Journal of Asian Multicultural Research for Medical and Health Science Study
ISSN: 2708-972X
Vol. 6 No. 2, 2025 (page 028-047)
DOI: https://doi.org/10.47616/jamrmhss.v6i2.641

Evaluation of Cost-Effectiveness and Patient Satisfaction of Topical, Topical Plus Systemic, and Topical Plus Laser Treatment in Patients with Acne Vulgaris

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Received: July 25, 2025 Received in Revised: August 24, 2025 Accepted: September 17, 2025

Abstract

Acne vulgaris is a common skin disease and can reduce the quality of life and cause psychological distress. This study evaluated the clinical effectiveness, patient satisfaction, and cost-effectiveness of topical monotherapy, topical plus systemic, and topical plus laser treatment in patients with acne vulgaris. A quantitative study with a prospective cohort design was conducted at Erha clinic from April 2024 to March 2025. Data determining clinical efficacy, patient satisfaction, treatment cost and cost-effectiveness using lesion counting, Investigator Global Acne (IGA) scale, Visual Analogue Scale (VAS), and total cost calculations were measured at baseline, 2 weeks, 4 weeks, 8 weeks, and 12 weeks of treatment, and analysed using IBM SPSS version 22. Patients in topical monotherapy, topical plus systemic, and topical plus laser group recorded a median baseline lesion of 15 (14-16), 15 (15-17), and 21 (20-22), respectively, and 96.6% had mild to moderate acne, 90% moderate acne, and 76.7% severe acne based on IGA scores. These treatment modalities reduced 15 lesions for topical monotherapy, 15 lesions for topical plus systemic, and 21 lesions for topical plus laser, respectively, with 100% of topical monotherapy and topical plus laser, and 96.7% of topical plus systemic group achieving clear skin at week 12. The topical plus laser treatment provided the greatest and fastest acne lesion improvement and satisfaction, but at the highest cost. The choice of acne therapy should consider the balance between clinical effectiveness and cost-efficiency, especially in Southeast Asia with limited access and resources.

Keywords: Acne Vulgaris, Acne Lesion, Cost-Effectiveness, Patient Satisfaction, VAS, Acne Treatment

Introduction

Acne is one of the most common chronic inflammatory skin diseases involving the pilosebaceous unit, characterised by the formation of comedones, papules, pustules, nodules and even cyst (Vasam et al., 2023). It mainly affects regions where sebaecous glands are abundant, such as the face, chest, and upper back. The underlying pathology that leads to the acne includes increase sebum production, abnormal hyperkeratinisation of the pilosebaceous

follicles leading to obstruction of the lumen, increased growth of propionibacterium acne due to high sebum concentration in the pilosebaceous unit and finally followed by inflammation (Vasam et al., 2023). Globally, the estimated prevalence of acne vulgaris for all ages is up to 9.38% (Heng & Chew, 2020).

However, the precise prevalence based on the available data varies depends on the population studied and methodology used, with a range of 26.8% to almost 100% especially among adolescents, coinciding with the onset of puberty, where the sebaceous gland activity is the most active (Heng & Chew, 2020). Although acne is commonly seen as a benign disease, it should not be underestimated, as literature has shown that it could lead to critical consequences. Studies found that patients with acne, especially those with moderate and severe grades, or those developed acne scars, suffered serious psychosocial morbidity like embarassment, low self-esteem, frustration, depression, and even suicidal ideation (Halvorsen et al., 2011; Tayel et al., 2020).

Besides, patients with acne scars also have a poorer quality of life comparable to more severe skin disease (Chuah & Goh, 2015). Acne could also significantly disturb friendship, affect academic achievement, and even sexual relationship of the sufferers (Halvorsen et al., 2011; Tayel et al., 2020). Thus, efforts must be made to treat patient with acne promptly and utilising the most appropriate treatment regimen. The goals are to achieve resolution of lesions, alleviating the psychological morbidity of the sufferers, as well as preventing the development of permanent acne scar (Ministry of Health Malaysia, 2022).

Currently, there are few treatment modalities available to treat acne. These include topical medications, systemic medications, physical therapies as well as cosmoceutical products (Ministry of Health Malaysia, 2022; Wasitaatmadja et al., 2015). The choice of treatment should be based on the grading and severity of acne, as well as the current psychological status of the patient (Ministry of Health Malaysia, 2022; Wasitaatmadja et al., 2015). Examples of the topical medications include benzoyl peroxide (BPO), retinoid like tretinoin and adapalene, antibiotics like clindamycin, azelaic acid, and salicylic acid.

These medications can be used in the form of monotherapy or in fixed combination to enhance the efficacy (Ministry of Health Malaysia, 2022; Wasitaatmadja et al., 2015). For systemic medications, the examples include oral antibiotics like doxycycline and azithromycin, isotretinoin, and hormonal medication like combined oral contraceptives, spironolactone, and metformin, especially for females with signs of hyperandrogenism (Ministry of Health Malaysia, 2022; Wasitaatmadja et al., 2015). Physical therapies are mainly used as adjunctive therapy on top of the topical plus systemic medications above, which include intralesional corticosteroid injection for nodules and cyst, comedone extraction, chemical peels, and the energy-based devices.

Energy based devices can be further categorised into light therapies (photodynamic therapy, intense pulse light, blue light, red light), laser therapies (erbium glass laser, neodymium-doped yttrium aluminium garnet (Nd: YAG), pulsed dye laser, and non-ablative fractional laser), as well as radiofrequency emitting device (Ministry of Health Malaysia, 2022). In existing guidelines, topical medications are advocated as the first line treatment for mild to moderate acne. In mild acne with predominantly inflammatory lesions, topical BPO is recommended, while topical retinoid is recommended when non-inflammatory lesion is predominant (Ministry of Health Malaysia, 2022; Wasitaatmadja et al., 2015).

If there is minimal improvement after 3 months of treatment with a monotherapy agent, or in moderate acne, combination of any two topical agents is recommended (Ministry of Health

Malaysia, 2022; Wasitaatmadja et al., 2015). Following that, if there is still marginal clinical improvement after another three months with the above treatment regime, or in severe acne or the patient is suffering from serious psychological morbidities, combination of two topical agents plus oral antibiotic is recommended (Ministry of Health Malaysia, 2022; Wasitaatmadja et al., 2015).

Alternatively, isotretinoin, the most potent medication for acne, can be used to treat patient with severe acne, especially those with nodulocystic acne or who is resistant to topical plus oral medications (Ministry of Health Malaysia, 2022). Despite the increasing popularity of physical treatment, at the present moment, these modalities only serve as an adjunctive therapy without replacing the conventional pharmacological oral and topical therapies, as there is limited evidence supporting the use of these treatment as the main treatment modalities (Ministry of Health Malaysia, 2022; Wasitaatmadja et al., 2015).

Recently published systematic review and network meta-analysis based on 179 randomised controlled trials evaluating the efficacy of topical, oral, and physical treatments for acne vulgaris revealed efficacy of several treatment types on the acne lesion reduction. For mild to moderate acne, the most effective option for topical medications was combined retinoid/BPO, reducing acne lesions up to 26.2% from baseline compared to placebo, for physical treatment was chemical peels using salicylic acid or mandelic acid reducing 39.7% of lesions, and for photochemical therapy was combined blue/red light reducing 35.4% of lesions (Mavranezouli, et al., 2022a) Whereas, for moderate to severe acne, most effective option for topical medication was combined retinoid with lincosamide (44.4% reduction), for systemic medication and the most potent was oral isotretinoin with total cumulative dose of ≥ 120 mg/kg per single course (58.1% reduction), for physical therapy was the photodynamic therapy (40.5% reduction), and for combined medication was the retinoid/BPO plus oral tetracycline (43.5% reduction) (Mavranezouli et al., 2022a).

The same author in the subsequent publication focusing on cost-efficacy in the United Kingdom (UK) setting concluded that for mild to moderate acne, the most cost-effective acne treatments were combined fixed dose topical medications such as BPO with adapalene (£195) and tretinoin with clindamycin (£189), and photochemical therapy in the form of combined blue and red light with a higher cost of £546 but offer strong clinical benefits (Mavranezouli et al., 2022b). For moderate to severe acne, topical tretinoin with clindamycin (£224.46), oral lymecycline combined with BPO/adapalene (£287.80), and oral isotretinoin were the most cost-effective treatment (Mavranezouli et al., 2022b).

Oral isotretinoin cost differed between gender, as the treatment cost for females was higher compared to male due to gender specific requirement (£902 and £582) (Mavranezouli et al., 2022b). The author also emphasized that physical therapies like chemical peels and photodynamic therapy were less cost-effective compared to the treatment mentioned above, considering the high cost but only offer modest improvement in alleviating the acne lesions (Mavranezouli et al., 2022b). Besides, another investigator also supports the use of oral isotretinoin and a combination of fixed dose adapalene/BPO plus the oral doxycycline (A-BPO/D) as these treatments capable in reducing 80-90% and 72% acne lesions, which is affordable and costed about $72.1 and $47.41 respectively (Penna et al., 2014).

Thus, these evidence supports the recommendation of several clinical guideline where topical and systemic medications should be the preferred first line agent for treating mild to moderate acne and moderate to severe acne, while the physical therapy only serves as adjunctive treatment on top of the conventional pharmacological treament, considering the cost and also the clinical efficacy towards the improvement of acne (Ministry of Health Malaysia, 2022;

Wasitaatmadja et al., 2015). Nevertheless, few studies had verified the effectiveness of laser treatment particularly Nd: YAG laser in treating acne vulgaris. Dhaher & Yosif, (2022) for instance had assessed efficacy of this laser among 61 patients with acne vulgaris where they underwent three session of laser treatment with 2-week interval, combined with topical emollient and sunscreen. 80.3% of the participants showed very good response yielding 80% reduction of the acne lesions, and only 13.1% of them showed poor response.

In addition, most mild to moderate acne patients only required three treatment sessions, indicating highly effective treatment, although patients with severe acne required more session (Dhaher & Yosif, 2022). Similarly, another author also had determined the efficacy of this laser and discovered that 99% of the participants had achieved clear or almost clear IGA score, with a mean of five laser sessions (Sapra et al., 2022). However, these studies did not explore the cost of treatment as well as it's cost-effficacy. Current available evidence supports combination of topical agents and combination therapy using fixed-dose topical medication and oral agents as the most cost effective in treating mild to severe acne.

However, the data depicted in the meta-analysis was based on different studies where the methodology, patients' demography, and treatment outcomes were different and direct comparison cannot be made. Besides, direct comparison of topical, topical plus systemic medication, and topical plus laser treatment especially in real-world setting and private clinics in southeast asia is lacking. A study directly compares these three treatment types could evaluate these therapies under similar condition, using similar grading scale, follow-up period, and patient population. Thus, this study aimed to evaluate and compare the cost-effectiveness and patient satisfaction of topical alone, topical plus systemic, and topical plus laser treatment for treating acne vulgaris.

Methods

Study Design and Subjects

This study was conducted in four private dermatological aesthetic clinics in Indonesia. Each clinic was assigned to one of the treatment regimes to minimise contamination. As this are private clinics, the patients typically choose their own treatment regimen after being clinically examined and briefed on the available and suitable treatment modalities, thus no randomisation was performed. Instead, this study utilised prospective cohort study design where the patients chosed their own treatment, and then study outcome were measured at each specific point throughout the study period. All patients with acne vulgaris came to this clinic for treatment were screened for suitability for this study. Patients were invited to participate in this study if they had inclusion criteria and did not have exclusion criteria. The inclusion criteria include male and female aged 16 years old and above with mild to severe acne and were able to follow treatment and research protocol. The patients were excluded if they had any exclusion criteria, such as being pregnant or currently breast feeding, had received previous acne treatment within three months, received oral isotretinoin within the past one year, received antibiotic treatment in the last month, previously treated with laser treatment for acne, had history of photosensitivity and liver disease, and also had a tendency to develop keloid or hypertrophic scars. The recruitment and data collection were performed from April 2024 until May 2025. 30 patients were recruited for each treatment arm, thus a total of 90 patients were recruited. Consecutive convenience sampling method was utilised for this study, where the patients were recruited sequentially until the required number was met. All patients were being followed-up closely by their healthcare provider of each clinic and had continued their treatment regime from the begining until the end of the study.

Treatment Protocol

For patients treated with topical monotherapy, the medications used were combined topical medications as showed in the table 1, while the systemic medications used were as listed in table 2. In this study, we group the patients receiving only topical medication as topical monotherapy as a whole although their received different formulation of combined topical medications, and we grouped the various systemic medications as a whole with similar reason.

Table 1. Topical Medications

No	Topical Medications
1	Azelaic Acid plus Nicotinamide
2	Azelaic acid plus clindamycin plus ceramide
3	Azelaic Acid plus Niacinamide plus adapalene
4	Azelaic Acid plus Niacinamide plus Tranexamic
5	Azelaic Acid plus Clindamycin plus Benzoyl Peroxide
6	Adapalene plus benzoyl peroxide plus nicotinamide
7	Clindamycin plus nicotinamide
8	Clindamycin plus Flacinol Acide plus Ceramide
9	Clindamycin plus benzoyl peroxide plus Azelaic acid

When using topical medications, patients were instructed to wash their face first with a mild cleanser and pat dry with a clean towel. At the beginning of the therapy, patients were advised to apply the medication only at the affected area once daily at night to minimise the risk of irritation. Once the patient tolerating, by week 2, they were advised to apply the cream throughout the face but to avoid contact with the eyes, lips, and mucous membranes, and increase the frequency of cream application in the morning and at night. Besides, the patients were also advised to apply sunscreen with a sun protecting factor of at least 30 every morning to protect against the ultraviolet ray and also moisturizer to alleviate skin dryness. Patients were also advised to report to the doctor if they experience any adverse reactions like skin irritation, redness, or peeling.

Table 2. Systemic Medications

No	Systemic Medications
1	Cefixime
2	Cefditoren
3	Clindamycin
4	Doxycycline
5	Pivoxil Zincore Erha

In patients receiving topical and systemic medications, topical medications were administered according to the protocol explained above. Systemic antibiotics were prescribed based on the severity of the acne and individual patient's medical history, with a maximum duration of 12 weeks to avoid bacterial resistance. Additionally, Zincore supplementation was prescribed and used as supportive therapy to accelerate skin healing and reduce inflammation. The laser used in this study was a Neodymium: Yttrium-Aluminum-Garnet (Nd: YAG) laser with a long pulse wavelength of 1064 nm. Patients were treated with laser treatments in the week 2 and week 4 with a two-week interval between sessions.

Throughout the treatment period of up to 12 weeks, patients undergoing laser procedures continued to use topical therapy from the beginning until the end of the treatment. Before laser therapy, the patient's face was washed with water, then a topical anesthetic cream containing

2.5% lidocaine and 2.5% prilocaine was applied and left on for 40 minutes. Next, the skin was cleansed using 70% alcohol. During laser treatment session, the lesional acne area was given three overlapping treatments. In contrast, the perilesional area (approximately 2 cm from the lesion) and the normal skin area (approximately 10 cm from the lesion) were only given one treatment. The laser settings used included fluences of 35 J/cm² for the lesion area and 30 J/cm² for the surrounding healthy tissue, with a pulse time of 20 ms, a spot size of 10 mm, and the device tip maintained at 4°C.

Medical Costs

In this study, the medical costs of interest were direct cost borne by patients, as depicted in table 3. These costs included physician consultation fees, topical and systemic medication, procedural fees (laser treatment), and laboratory examination fees. However, medication and laboratory examination costs were counted as treatment costs. Non-medical costs such as transportation or lost productivity were not included and calculated in this study. After therapy began at week 2, there was a difference in costs based on the type of treatment. In the topical monotherapy group, the cost of USD 46.16 came from the combined cost of consultation (USD 14.06) and topical medication (USD 32.10), and this amount remained constant from week 2 to week 12, reflecting continued use of topical medication. The topical plus systemic group showed a fixed cost of USD 71.16 throughout week 2 to week 12, consisting of consultation fees (USD 14.06) and a combination of topical and systemic medications (USD 57.10). Meanwhile, the topical plus laser therapy group showed high costs at weeks 2 and 4, amounting to USD 177.51, which included consultation fees (USD 14.06) and the laser and topical therapy package (USD 163.45). This cost covered the entire treatment series, including the topical cream used up to weeks 8 and 12. There were no additional costs at weeks 8 and 12, indicating that the entire laser treatment cost was paid upfront as a complete package.

Table 3. Medical Cost

No	Medical Cost	Topical Monotherapy	Topical Plus Systemic	Topical Plus Laser
		USD	USD	USD
1	**Baseline**			
	Doctor Consultation Fee	14.06	14.06	14.06
	Total	14.06	14.06	14.06
2	**2 Weeks**			
	Doctor Consultation Fee	14.06	14.06	14.06
	Treatment Cost	32.10	57.10	163.45
	Total	46.16	71.16	177.51
3	**4 Weeks**			
	Doctor Consultation Fee	14.06	14.06	14.06
	Treatment Cost	32.10	57.10	163.45
	Total	46.16	71.16	177.51
4	**8 Weeks**			
	Doctor Consultation Fee	14.06	14.06	0
	Treatment Cost	32.10	57.10	0
	Total	46.16	71.16	0
5	**12 Weeks**			
	Doctor Consultation Fee	14.06	14.06	0
	Treatment Cost	32.10	57.10	0
	Total	46.16	71.16	0
Total Cost of Treatment		**198.71**	**298.71**	**369.09**

Measure of Effectiveness

In this study, treatment effectiveness was assessed using several indicators, including: (1) lesion count, which refers to the objective reduction in the number of acne lesions. Non-inflammatory lesions (open and closed comedones) and inflammatory lesions (papules, pustules, nodules, and cysts) were counted together as the total number of lesions; (2) IGA, a clinical assessment tool that evaluates the overall severity of acne based on standardized criteria. The IGA uses a scale of 0 to 4, with lower scores indicating clear skin and higher scores indicating severe acne; (3) VAS was used to correlate it with patient satisfaction.

IGA

The IGA is a standardised scoring system used to determine the severity of acne. It consists of five scales, ranging from 0 to 4 as depicted in table 4. Each scale has its own criteria, and the assessor rate the patient's acne severity based on one of these scores.

Table 4. IGA Grade

Grade	Description
0	Clear skin with no inflammatory or noninflammatory lesions
1	Almost clear; rare noninflammatory lesions with no more than one small inflammatory lesion
2	Mild severity; greater than grade 1; some noninflammatory lesions with no more than a few inflammatory lesions (papules/pustules only, no nodular lesions)
3	Moderate severity; greater than grade 2; up to many noninflammatory lesions and may have some inflammatory lesions, but no more than one small nodular lesion
4	Severe; greater than grade 3; up to many noninflammatory and inflammatory lesions, but no more than a few nodular lesions

VAS

VAS was used to measure patient satisfaction with acne treatment at each clinic visit. The scale is a 10 cm (100 mm) horizontal line, with left end indicating total dissatisfaction and the right end indicating maximum satisfaction.

Cost-Effectiveness

Cost-effectiveness analysis (CEA) compares the costs of an intervention with the health outcomes of the intervention, regardless of its financial value (Bertram et al., 2021). Treatment effectiveness is determined by comparing the total cost of the intervention with the change in the clinical effectiveness from baseline. The total cost of all treatment modalities was divided by total acne lesions reduction throughout the treatment period. However, patients in the topical plus laser group was not charged at week 8 and 12 because in a standard treatment protocol of this modality at these clinics, most of the patients had achieved clear skin by this time. After week 4, patients' skin in this group were declared clear, and therefore no further therapy was scheduled. Only monitoring of the lesions, IGA, and satisfaction were conducted at weeks 8 and 12, which is outside the treatment schedule.

Incremental Cost-Effectiveness Ratio (ICER)

It indicates the incremental cost required to gain one additional unit of effectiveness when switching from a standard treatment to a new intervention, such as a topical and laser

combination. The intervention is considered cost-effective if the ICER is below the willingness-to-pay threshold.

Ethical Considerations

This study was conducted according to the principles of Declaration of Helsinki. Ethical approval was obtained from the Universiti Sultan Zainal Abidin Human Research Ethics Comittee (UHREC) with the approval code of UniSZA/UHREC/2023/575. Written informed consent was obtained from all participants prior to the participants recruitment.

Data Analysis

Data were analyzed using IBM SPSS version 22. First, descriptive statistics were performed to summarize the research variables, including mean, median, standard deviation, interquartile range, minimum, maximum, and frequency distribution. Next, the Shapiro Wilk test was conducted to assess normality. The results showed a significance value < 0.05, indicating that the data were not normally distributed. Therefore, subsequent analyses were conducted using non-parametric tests. Differences between treatment groups were assessed using the Kruskal Wallis Test, with Mann Whitney Test as the post-hoc analysis to identify significant pairwise differences. Within-group comparisons across multiple time points were analyzed using the Friedman Test. In addition, socio-demographic characteristics with expected frequencies less than five in some cells were analyzed using Fisher's Exact Test. All results are presented in tables and figures to illustrate the distribution of treatment costs, effectiveness, satisfaction levels, and significant relationships between variables.

Results and Discussion

Normality Test-Shapiro-Wilk

Based on the Shapiro-Wilk test, it shows Asymp.Sig probability of 0.000 < 0.005, so Ho is rejected, meaning the average number of lesions in the three treatments, namely topical monotherapy, topical plus systemic, and topical plus laser, is different and significant.

Table 5. Results of the Shapiro-Wilk Normality Test

No	Treatment	Sig. Shapiro-Wilk				
		Baseline	Week 2	Week 4	Week 8	Week 12
1	Topical Monotherapy	0.000	0.000	0.000	0.000	0.000
2	Topical Plus Systemic	0.000	0.002	0.002	0.000	0.001
3	Topical Plus Laser	0.001	0.000	0.000	-	-

Table 6. Socio-Demographic Characteristic Using Fisher's Exact Test

Characteristic	Topical Monotherapy		Topical Plus Systemic		Topical Plus Laser		P-Value
	n	%	n	%	n	%	
AGE							
16 – 28	20	66.7	20	66.7	20	66.7	0.876
29 – 38	8	26.7	6	20.0	6	20.0	
39 – 48	2	6.7	4	13.3	4	13.3	
Total	**30**	**100**	**30**	**100**	**30**	**100**	
Gender							
Male	0	0.0	10	33.3	3	10.0	0.001
Female	30	100.0	20	66.7	27	90.0	

Total	**30**	**100**	**30**	**100**	**30**	**100**	
Education							
High School (SMA)	1	3.3	5	16.7	7	23.3	0.003
Diploma (D3)	3	10.0	9	30.0	12	40.0	
Bachelor's degree)	26	86.7	16	53.3	11	36.7	
Master (S2)	0	0.0	0	0.0	0	0.0	
PhD (S3)	0	0.0	0	0.0	0	0.0	
Total	**30**	**100**	**30**	**100**	**30**	**100**	
Occupation							
Government	0	0.0	8	26.7	7	23.3	0.007
Student	1	3.3	5	56.7	19	63.3	
Self-employed	29	96.7	17	16.7	4	13.3	
Pensioner	0	0.0	0	0.0	0	0.0	
Not working	0	0.0	0	0.0	0	0.0	
Total	**30**	**100**	**30**	**100**	**30**	**100**	
Salary							
<123.68 USD	1	3.3	1	3.3	0	0.0	0.000
123.68 USD <309.21 USD	15	50.0	5	16.7	27	90.0	
>309.21	14	46.7	24	80.0	3	10.0	
Total	**30**	**100**	**30**	**100**	**30**	**100**	
Relationship							
Married	14	46.7	15	50.0	11	36.7	0.557
Not married	16	53.3	15	50.0	19	63.3	
Total	**30**	**100**	**30**	**100**	**30**	**100**	

Based on the table 6, the socio-demographic characteristics showed that most patients were in the 16 to 28-years old age group with no significant difference between treatment groups based on Fisher's Exact Test (p=0.876). A significant difference was seen in gender (p=0.001), where women dominated the topical monotherapy group, while the topical plus systemic and topical plus laser groups had presence of proportion of men. Education level was also significantly different (p=0.003), with more patients having a bachelor's degree in the topical monotherapy group. In contrast, the other groups were more diverse, ranging from high school to diploma level. Occupation showed a significant difference (p=0.007), where self-employed dominated the topical monotherapy group, while the topical plus systemic and topical plus laser groups were dominated by students. The most prominent difference was income (p=0.000), with the topical plus laser group being dominated by patients with middle-income group, while high-income patients dominated the topical plus systemic group. Meanwhile, marital status did not significantly differ between treatment groups (p=0.557).

Lesion Count

Based on the table 7, at the beginning of the study, the topical plus laser group had the highest median number of lesions, followed by the topical plus systemic and topical monotherapy group. At week 12, the lowest residual lesions were in the topical plus laser group. For total lesion reduction, the topical plus laser group showed the most significant improvement, followed by the topical plus systemic group and the topical monotherapy group. Within the group analysis using Friedman test showed that all treatment groups experienced a significant reduction in lesion counts at week 12. Statistical analysis using the Kruskal–Wallis's Test showed a significant difference in lesion reduction among the three treatment groups ($p < 0.001$), with Mann–Whitney post-hoc analysis confirming that topical plus laser was more effective than topical monotherapy ($p < 0.001$) and topical plus systemic ($p = 0.002$), and topical plus systemic was superior to monotherapy ($p = 0.010$). Based on table 8, over 12

weeks, all treatment modalities significantly reduced acne lesion ($p < 0.001$). Topical monotherapy showed a gradual decrease in lesion counts from a median of 15 (IQR 14–16) to 0 (IQR 0–1), with a reduction of 15 (IQR 0–15). The combination of topical and systemic therapy showed a more rapid decrease from baseline, from a median of 15 (IQR 15–17) to 0 (IQR 0–1), with a reduction of 15 (IQR 0–15), indicating more consistent effectiveness than monotherapy. Meanwhile, topical plus laser provided the most rapid acne lesion reduction, with a reduction from a median of 21 (IQR 20–22) to 0 (IQR 0–0), and the most significant reduction of 21 lesions (IQR 0–21).

Table 7. Reduction in Number of Lesions for Each Treatment from Baseline to Week 12

No	Treatment	Median (IQR)			Sig. within group (Friedman)	Sig. between group (Kruskal–Wallis	Post-hoc Mann–Whitney (p-value)
		Baseline	Week 12	Total Reduction			
1	Topical monotherapy	15 (14–16)	0 (0–1)	15 (0-15)	p <0.001	p <0.001	vs. Topical + Systemic = 0.010 vs. Topical + Laser <0.001
2	Topical plus systemic	15 (15–17)	0 (0–1)	15 (0-15)	p <0.001		vs. Topical monotherapy = 0.010 vs. Topical + Laser = 0.002
3	Topical plus laser	21 (20–22)	0 (0–0)	21 (0-21)	p <0.001		vs. Topical monotherapy <0.001 vs. Topical + Systemic = 0.002

Table 8. Lesion Count Over 12 Weeks Using Friedman Test

No	Treatment	Median (IQR)						Sig. (Friedman)
		Baseline	Week 2	Week 4	Week 8	Week 12	Total Reduction	
1	Topical monotherapy	15 (14-16)	13 (11-13)	9 (7-9)	4 (3-5)	0 (0-1)	15 (0-15)	p <0.001
2	Topical plus systemic	15 (15-17)	12 (12-13)	8 (7-9)	2 (2-3)	0 (0-1)	15 (0-15)	p <0.001
3	Topical plus laser	21 (20-22)	10 (9-12)	3 (2-4)	1 (0-2)	0 (0-0)	21 (0-21)	p <0.001

IGA Score Reduction

At baseline, most patients in the topical monotherapy group had mild to moderate acne (96.6%). The topical plus systemic group predominantly had moderate acne (90%), while most

of the topical plus laser group (76.7%) experienced severe acne. At week 12, the topical plus systemic group showed comparable but slightly lower results, with 96.6% achieving clear skin, slightly below the 100% clear skin seen in the topical monotherapy and topical plus laser groups. This indicates that all interventions were effective in reducing IGA scores from mild, moderate, or severe to clear skin, with the fastest and most consistent reduction in scores seen in the topical plus laser group, which showed optimal results starting at week 4 of treatment and maintained through the end of the study. The Chi-square test in table 9 shows although from the beginning until week 8, the proportion of patient's acne severity were significantly different, there was no no significant difference between groups in the proportion of patients achieving clear skin after 12 weeks. Thus, despite variations in initial severity, all treatment modalities provided relatively similar rates of healing at the end of the observation period.

Table 9. IGA Score Changes by Treatment Group Analysed Using Chi-Square Test

No	IGA Characteristic	Topical Monotherapy		Topical Plus Systemic		Topical Plus Laser		P-Value
		n	%	n	%	n	%	
1	**Baseline**							< 0.001
	Clear skin	0	0.0	0	0.0	0	0.0	
	Almost clear	0	0.0	0	0.0	0	0.0	
	Mild severity	22	73.3	3	10.0	0	0.0	
	Moderate severity	7	23.3	27	90.0	7	23.3	
	Severe	1	3.3	0	0.0	23	76.7	
	Total	**30**	**100**	**30**	**100**	**30**	**100**	
2	**Week 2**							0.008
	Clear skin	0	0,0	0	0,0	0	0.0	
	Almost clear	1	3.3	1	3.3	4	13.3	
	Mild severity	28	93.3	29	96.7	20	66.7	
	Moderate severity	1	3.3	0	0.0	6	20.0	
	Severe	0	0.0	0	0.0	0	0.0	
	Total	**30**	**100**	**30**	**100**	**30**	**100**	
3	**Week 4**							< 0.001
	Clear skin	0	0.0	0	0.0	9	30.0	
	Almost clear	24	80.0	20	66.7	21	70.0	
	Mild severity	6	20.0	10	33.3	0	0.0	
	Moderate severity	0	0.0	0	0.0	0	0.0	
	Severe	0	0.0	0	0.0	0	0.0	
	Total	**30**	**100**	**30**	**100**	**30**	**100**	
4	**Week 8**							<0.001
	Clear skin	3	10.0	10	33.3	30	100.0	
	Almost clear	27	90.0	19	63.3	0	0.0	
	Mild severity	0	0.0	0	0.0	0	0.0	
	Moderate severity	0	0.0	0	0.0	0	0.0	
	Severe	0	0.0	0	0.0	0	0.0	
	Total	**30**	**100**	**30**	**100**	**30**	**100**	
5	**Week 12**							0.364
	Clear skin	30	100.0	29	96.7	30	100.0	
	Almost clear	0	0.0	1	3.3	0	0.0	
	Mild severity	0	0.0	0	0.0	0	0.0	
	Moderate severity	0	0.0	0	0.0	0	0.0	
	Severe	0	0.0	0	0.0	0	0.0	
	Total	**30**	**100**	**30**	**100**	**30**	**100**	

Treatment satisfaction

Over the 12-week follow-up period, based on the table 10, all acne treatment groups demonstrated significant patient satisfaction ($p < 0.001$) based on the Friedman Test. In the topical monotherapy group, patient satisfaction increased gradually from a baseline median (IQR) of 3 (3-3) to 10 (9-10) at week 12, indicating slow but steady progress. The topical plus systemic group experienced a more rapid increase in satisfaction, going from 3 (2-4) at baseline to 10 (10-10) at week 12, but with an accelerated patient response at week 4 of the therapy. Meanwhile, the topical plus laser group demonstrated the fastest increase in satisfaction among the three groups, from a baseline median (IQR) of 3.5 (3-4) to 7 (7-8) at week 2 to 10 (9-10) at week 12.

Table 10. Satisfaction Score of Each Treatment Modalities Analysed with The Friedman Test

No	Treatment	Median, IQR of Satisfaction					Sig. (Friedman)
		Baseline	Week 2	Week 4	Week 8	Week 12	
1	Topical Monotherapy	3.0 (3–3)	5.0 (5-4)	6.0 (6–7)	8.0 (8.5-8)	10.0 (10-9)	<0.001
2	Topical Plus Systemic	3.0 (2–4)	5.0 (7–8)	7.0 (6–7)	8.0 (7–9)	10.0 (10–10)	<0.001
3	Topical Plus Laser	3.5 (3–4)	7.0 (7–8)	9.0 (8–9)	9.0 (9–10)	10.0 (9–10)	<0.001

According to the table 11, at the beginning of the study, the median patient satisfaction scores were relatively similar between the topical monotherapy and topical plus systemic groups (median 3.0), while the topical plus laser group was slightly higher (median 3.5). However, this difference was not statistically significant ($p = 0.400$). At week 2, satisfaction scores increased in all groups, with the highest score in the laser group (median 7.0), which was significantly different from the topical monotherapy and topical plus systemic (median 5.0) ($p < 0.001$). This similar trend continued at week 4, with the laser group showing higher satisfaction (median 9.0) than the other groups ($p < 0.001$). Entering week 8, patient satisfaction increased equally in both topical monotherapy and topical plus systemic group with a relatively similar median (8.0), with topical plus laser increasing more (9.0). However, the difference remained statistically significant ($p < 0.001$), likely due to the consistently higher distribution of satisfaction scores in the laser group. By week 12, the median satisfaction reached a maximum of 10.0 in all three groups. However, this difference was not significant ($p < 0.001$), indicating that at the end of therapy, patient satisfaction levels were relatively similar across all groups. Overall, these results confirm that laser therapy improves patient satisfaction more quickly than the other groups. However, all three treatment modalities demonstrated equivalent satisfaction at the end of the treatment course.

Table 11. Comparison of Patient Satisfaction Between Treatment Group (Kruskal-Wallis's Test)

No	Median (IQR)				Sig. (Kruskal - Wallis)
	Week	Topical Monotherapy	Topical Plus Systemic	Topical Plus Laser	
1	Baseline	3.0 (3–3)	3.0 (2–4)	3.5 (3–4)	p = 0.400

2	2 weeks	5.0 (4-5)	5.0 (7–8)	7.0 (7–8)	p <0.001
3	4 weeks	6.0 (6–7)	7.0 (6–7)	9.0 (8–9)	p <0.001
4	8 weeks	8.0 (8-8.5)	8.0 (7–9)	9.0 (9–10)	p <0.001
5	12 weeks	10.0 (9-10)	10.0 (10–10)	10.0 (9–10)	p = 0.310

Cost of treatment

The reduction in the number of lesions in each treatment group showed a close relationship with the treatment costs incurred. Topical plus laser group showed the most significant in the mean lesion reduction, followed by topical plus systemic group, and finally topical monotherapy group, as shown in the table 12.

Table 12. Treatment Cost Per Lesion

Treatment Group	Baseline Mean Lesions	Week 12 Mean Lesions	Mean Lesions Reduction	Total Treatment Cost (USD)	Treatment Cost Per Lesion (USD)
Topical monotherapy	15.17	0.4	14.77	198.71	13.45
Topical plus systemic	15.50	0.17	15.33	298.71	19.48
Topical plus laser	21.17	0.10	21.07	369.09	17.52

*Costs are per patient over 12 weeks, 2024 USD, patient perspective; lesion reduction = baseline minus week-12 (median reported for descriptives). 'Cost per lesion' uses total cost ÷ lesion reduction. Lesion count data were not normally distributed; therefore, clinical outcomes in Tables 7 and 8 are reported as median (IQR). However, for cost-effectiveness analysis (Table 12), mean lesion reductions were used in accordance with economic evaluation standards (ICER = ΔCost/ΔMean Effect).

Cost-Effectiveness Ratio (CER)

Based on table 12, the CER compares the total cost of treatment with the average reduction in the number of lesions over 12 weeks of treatment. Based on the analysis, topical monotherapy incurred a total cost of USD 198.71 with a reduction of 14.77 lesions, resulting in a CER of approximately USD 13.45 per lesion reduced. Topical plus systemic treatment costed USD 298.71 and reduced 15.33 lesions, resulting in a CER of USD 19.48 per lesion. Meanwhile, despite having the highest total cost of USD 369.09, topical plus laser treatment demonstrated the most significant lesion reduction 21.07, resulting in a CER of USD 17.52 per lesion.

ICER

Based on table 13, the ICER analysis, the topical plus laser therapy provides significant cost-efficiency compared to topical monotherapy or topical plus systemic therapy. Although the initial cost is higher, this modality produced more significant clinical improvement, making the additional cost commensurate with the benefits. Based on the ICER analysis, topical plus laser treatment compared to the other two therapies topical alone and systemic plus topical shows cost-efficiency. Compared with the topical monotherapy, the topical plus laser therapy has a cost difference of USD 170.38 resulting in additional 6.30 lesion reduction, producing an ICER of USD 27.05 per lesion reduced. Meanwhile, compared to topical plus systemic therapy, topical plus laser therapy exhibited an incremental cost of USD 70.38 for an incremental effect of 5.74 lesions, resulting in a lower ICER of USD 12.27 per lesion reduced. This evidence suggests that although topical plus laser bear higher upfront, it is clinically justifiable as it

delivers superior clinical benefit with a favourable incremental cost-effectiveness profile, especially when compared against topical plus systemic therapy.

Table 13. ICER (Incremental Cost-Effectiveness Ratio)

Comparison	Cost Difference (USD)	Effect Difference (Mean lesions reduced)	ICER (USD Per Additional Lesion Reduced)
Topical plus laser vs. topical monotherapy	170.38	6.30	27.05
Topical plus laser vs. topical plus systemic	70.38	5.74	12.27

Discussion

According to the existing literature, there is paucity of data directly comparing clinical effectiveness, satisfaction, cost, and cost-effectiveness among topical monotherapy, topical plus systemic, and topical plus laser treatment. Furthermore, the information on the comparative cost effectiveness among these three treatment modalities is also scarce, necessitating an exploration to fill this gap. To the best of our knowledge, this is the first head-to-head comparison study on these three treatment modalities over 12 weeks. The finding of this study provides critical insights into real-world clinical and economical perspective of acne management, relevant for settings were cost consideration influence treatment decisions. Based on sociodemographic profile of our patients, the 16–28 years old group comprised the majority across all treatment groups, comprising 66.7% of participants in the topical, topical plus systemic, and topical plus laser categories. In comparison, individuals aged 29–38 and 39–48 years showed a gradual increase in preference for more advanced therapies, particularly topical combined with systemic or laser treatments. This finding coincides with the prevalence of acne where it begins at the start of the puberty due to the increasing sebum production in response to the increased androgen release, and slowly reduced in prevalence when the individual approaching late teenagers and young adulthood (Heng & Chew, 2020). However, the differences of the age and types of treatment modalities were not statistically significant. Despite this trend, the age distribution between the systemic and laser groups was similar, reflecting a consistent pattern with no significant variation. Statistical analysis confirmed that the difference in age distribution was not significant, indicating that age was not a significant factor influencing treatment choice.

In contrast, gender distribution differed significantly between the groups. All patients in the topical-only group were female (100%), while the topical plus systemic group consisted of 33.3% male patients and 66.7% female patients. The topical plus laser group included 10% male patients and 90% female patients. This gender variation was statistically significant, with a p-value of 0.001, indicating a strong correlation between gender and treatment preference. These significant gender differences suggest that, in general, female was more concerned about acne and sought treatment more than men. As these clinics were the private clinic, we postulate that female were willing to spend their money to seek treatment despite the cost of the treatment. The possible explanation for this is, as acne mainly affect the face that is easily visible and directly impact the appearance, this could lead to low self-esteem and has more pronounced psychological and social impact which drives female with acne to seek treatment actively compared to men (Tayel et al., 2020). Besides, one study mentioned that among male and female who developed acne scars, female was more consistently reported poorer quality of life compared to male even the severity of the scars is similar (Chuah & Goh, 2015). Nevertheless, in this study, we did not explore the willingness to pay (WTP) for the acne

treatment of both genders that could support our hypothesis. In other study that has explored the WTP for chemical peeling in treating acne vulgaris among chinese patients, the author found that male was more willing to pay for this treatment although it is expensive as compared to female, despite the female reported worse quality of life due to acne, which is in contrasts with our study.

The author hypothesized that female respondents in their study might have wider access to information on the treatment options and considered chemical peeling as one option of many other treatment, whereas male patients have limited access to information for acne treatment modalities and valued this kind of treatment and more willing to pay more (Xiao et al., 2019). In terms of education (p=0.003), majority of our participants in topical monotherapy group were bachelor's degree holder (86.7%), while topical plus systemic group had mixed education level comprising of bachelor's (53.3%), diploma (30%), and high schools (16.7%), whereas the topical plus laser group had larger proportion of diploma holder (40%) and fewer bachelor's degree holders (36.7%) and the remaining was high schools (23.3%). This indicate education level influence treatment preference, as patient with higher education level are more likely to have higher health literacy and capable of looking for the method to control their acne through over the counter product or have better knowledge on acne prevention skin care routine, while the lower education participants perceived more advanced treatment modalities as more effective and could provide faster resolution. Occupation also significantly differed (p= 0.007), where almost all topical group patients were self-employed (96.7%), while the topical plus systemic and topical plus laser group dominated by the students (56.7% and 63.3%). We postulate that although they did not have their own income, they might be relied on their parents for the treatment expenses.

However, we did not obtain this information to support our claim as we only asked about monthly income of the patients, not household income. One researcher had explored how young patients with acne perceive this condition and treatment, and the researcher revealed that these patients expect the acne treatment to bring immediate result, however their experience showed that topical and systemic treatment often slow to deliver favourable results (Ip et al., 2020). Besides, adherence to this treatment is also challeging due to the side effects like skin irritation, dryness, and constant application requirement that they need to endure over the course of treatment (Ip et al., 2020). This could explain why younger patients who were mostly students opted for more advanced treatment which require less strict adherence and perceived to bring more rapid results. Furthermore, the salary distribution also highlights significant disparities (p = 0.000), where 50% of the topical group included patients with middle salary category (USD 123.68 - 309.21) and 46.7% had the highest salary (> 309.21 USD) category, the topical plus systemic group was consisted mostly of patients with the highest salary categories (80%), and the laser group was mainly middle salary patients (90%). We could not explain this finding as the relevant information was not captured in our study. Our finding is in contrasts with a study conducted in Saudi Arabia by Alkeraye et al., (2024) among patients with acne scars where the WTP for the treatment associated with higher income, participants with income equal and more than 20,000 saudi riyal were associated with 2.69 times more likely to pay compared to those with income of less than 5,000 saudi riyal.

In this study, we discovered that all treatment modalities substantially reduced acne lesions, improved acne severity, and resulted in high patient satisfaction. Topical plus laser treatment demonstrated the highest clearance of the lesions, with a median reduction of 21 lesions, followed by topical plus systemic with 15 lesions, and topical monotherapy with 15 lesions at the end of 12 week. Besides, the topical plus laser also was the most efficacious as all of them had achieved clear skin by the end of 12 week, despite majority of them (76.7%) started with

severe acne, showing topical medication augmented the efficacy of the laser treatment. By 12 weeks, 100% of the topical monotherapy and 96.7% of the topical plus systemic also had achieved clear skin. In terms of satisfaction, the topical plus laser group also achieved the most rapid and sustained patient satisfaction, started to rise at week 2, peaked at week 4 and persistent until week 12, indicating the patients quite pleased with the effect of the treatment. Satisfaction on the topical monotherapy and topical plus systemic were not different from baseline and week 2, but the topical plus laser provided higher satisfaction starting at week 4 as compared to topical monotherapy. The satisfaction correlates with the degree of lesion reduction, where the satisfaction rate was highest and more rapid among patients treated with topical plus laser where lesion reduction is the greatest. This finding is consisent with other studies where effective acne treatment results in high patient satisfaction (Dhaher & Yosif, 2022; Hammoda et al., 2023). The Nd: YAG laser treats acne by aiming at the vascular elements of the inflammatory acne, decreasing perifollicular stratum corneum and epitheliam, damaging sebaceous gland through photothermal destruction leading to lower sebum production, and regulating the cytokines release related to acne by increasing the TGF-β1 and lowering the interleukin-8 and Toll-like-receptor-2 (Xu et al., 2025).

The effectiveness of this laser in treating acne vulgaris particularly for mild to moderate severity has been validated by previous studies. For instance, Dhaher & Yosif, (2022) had investigated the efficacy of this laser among 61 acne patients where they underwent 3 sessions of laser treatment with 2-week interval without adjunctive medication. After the treatment, 80% of the patients achieved good outcome with 80% reduction of the total lesion, indicating high efficacy of this modality. Retrospective analysis of treatment outcome by Olugbade et al., (2025) involving 255 patients who underwent a median of 3 sessions of Nd: YAG laser demonstrated that 48% of the patients had complete clearance of the lesion, the IGA score also improved from 3 to 1 at 6 months, and 80% of the patients did not require isotretinoin. Another retrospective review by Sapra et al., (2022) examining the safety, effectiveness and patient satisfaction underwent concomitant treatment of oral isotretinoin with multiplex pulsed dye laser (PDL) and Nd: YAG laser involving 187 patients with a mean of 5.3 laser sessions also exhibited that 99.2% of them achieved clear or almost clear acne based on IGA score and the acne clearance was maintained until recent follow-up. 65.2% patients reported satisfaction and and discontinuation rate was only 9.1%. Although 31.6% of patients experienced side effects, most were mild and none are serious (Sapra et al., 2022). This evidence supports the efficacy of this laser in treating acne vulgaris.

As the efficacy and safety of the Nd: YAG laser in treating acne vulgaris has been established but not the fractional CO_2 laser, Hammoda et al., (2023) interested to find out whether both type of lasers were equally effective and if one is more superior to the other. The team conducted split face study where half of the face was treated with fractional CO_2 laser and other half was treated with Nd: YAG laser. The author highlighted that while both lasers were significantly effective, fractional laser was more superior in reducing the lesion, improving scars and facial pores, and provided greater patient satisfaction. After 4 treatment sessions, fractional CO_2 laser lessen inflammatory lesions by 88% (87% at 3 months) and non-inflammatory lesions by 78% (86% at 3 months), while the Nd: YAG laser lessen inflammatory lesions by 81% (77% at 3 months) and non-inflammatory lesions by 62% (70% ay 3 months). Nevertheless, the patients informed that the fractional CO_2 laser treatment procedure was significantly more painful and less tolerated compared to Nd: YAG laser. Thus, Nd: YAG laser is more suitable for the general patients and those who not capable of tolerating more painful procedure. In our study, topical monotherapy incurred the lowest cost (USD 198.71)

compared to topical plus systemic treatment (USD 298.71) and topical plus laser treatment (USD 369.09).

Futher cost-effectiveness analysis indicated that topical monotherapy provides the lowest cost per lesion reduction costing USD 13.45 per lesion reduced, followed by topical plus laser (USD 17.52 per lesion), and the highest cost was the topical plus systemic treatment (USD 19.48 per lesion). This finding demonstrates that even though the topical plus laser treatment had the highest total and upfront cost, it provides substantial lesion clearance at competitive price per unit of effectiveness, making it an attractive clinical and economic choice when rapid acne resolution is desired. The analysis of incremental cost-effectiveness ratio justifies this claim. Compared with topical monotherapy, topical plus laser require an additional USD 170.38 but lower the lesion by 6.3, giving an ICER of USD 27.05 per additional lesion reduced. Compared with topical plus systemic treatment, it required another extra USD 12.27 for 5.74 lesion reduced, producing lower ICER of USD 12.27. This result emphasizes that despite expensive cost of the topical plus laser treatment, the clinical benefit justifies the expense, especially relative to topical plus systemic therapy. These results are in accordance with the findings of Mavranezouli et al., (2022b) who examined the cost-effectiveness of acne treatment in UK. However, the authors assessed the cost-effectiveness against the quality-adjusted life year (QALY) gained over a year, not cost per lesion reduced as our study. The author recommends that, for mild to moderate acne, the most cost-effective interventions were topical combinations like BPO plus adapalene or tretinoin plus clindamycin which cost about £188–£195 per course, along with photochemical therapy with blue/red light which cost about £546.14. For moderate to severe acne, the topical combinations (£224–£235), oral antibiotics combined with topicals (£224–£235), and oral isotretinoin (£582 for males and £902 for females) were most cost effective (Mavranezouli et al., 2022b).

Their analysis indicate that combination treatments deliver the best balance of cost and health impact, while more expensive modalities like physical therapies and isotretinoin serves as cost-effective options in severe acne cases (Mavranezouli et al., 2022b). The author conforms our finding, in which conventional topical treatment should be the most economical and first line option owing to its affordability and high efficacy, while more expensive treatments such as tretinoin and laser can be considered as the alternative for the patients who are willing to pay more to obtain their superior outcome. Similarly, McNeil et al., (2023) also emphasized that the first-line treatment for mild to moderate acne should include topical medications like retinoid, BPO, topical or oral antibiotics either as monotherapy or in combination as it is cost-effective, easily accessible, effective, and capable of targetting related pathogenesis of acne. For instance, calculating the prices provided by the author over 12-week treatment period, for mild acne where topical monotherapy is utilised, generic adapalene 0.1%, tretinoin cream, tazarotene, and BPO leave on gel costs about USD 72, USD 109, USD 234, and USD 60 - 130, and combination of adapalene 0.1% plus BPO cleanser costs about USD 100-120. For moderate acne requiring combination therapy, combination of triple therapy consisting of topical retinoid plus BPO plus oral antibiotic is costs about USD 140 - 160, cheaper to our study (McNeil et al., 2023). However, the costs in this article are only considering the drug costs and not including the consultation cost as our study.

In China, Xiao et al., (2019) had explored the willingness to pay (WTP) for chemical peeling procedure among patients with acne, which is not considered as a first-line therapy. The average cost of three treatment session of this procedure in China was USD 383.4, close to the cost of topical plus laser treatment in our study. The authors found that the WTP values of the respondents were USD 234.6 for mild recovery, USD 222 for moderate recovery, and USD 401.7 for strong recovery, with only the most effective case achieving a benefit-cost ratio above

1. This indicates that the patient appreciates the rapid and visible improvement of treatment modality and are willing to pay higher prices provided that the clinical outcome is high (Xiao et al., 2019). This finding is also in concordance with our study, although topical plus laser therapy comes with a higher cost, it capable to achieve the most rapid and greatest lesion reduction, thereby justifying its use in patients who desire rapid results and willing to spend more. All in all, these finding present a coherent picture. Our study validates that topical monotherapy and topical plus systemic treatments were effective and cost-effective, and topical plus laser therapy despite the highest cost deliver superior outcomes at reasonable incremental cost. Mavranezouli et al., (2022b) cited that across various type of interventions, combination therapies still the most cost-effective, with more expensive modalities like isotretinoin and physical therapies like laser can be considered in severe form of disease. Xiao et al., (2019) highlighted that the patient's willingness to pay aligns with this trend, patients are ready to pay higher if the treatments provide better results. Therefore, both clinical evidence and patient preference become one on the principle that while economical options like topical combinations are important first-line treatments, advance treatmement can be justified when their superior efficacy and patient demand are factored into cost-effectiveness.

Limitations

However, this study is not without limitation. It utilised non-randomized study design and patient self-selection towards the individual treatment modalitiy introduced potential selection bias, as treatment choice may have been influenced by baseline acne severity, patient's socioeconomic factors, and personal preferences and health literacy. Besides, the sample size also was small and limited to to four private dermato-aesthetic clinics in Indonesia, affecting generalizability to the larger population. In addition, the 12-week follow-up is short and could not capture the long-term efficacy and maintenance costs. Longer follow-up, larger sample size covering more diverse populations, and randomised study design is needed to validate these study findings.

Conclusion

In conclusion, all treatment modalities were effective in treating acne provided patient satisfaction though the rate differed. This study also showed that, while topical monotherapy was the most cost-effective per lesion reduction, the topical plus laser treatment offered the most rapid and greatest acne reduction with favourable ICER compared to other treatment modalities, supporting the use of laser treatment for patients who are looking for the rapid clinical improvement and can afford the extra cost of the treatment.

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