveness ratio (ACER) and incremental cost-effectiveness ratios (ICERs). Effective cost data were used to calculate the ACER, whereas the ICER method was used to determine the increase in wound care costs by adding or replacing wound care, which may increase treatment costs. However, an increase in financing for these patients will have a better effect on wound care management. The four quadrants must be analysed to calculate the ICER for wound care service selection relative to the current standards of care. Negative ICERs are observed in the southeastern and northwestern quadrants. The results in the southeast quadrant show that the new therapy was more successful and cheaper. The ICERs in the northeastern and southwestern quadrants were positive. Most new therapies were more effective and expensive; therefore, the literature focuses on the northeast region.[22,23]

Based on these quadrants, our study illustrated a wound care strategy that is more effective and less expensive than conventional treatment (the predominant therapy and therefore typically preferred) and a wound care strategy that is costlier and less effective (and therefore typically rejected). Therefore, wound care that is more effective, but also more expensive, must be considered when deciding whether to accept or reject a decision. Additional wound care services are less effective and more expensive than standard care services. Accepting or rejecting such an intervention is difficult because patients will have to sacrifice their health to save on cost.[24]

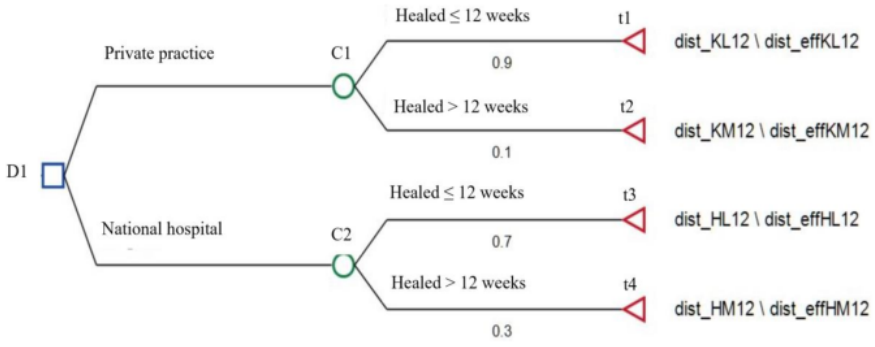

FIGURE 1 Decision tree. C, circle; D, decision.

Calculations were performed using the ACER (average total cost of wound care services/effectiveness) and the ICER (average value of the total cost of private wound care practice minus the average total cost of national hospitals divided by the effectiveness of private practices minus the effectiveness of wound care services at the hospital) formulae. This study's effective cost calculation formulation is based on previous literature by McFarlane and Bayoumi,[22] Arnold[25] and Bang and Zhao.[26]

2.4 | Probability sensitivity analysis

A Monte Carlo simulation with 10,000 iterations was used for the probabilistic sensitivity analysis to include uncertainty in the cost estimates. This study examined the costs and efficacy of wound treatment in national hospitals and private practice settings using normal-distribution data. The study divided the wounds into two groups: those that took more than 12 weeks to heal and those that recovered within 12 weeks. Data were derived using a normal-distribution reflecting variability, based on a dataset specific to each national hospital and private practice. To determine the data distribution for treatment efficacy in quality-adjusted life years (QALY), we calculated the mean value as the average and the standard deviation as a measure of variability across all datasets.

This study used a willingness-to-pay (WTP) value of 62,200,00.00 IDR per QALY. The construction of the cost-effectiveness acceptability curve was based on the provided data, illustrating the proportion of cost-effective scenarios in relation to varying WTP levels. Analyses were conducted using TreeAge Pro Version 2017, developed by TreeAge Software, Inc., Williamstown, MA, USA.

3 | RESULTS

3.1 | Participant characteristics

This study recruited and analysed 89 participants. Demographic differences between private practices and national hospitals were not statistically significant. Table 1 shows the patient characteristics. Similar demographic characteristics were observed in private practices and national hospitals with equal proportions of men and women. Senior high school age, wound site, absence of smoking and positive neuropathy were the major factors in both groups. No significant differences were found in age ($p = 0.869$), diabetes duration ($p = 0.626$), baseline and mean DMIST scores ($p = 0.058$), Wagner wound classification ($p = 0.255$), glycated haemoglobin (HbA1c) levels ($p = 0.869$), ABI ($p = 0.902$) or baseline QOL ($p = 0.361$) between the two groups. There were significant differences in the frequency of dressing changes, number of days from the initial visit/assessment until complete healing, mean QOL ($p < 0.001$) and baseline wound size ($p = 0.47$) between the groups. Our results indicate a significant difference between the wound care services offered by private practices and the polyclinic at national hospitals covered by the BPJS. These differences were evaluated for various aspects, including the total cost ($p < 0.001$), service costs, dressings, disposal and transportation ($p < 0.05$), with the exception of medical expenses ($p > 0.05$), as shown in Table 2.

3.2 | Best case analysis

The cost-effectiveness of wound care in private practices by WCS for patients with a chronic wound healing time of 12 weeks was 93.6%, compared to 71.4% in national hospitals by WCNs (Table 3). The ACER for WCNs in national hospitals was higher (6,483,493.4 IDR) than that for WCS in private practices (2,804,423.3 IDR). ACER shows that for every 1% increase in effectiveness/outcome, a cost equal to that of ACER is required. Our study found that private practices are cheaper and more effective. The ICER is the cost per incremental unit of effectiveness. Although a negative ICER is not easily interpretable, it favours an intervention.

3.3 | QOL and utilities

Original data from this study were used to determine the utility of various health states: 0.84 for private practice and 0.76 for national hospitals. Our study used a time trade-off method to estimate the utility weights associated with a variety of DFUs in Indonesia-related health states.[19] QOL estimates were also derived from this study data for the cost-effectiveness analysis. The QALY was determined by multiplying the QOL utility weight for the health state by 1 year in that state. We based our analysis on the fact that ulcer recurrence can occur four times per year in patients with diabetes who have recovered from an ulcer.[27]

3.4 | Probability sensitivity analysis

The cost-effectiveness acceptability curve provides the probability that wound care in private practices/national hospitals is cost-effective, depending on the WTP, based on the Monte Carlo simulation (Figure 2). The private practice curve (green dots) lies above the national hospital curve (red triangles) for all the WTP levels. An incremental cost-effectiveness diagram of the sensitivity analysis after 10,000 replications is shown in Figure 2, where each point represents the ICER for one sensitivity analysis iteration. This study showed that wound care services provided by WCS in private practices in the lower right quadrant could be considered cost-effective (higher effectiveness and lower cost), whereas those provided by WCNs in national hospitals in the upper left quadrant could not be considered cost-effective (lower effectiveness and higher cost). The green dotted curve represents the percentage of iterations, and WCS is a cost-effective strategy at each WTP threshold. In this instance, the WTP for a unit of incremental effectiveness determines whether decision makers view a particular scenario as cost-effective. Cost-effectiveness

TABLE 1 Comparison of participant characteristics between the two groups.

Variables	Private practice, *n* (47)	National hospital, *n* (42)	*p*
Sex, no (%)			
Male	16 (38.1)	26 (55.3)	0.104
Female	26 (61.9)	21 (44.7)	
Age (median)	57 (34–79)	56.8 (40–94)	0.869
Education, no (%)			
Elementary school	7 (14.9)	6 (14.3)	
Junior high school	3 (6.4)	2 (4.8)	
Senior high school	26 (55.3)	24 (57.1)	0.988
Higher education	11 (23.4)	10 (23.8)	
Wound location, no (%)			
Forefoot	22 (47.8)	21 (48.8)	
Midfoot	10 (21.7)	16 (37.2)	0.170
Hindfoot	4 (8.7)	2 (4.7)	
Malleolus	1 (2.2)	0	
Above malleolus	9 (19.6)	4 (9.3)	
Total dressing changes (frequency), (median)	18.5 (3–65)	28.5 (10–120)	<0.001
Smoke, no (%)			
Smoking	6 (12.8)	4 (9.5)	0.629
No smoking	41 (87.2)	38 (90.5)	
Duration of diabetes, (median)	5 (1–22)	5 (1–25)	0.626
Baseline DMIST score, (median)	10 (3–20)	11 (5–20)	0.058
Mean DMIST score, (median)	6 (1.5–12.3)	6.7 (3–13.3)	0.056
Wagner wound classification (median)	2 (1–4)	2 (1–3)	0.255
Days from first visit/assessment until complete healing, (median)	37 (6–140)	57 (20–254)	<0.001
HbA1c (%), (median)	8.3 (6.1–15.2)	8.7 (6.2–12.4)	0.869
Neuropathic, no (%)			
Positive	24 (51.1)	28 (66.7)	0.138
Negative	23 (48.9)	14 (33.3)	
ABI, (median)	1 (0.72–1.48)	1 (0.8–1.6)	0.902
Baseline wound size (cm), mean (SD)	28.4 (37.4)	15.5 (18.5)	0.047
	Utility	**Utility**	
Baseline QOL, (median)	0.69 (0.53–0.82)	0.62 (0.53–0.86)	0.361
Mean QOL, (median)	0.84 (0.69–1)	0.76 (0.53–0.92)	<0.001

Abbreviations: ABI, ankle-brachial index; DM, diabetes mellitus; HbA1c, glycated haemoglobin; QOL, quality of life; SD, standard deviation.

TABLE 2 Comparison of mean costs of wound care services in private practice and national hospitals.

	IDR, mean (95% confidence interval)		
Variables	Private practice	National hospital	*p*
Total cost	915,531 (713,942.0–1,117,121.8)	1,728,214 (1,295,678.9–2,160,749.6)	<0.001
Dressing	430,957.4 (322,356.5–539,558.4)	926,071,4 (322,356.5–539,558.4)	0.004
Provider health services	915,531.9 (713,942,0–1,117,121.8)	1,728,214.3 (1.295.678,9–2.160.749,6)	0.001
Medication	428,855.3 (328,270.4–529,440.2)	537,190.5 (408,019.6–666,361.3)	0.181
Disposal	707,874.5 (513,638.9–902,110.0)	1.179.642,9 (807.501,5–1.551.785,0)	0.022
Transportation	188,301.9 (118,136.5–258,467.3	415,238.1 (228,022.2–602,453.9)	0.019

Abbreviation: IDR, Indonesian rupiah.

TABLE 3 Wound care effectiveness for chronic wound healing time ≤12 weeks and ACERs and ICERs.

	≤12 weeks wound healing time	*N* (89)	Wound care effectiveness (%)	Total cost of wound care services per patient IDR	ACER, IDR	ΔC	ΔE	ICER, ΔC/ΔE, IDR
Private practice	44	47	93.6	2,624,940.2	2,804,423.3	−3,679,070.1	22.2	−165,723.9 dominated
National hospital	30	42	71.4	4,629,214.3	6,483,493.4			

Abbreviations: ACER, average cost-effectiveness ratio; ICER, incremental cost-effectiveness ratio; IDR, Indonesian rupiah.

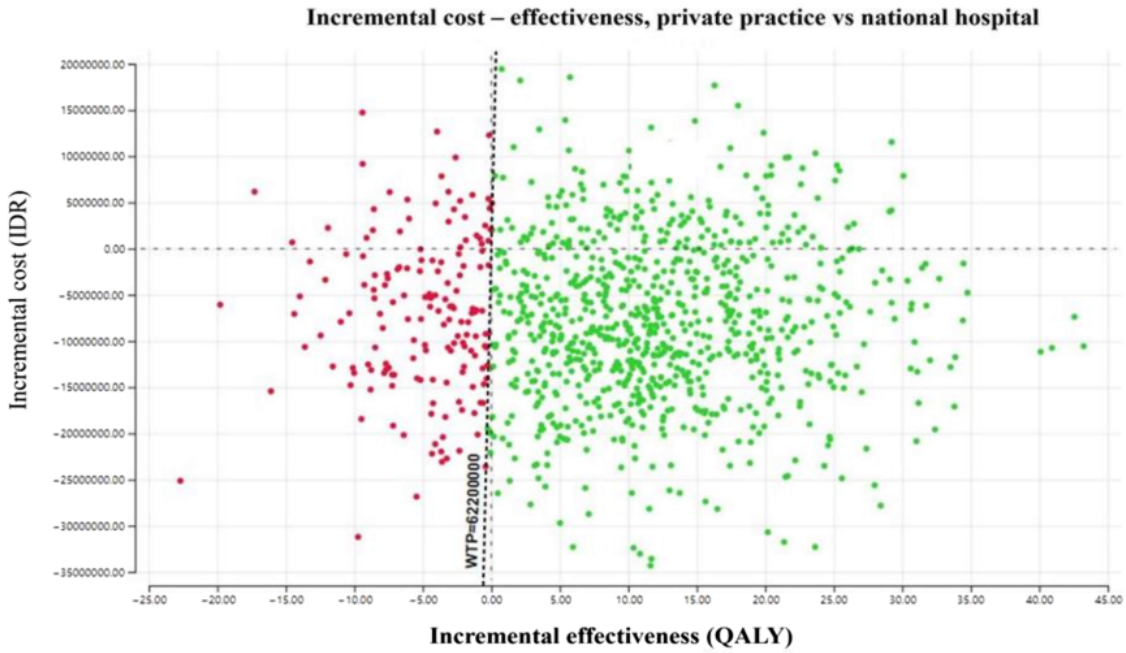

FIGURE 2 Incremental cost-effectiveness scatter plot for private practices versus national hospitals. BPJS, Social Health Insurance Administrative Body; IDR, Indonesian rupiah; QALY, quality-adjusted life years; WTP, willingness-to-pay.

acceptability curves (Figure 3) showed that WCS had a higher probability (approximately 80%–90%) of cost-effectiveness, regardless of the value of the WTP threshold. Therefore, management by WCS in private practices is the dominant strategy compared to management by WCNs in national hospitals, meaning that it is advantageous in terms of cost and provides better clinical outcomes.

4 | DISCUSSION

To our knowledge, this study is the first in Indonesia to assess the cost-effectiveness of wound care treatments provided by WCNs in BPJS-covered national hospitals in comparison with that provided by WCS in private practices. Our study found no gender difference in the two groups, indicating that the incidence of DM Type 2 is increasing in both sexes.[28] The mean age of patients with Type 2 diabetes in our study across both groups was above 50 years; Type 2 DM risk increases considerably in this age group.[29] In contrast to previous studies that found that most individuals with DFU were elementary school-aged, this study identified most individuals were in senior high school in both health services.[30,31] This study corroborates the results of a previous study that suggested that DFUs occur most often in the forefoot.[32,33] Patients with DFU recovered with a mean DMIST score of 6 in our study, contrary to previous studies that used a cut-off score of 9 for 4 weeks.[18,34]

Based on the outcomes of this study, our findings demonstrate that private wound care is cheaper and more effective. Our findings also suggest that the ACER of WCNs in national hospitals surpassed that of WCS in private clinics. A previous study demonstrated that WCNs in private practices exhibit a higher level of cost-effectiveness than that observed in our study conducted at both private clinics and national hospitals, with an average cost of 2,182,255 IDR.[35] However, that study did not include the calculation of transportation expenses and overlooked ACER values. The ACER demonstrates the proportional

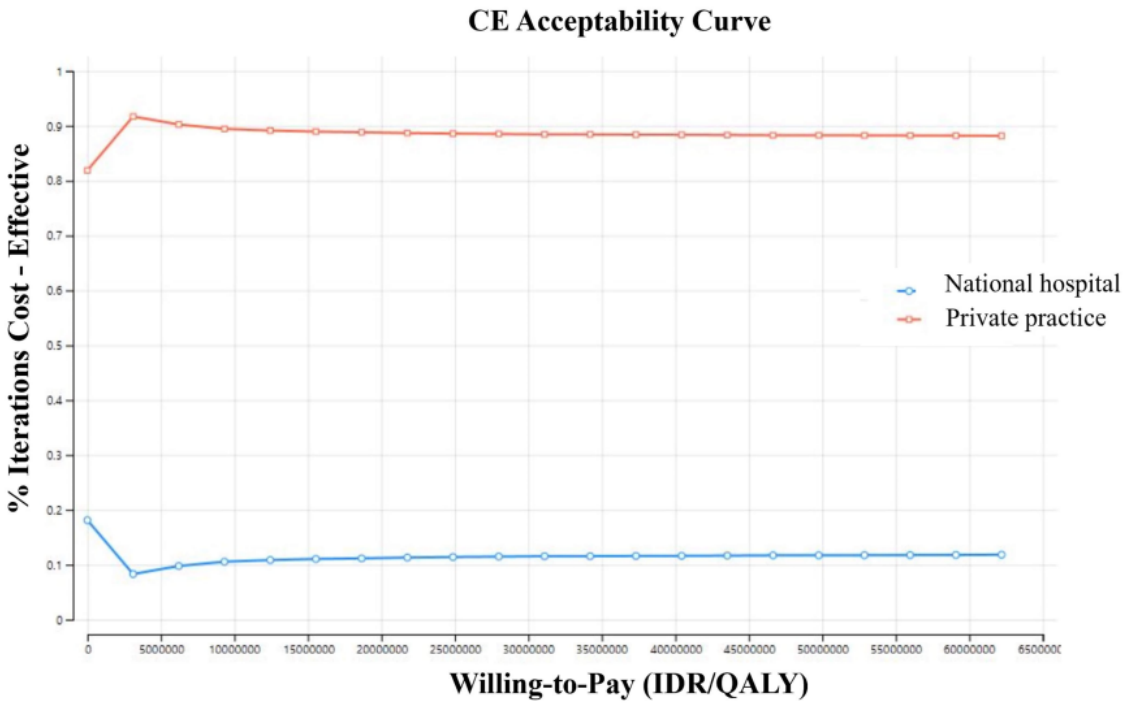

FIGURE 3 The cost-effectiveness (CE) acceptability curve. The incremental cost effectiveness ratio stayed within threshold levels for the private practices (red colour) delivering wound care at 80%–90%. IDR, Indonesian rupiah; QALY, quality-adjusted life year.

relationship between an increase in effectiveness or outcome and a corresponding increase in cost. This finding suggests that a 1% improvement in effectiveness requires an equivalent increase in costs. Our findings show that private clinics offering wound care services are the most cost-effective because of their low ACER values and high effectiveness. Interestingly, our study showed that hospital transportation costs were higher than those of private clinics. This could be because of the frequency and/or duration of wound care, longer distances and the fact that patients continue to choose BPJS-covered wound care services despite being farther from private clinics. Unfortunately, we did not collect information regarding patient incomes.

Our study also presented the ICER, which represents the additional costs necessary to achieve a one-unit change in the effectiveness of diabetic wound care. A negative or decreased ICER value indicates that the alternative treatment offered by the WCS in a private clinic would be more effective and less costly, making that the best option for wound care.[36] Negative values of WCS indicate that they provide the most cost-effective option for treating diabetic wounds. We found that the wound care strategy practiced by WCS in private clinics was superior to that of WCNs in national hospitals covered by the BPJS. Wound care services that are more effective are often more expensive. Health care services in Indonesia vary in policies, care, and treatment expenses, and occasionally incorporate a social dimension.[37]

According to the probability sensitivity analysis, regardless of the WTP threshold, the probability of a WCS providing cost-effective wound care services in private practice is always higher than that of a WNC in a national hospital. Health economic evaluations can provide guidance for policymakers and healthcare providers as WTP is a critical parameter for deciding whether wound care services can be regarded as cost-effective. In our study, higher effectiveness was associated with lower costs, which allowed cost savings and improved care for patients with chronic wounds.

Our study selected a healing time of ≤12 weeks as the primary endpoint for the cost-effectiveness analysis. Private practice wound healing is more effective, as shown by our study's mean HbA1c of 8,[38,39] mean QOL of 0.8,[40,41] and reduction in wound size[18,42] compared to that observed in national hospitals. This can be attributed to several factors. Standards of care and procedures have been established at both healthcare facilities to adhere to their respective policies. In the absence of complete care, it may be advantageous to implement both comprehensive and non-comprehensive wound care management strategies during outpatient clinic visits,[43] including patient education and routine blood sugar and blood pressure monitoring (which were not assessed in our study). In addition, the type of dressing is likely to be a factor, given that private practice offers a variety of options for modern dressings,[44] whereas national hospitals offer only a limited selection of dressings covered by the BPJS.

According to these study findings, the difference in QOL improvement between baseline and median QOL was 0.15 in the private clinic and 0.14 in the hospital service, which indicates roughly the same QOL and corroborates data from a previous study for chronic ulcers.[45] Although the factors were unknown in our study, it is probable that the patient continued to have concerns about the wound's condition, pain during dressing changes, walking abilities, self-care, activities and the grade of wound classification. The baseline QOL in both cervices was approximately 0.60, which is consistent with other studies that have reported the QOL index in DFU for acute or initial circumstances.[8,40] Following treatment, the mean QOL in private practices was significantly higher than that in the national hospitals and/or mean QOL in DFU from previous studies (0.70), which is the mean utility score in patients with diabetic foot problems.[40] The mean QOL in DFU varies from 0.53 to 1.00,[8,40,46,47] which is consistent with our study. The EQ-5D-5L consistently showed a 0.70 better QOL for healed ulcers compared with that associated with persistent ulcers, major amputation and active ulcers, with a possible mean QOL of 0.50.[8,48] This study postulated that QOL was related to accelerated wound healing.[49,50] Another factor contributing to the effectiveness and cost-efficiency of private practice is the presence of certified nurses specialised in wound care and completely certified diabetic wound care. These nurses possessed higher levels of expertise than that exhibited by their non-specialised counterparts. Thus, a generic wound care certificate is insufficient and requires specific training and time, especially for diabetic wounds. In Indonesia, various wound care certifications encompassing both fundamental and advanced levels are available. The management of chronic wounds, particularly in individuals with diabetes, follows a similar approach.[51,52] Due to the fact that diabetic wounds are complicated and can result in a variety of wound types that require comprehensive treatment,[53] universities must also incorporate wound specialist programmes that provide specialised education on diabetic wounds. Other factors that can affect wound healing include nutritional state, type of diabetic wound and biofilm conditions, which were not investigated in our study.[54,55]

Both types of wound care services continue to incur costs below WTP. Although the average monthly cost of goods and services in Indonesia is 2,777,870 IDR, wound care remains expensive for Indonesians.[35] Therefore, the government can use this study as a basis for national policy considerations when selecting and determining which health service systems to implement.

Evidence-based national wound care standards are required. Multicentre cost-effectiveness studies are essential in Indonesia because hospitals and private practitioners determine the wound care guidelines. In other countries, economic modelling has been used to assess the cost-effectiveness of evidence-based diabetes-related foot management therapies that enhance patient outcomes. The funding and implementation of evidence-based diabetic foot care practices in Sweden have decreased foot ulcers and amputations by 25%, covering preventative expenses.[10] The Netherlands followed worldwide DFU prevention and treatment standards. Dutch therapy is cost-effective and reduces DFU and lower limb amputation.[10] Thus, our study and other national studies imply that following national best-practice guideline recommendations for DFUs, WCS and WCNs with additional diabetic wound care knowledge and complication treatment may considerably cut national expenses, reduce morbidity and mortality, and enhance the QOL of patients with diabetes.

The simulation of models is always fraught with uncertainty. The simplicity of our model may have affected the results. First, the model was followed for 1 year rather than the patient's remaining lifetime. Second, we did not include recurrent ulceration, complications, severe infection, or death as separate conditions. The health utility of patients with DFUs is based on studies conducted in small, non-multicentre settings as well as on population characteristics. The possibility of such long-term survival costs in post-amputation patients was understated in this study.

5 | CONCLUSIONS

To our knowledge, this study is the first to describe the cost-effectiveness of care provided by WCS in private practices and WCNs in national hospitals. Decision tree analyses indicated that WCS in private practices are more effective and incur lower costs. Stakeholders should incorporate health economic evidence into routine healthcare practices as this facilitates the optimal allocation of resources and enhances outcomes within healthcare systems.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data supporting the findings of this study are available from the corresponding author upon request.

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