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Review Article

1064-nm Nd:YAG laser as an antibiotic-sparing treatment option for inflammatory acne: a narrative review and evidence-informed practical treatment framework

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ABSTRACT

Antibiotic stewardship has become an increasingly important consideration in acne management. Systemic antibiotics remain useful for selected patients with inflammatory acne, but repeated or prolonged exposure raises concerns regarding antimicrobial resistance, microbiome disruption, tolerability, and adherence. Non-antibiotic procedural approaches may therefore have a role as adjunctive or antibiotic-sparing options in carefully selected patients. To review the clinical rationale, evidence base, safety considerations, and practical integration of 1064-nm neodymium-doped yttrium aluminum garnet (Nd:YAG) laser therapy for inflammatory acne. A narrative PubMed-based review was conducted focusing on 1064-nm Nd:YAG laser therapy for active acne, antibiotic stewardship, standard acne therapy, device-based acne treatment, safety in skin of color, isotretinoin and energy-based devices, and competing technologies. Studies exclusively addressing acne scars, post-acne erythema, hidradenitis suppurativa, or acne keloidalis nuchae were excluded from the core evidence synthesis. Evidence for 1064-nm Nd:YAG laser therapy includes microsecond-domain 650-usec studies, millisecond long-pulsed protocols, Q-switched and carbon-assisted approaches, and comparative studies against other procedural modalities. A sham-controlled randomized trial supports 650-usec 1064-nm treatment, and prospective and retrospective studies report improvement across a range of acne severities and Fitzpatrick skin types. Comparative studies suggest benefit for inflammatory lesions, but protocols, outcomes, comparators, and follow-up periods remain heterogeneous. No study has definitively demonstrated reduced cumulative antibiotic exposure as a predefined endpoint. 1064-nm Nd:YAG laser therapy should not be presented as a replacement for guideline-based pharmacologic acne treatment. The most defensible role is as an adjunctive or potential antibiotic-sparing procedural option for selected patients with inflammatory acne. Future trials should prospectively measure antibiotic exposure, relapse, maintenance needs, patient-reported outcomes, and cost-effectiveness.

Keywords: Acne vulgaris, Inflammatory acne, 1064-nm, Nd:YAG laser, Antibiotic stewardship, Antibiotic-sparing, Laser therapy, Energy-based devices, Skin of color

INTRODUCTION

Despite increasing emphasis on antibiotic stewardship, systemic antibiotics remain a common component of care for inflammatory acne. Contemporary acne management is based on topical retinoids, benzoyl peroxide, topical and systemic antibiotics, hormonal therapies, and isotretinoin, with treatment selection guided by severity, morphology, patient preference, tolerability, pregnancy considerations, and risk of scarring.[1-3] However, prolonged or repeated antibiotic exposure is increasingly discouraged because of antimicrobial resistance, microbiome disruption, adverse effects, and the need for long-term stewardship.[4,5] Energy-based devices have

therefore gained interest as adjunctive non-antibiotic interventions. Among these, the 1064-nm neodymium-doped yttrium aluminum garnet (Nd:YAG) laser is clinically attractive because of its penetration depth, relative epidermal melanin sparing compared with shorter wavelengths, procedural familiarity, and availability in many dermatologic practices. The purpose of this review is to evaluate 1064-nm Nd:YAG laser therapy as a potential adjunctive or antibiotic-sparing option for selected patients with inflammatory acne.

This framing requires caution. The current literature does not prove that 1064-nm Nd:YAG laser therapy replaces oral antibiotics, topical therapy, or isotretinoin. Rather, it suggests that non-antibiotic lesion reduction may help reduce reliance on antibiotics in selected clinical scenarios. This review therefore presents an evidence-informed practical treatment framework rather than a formal guideline or algorithm.

METHODS

A narrative PubMed-based review was performed. Searches combined terms for acne vulgaris, inflammatory acne, active acne, 1064 nm, Nd:YAG, long-pulsed laser, 650 usec, microsecond-domain laser, Q-switched laser, carbon suspension, antibiotic stewardship, antimicrobial resistance, skin of color, Fitzpatrick phototypes, isotretinoin, safety, relapse, follow-up, and competing technologies including 1726-nm lasers, pulsed dye laser, intense pulsed light, photodynamic therapy, and radiofrequency devices.

Eligible articles included randomized controlled trials, split-face studies, prospective and retrospective clinical studies, systematic reviews, narrative reviews, guideline documents, and mechanistic studies. Publications dealing exclusively with acne scars, post-acne erythema, hidradenitis suppurativa, acne keloidalis nuchae, pigmentary disorders, or non-acne indications were excluded from the core clinical analysis unless they were directly relevant to safety or contextual discussion. Because of heterogeneity in device settings, outcomes, comparators, and follow-up, no meta-analysis was attempted.

ANTIBIOTIC-SPARING RATIONALE

Antibiotic stewardship in acne is based on limiting systemic antibiotic duration, avoiding antibiotic monotherapy, using benzoyl peroxide when appropriate to reduce resistance pressure, and transitioning patients to non-antibiotic maintenance regimens.[1,2,4,5] A network meta-analysis of acne treatments reinforces that standard pharmacologic combinations remain central to evidence-based care, while procedural modalities vary in supporting evidence and comparability.[3]

The antibiotic-sparing rationale for 1064-nm Nd:YAG laser therapy is therefore indirect. If inflammatory lesion counts can be reduced without antimicrobial exposure, some patients may avoid initiating, extending, or repeating systemic antibiotics. However, no current 1064-nm Nd:YAG trial has prospectively measured cumulative antibiotic exposure, time to antibiotic initiation, or antibiotic-free remission as predefined endpoints. This limitation should be explicitly stated in any clinically oriented review.

MECHANISTIC CONSIDERATIONS

Acne pathogenesis involves follicular hyperkeratinization, sebum production, Cutibacterium acnes activity, and inflammation. Device-based therapies may influence acne through photothermal, photochemical, vascular, inflammatory, or sebaceous mechanisms. The 1064-nm wavelength penetrates relatively deeply and has lower epidermal melanin absorption than shorter visible wavelengths, which contributes to a generally favorable safety profile when conservative parameters and cooling are used.

For 1064-nm Nd:YAG treatment, the most defensible mechanisms are anti-inflammatory, vascular, and nonspecific photothermal effects. Claims of direct sebaceous gland destruction or durable sebosuppression should be made cautiously unless supported by protocol-specific data. This distinction is important because 1726-nm lasers more specifically target sebaceous lipids and have been developed around selective sebaceous photothermolysis.[20-25]

The phrase '1064-nm Nd:YAG laser' is not a complete treatment descriptor. Microsecond-domain 650-usec systems, millisecond long-pulsed systems, Q-switched systems, and carbon-assisted protocols differ substantially in tissue interaction. Combining them without distinction risks misleading clinical translation.

CLINICAL EVIDENCE FOR 1064-NM ND:YAG LASER THERAPY

Table 1 summarizes key clinical studies. The strongest protocol-specific evidence comes from microsecond-domain 650-usec studies. Kesty and Goldberg conducted a double-blind randomized sham-controlled trial in 20 subjects with moderate-to-severe acne. Subjects received three treatments two weeks apart plus an additional session four weeks after the third treatment. The laser arm showed greater improvement than sham in Investigator global assessment, inflammatory lesion count, comedones, porphyrin score, and sebum score.[6]

Saedi et al conducted a prospective single-center study of a 650-microsecond 1064-nm Nd:YAG laser in subjects with Fitzpatrick skin types I to VI and mild, moderate, or severe facial acne. Subjects received five treatments at two-week intervals with follow-up at 30 and 90 days. The study reported rapid lesion-count reduction, high satisfaction, and no observed adverse events.[7] Olugbade

et al reviewed 225 patients treated with a 1064-nm Nd:YAG protocol and reported a median of three treatments to clearance, 48% clearance, limited adverse effects, and similar outcomes between white patients and patients with skin of color for most IGA-rated parameters.[8] This study is clinically useful because of its size and real-world setting, but its retrospective design and concomitant therapies limit causal interpretation.

Table 1: Key clinical studies of 1064-nm Nd:YAG laser therapy for active acne.

References	Design	Intervention/ comparator	Main relevance for review
Kesty et al (2020)[6]	Double-blind RCT, n=20	650-usec 1064-nm Nd:YAG versus sham	Most important sham-controlled support for 650-usec protocol.
Saedi et al, (2024)[7]	Prospective single-center study	650-microsecond 1064-nm Nd:YAG, five sessions	Clinical improvement, high satisfaction, no adverse events reported across Fitzpatrick I-VI.
Olugbade et al, (2025)[8]	Retrospective chart review, n=225	1064-nm Nd:YAG microsecond-domain protocol	Large real-world series; useful but limited by retrospective design and concomitant therapies.
Chalermsuwiwattanakan et al, (2021)[9]	Comparative study	Long-pulsed 1064-nm Nd:YAG versus 595-nm PDL	Both modalities improved inflammatory lesions and erythema.
Ibrahim et al, (2023)[10]	Split-face study	Long-pulsed Nd:YAG versus botulinum toxin type A	Comparative procedural evidence for inflammatory acne.
Moftah et al, (2022)[11]	Split-face comparative study	Long-pulsed Nd:YAG versus PRP	Supports procedural efficacy but comparator differs mechanistically.
Hammoda et al, (2023)[12]	Randomized split-face study	Fractional CO_2 versus long-pulsed Nd:YAG	Supports activity of Nd:YAG but Co_2 performed better in that study.
Jung et al, (2012)[13]	Randomized clinical and histopathological study	Dual-mode quasi-long pulse/Q-switched Nd:YAG plus carbon suspension	Mechanistically relevant but not equivalent to monotherapy long-pulsed Nd:YAG.
Maghsoodloo et al, (2026)[14]	Pilot double-blind split-face study	Long-pulsed versus Q-switched fractional Nd:YAG with azithromycin background	Adjunctive evidence only; QS outperformed LP in this study.

Table 2: Source-matched interpretation of major 1064-nm evidence categories.

Evidence category	Most appropriate interpretation	Reviewer-safe wording
650-usec/microsecond-domain	Best protocol-specific evidence among 1064-nm studies, including sham-controlled RCT.	650-usec 1064-nm Nd:YAG has clinical evidence supporting improvement in selected patients.
Millisecond long-pulsed	Supported by comparative and split-face studies, but heterogeneous.	Long-pulsed 1064-nm Nd:YAG may improve inflammatory lesions, but protocols and comparators vary.
Q-switched/carbon-assisted	Different tissue interaction and external chromophore effects.	These protocols should be discussed separately from standard long-pulsed monotherapy.
Antibiotic-sparing	Conceptually supported by stewardship rationale, not proven by antibiotic exposure endpoints.	May represent a potential antibiotic-sparing adjunct in selected patients.
Long-term durability	Some short- to mid-term signals; robust relapse data limited.	Improvement may persist after treatment, but long-term recurrence data remain limited.

Table 3: Safety considerations and practical risk mitigation.

Issue	Clinical concern	Practical mitigation
Post-inflammatory hyperpigmentation	Higher risk in darker phototypes and inflamed lesions.	Use conservative settings, avoid stacking, ensure photoprotection, consider test spots.
Acne flare/dryness	Reported in retrospective series and clinically plausible after thermal stimulation.	Counsel patients; adjust irritant topicals; provide barrier support.
Cooling variability	Cooling affects epidermal protection and tissue delivery.	Document cooling method and avoid transferring parameters between devices.
Recent tanning	Increased epidermal melanin load raises adverse-event risk.	Delay treatment until baseline pigmentation has stabilized.
Isotretinoin	Historical concern for wound healing and scarring.	Individualize; distinguish nonablative laser from ablative resurfacing.
Device dependency	Beam profile, pulse structure, and cooling differ by platform.	Do not assume settings are interchangeable across manufacturers.

Table 4: Comparison with competing device-based acne treatments.

Technology	Main target/rationale	Advantages	Limitations
1064-nm Nd:YAG	Vascular, inflammatory, nonspecific photothermal effects	Widely available; usable across skin types with conservative settings	Less sebaceous-selective; heterogeneous protocols
1726-nm laser	Sebaceous lipid absorption/selective photothermolysis	More directly sebaceous-selective; growing durability data	Specific device availability and cost
595-nm PDL	Oxyhemoglobin/vascular inflammation	Useful for erythematous inflammatory phenotypes	Purpura and PIH risk depend on parameters
IPL	Broad-spectrum hemoglobin and porphyrin targeting	Versatile and accessible	Operator-dependent; less suitable for darker skin types
PDT	Photosensitizer-enhanced follicular/sebaceous targeting	Strong evidence among light-based approaches	Pain, erythema, crusting, downtime, dyspigmentation
RF-based approaches	Thermal remodeling/ sebaceous modulation	Useful in selected acne and scar phenotypes	Different mechanism; protocol heterogeneity

Millisecond long-pulsed 1064-nm Nd:YAG protocols have been evaluated in comparative and split-face studies. A comparative study with 595-nm pulsed dye laser found both modalities effective for inflammatory lesions and acne erythema.[9] Other split-face studies compared long-pulsed Nd:YAG with intralesional botulinum toxin type A, platelet-rich plasma, and fractional CO_2 laser.[10-12] These studies support a procedural role for 1064-nm Nd:YAG in inflammatory acne, but the comparator heterogeneity prevents direct pooled conclusions.

Q-switched and carbon-assisted approaches should be interpreted separately. Jung et al evaluated a dual mode quasi-long pulse and Q-switched 1064-nm Nd:YAG protocol assisted by topical carbon suspension with clinical and histopathological assessment.[13] A recent pilot split-face study compared Q-switched and long-pulsed fractional 1064-nm Nd:YAG as adjuncts to azithromycin; both reduced acne severity, but Q-switched treatment performed better in that study.[14] Because systemic antibiotics were used, that trial supports adjunctive procedural efficacy rather than antibiotic-sparing monotherapy.

SAFETY AND SKIN OF COLOR

Safety is a major practical advantage claimed for 1064-nm Nd:YAG treatment, particularly in darker skin types. The 1064-nm wavelength is relatively melanin-sparing compared with shorter wavelengths, but wavelength alone does not determine safety. Fluence, pulse duration, repetition rate, spot size, cooling, treatment density, stacking, baseline inflammation, recent tanning, topical irritants, and post-treatment photoprotection are all clinically important.

The prospective 650-microsecond study included Fitzpatrick skin types I to VI and reported no adverse events.[7] The retrospective 225-patient series included both white patients and patients with skin of color and reported adverse effects limited to flare-ups and dryness.[8]

However, actively inflamed acne lesions can be prone to post-inflammatory hyperpigmentation, especially in Fitzpatrick skin types IV to VI. A broader systematic review of nonablative lasers and energy-based devices in phototypes IV to VI supports the need for conservative settings and careful counselling.[26] Practical risk reduction should include conservative initial settings, avoidance of recent tanning, adequate epidermal cooling, avoidance of aggressive stacking, adjustment of irritating topicals around treatment, strict photoprotection, and early management of flare-ups. Cooling should be considered an essential treatment variable because contact, cryogen, and forced-air cooling influence epidermal protection and therapeutic delivery.

COMBINATION THERAPY

In most patients, 1064-nm Nd:YAG laser therapy should be integrated into multimodal acne care rather than used as an isolated intervention. Topical retinoids and benzoyl peroxide remain important for comedonal control, maintenance, and antibiotic-resistance mitigation.[1,2] Laser therapy may be considered when inflammatory lesions persist despite optimized topical care, when systemic antibiotics are poorly tolerated or undesirable, or when patients seek a non-antibiotic adjunct. Combination with isotretinoin requires individualized judgment. Historical concerns about procedural treatment during or soon after isotretinoin have been reassessed, and a systematic review of energy-based devices plus isotretinoin suggests that blanket delays are not uniformly supported by current evidence.[27] Nevertheless, this evidence is not specific to every acne laser protocol, and ablative or high-injury procedures require separate risk assessment.

DURABILITY, MAINTENANCE AND RELAPSE

Short-term improvement after 1064-nm Nd:YAG treatment is supported by several studies, but durability data are less robust. Saedi et al reported maintained improvement at 90 days after the final treatment, and Olugbade et al reported a six-month follow-up median IGA score of almost clear.[7,8] Comparative studies often have shorter follow-up periods, and recurrence is inconsistently defined. The practical conclusion is that 1064-nm Nd:YAG may provide improvement beyond the immediate treatment series, but long-term remission cannot be assumed. Patients should be counseled that maintenance topical therapy remains important and that procedural maintenance sessions may be required, particularly in chronic or hormonally influenced inflammatory acne.

COMPARISON WITH COMPETING TECHNOLOGIES

Competing device-based therapies include 1726-nm sebaceous-selective lasers, pulsed dye laser, intense pulsed light, photodynamic therapy, and radiofrequency-based devices. The 1726-nm laser is the most relevant comparator because its target and development pathway align more directly with selective sebaceous photothermolysis.[20-25] Clinical studies of 1726-nm systems report improvement in moderate-to-severe acne across skin types, with follow-up extending to at least 26 weeks and one-year multicenter data.[22-25]

Compared with 1726 nm, 1064 nm is less sebaceous-selective but may be more widely available and familiar in procedural dermatology. Pulsed dye laser offers stronger vascular targeting but has shallower penetration and parameter-dependent purpura risk. Intense pulsed light is versatile but operator-dependent and more challenging in darker skin types. Photodynamic therapy has comparatively strong evidence among light-based approaches but may involve pain, erythema, crusting, downtime, and dyspigmentation. Radiofrequency-based approaches may be useful in selected acne and acne-scar phenotypes but act through different mechanisms.

EVIDENCE-INFORMED PRACTICAL TREATMENT FRAMEWORK

The proposed framework is not a guideline. It is a pragmatic clinical structure for selected patients with inflammatory acne (Figure 1). Candidates may include patients with mild-to-moderate inflammatory acne who wish to reduce antibiotic exposure, patients with poor tolerance of systemic antibiotics, patients with contraindications or reluctance toward systemic therapy, and patients with persistent inflammatory lesions despite optimized topical care.

Patients with severe nodulocystic acne, acne fulminans, rapidly scarring disease, marked systemic symptoms, or clear indication for isotretinoin should be evaluated according to guideline-based care rather than diverted into repeated laser monotherapy. Similarly, patients with recent tanning, uncontrolled barrier disruption, unrealistic expectations, inability to adhere to photoprotection, or inability to attend serial visits may be poor candidates.

A practical sequence is: confirm acne subtype and severity; optimize non-antibiotic topical therapy; assess the need for systemic therapy; consider 1064-nm Nd:YAG as an adjunctive or potential antibiotic-sparing option; use conservative initial parameters; counsel regarding flare, dryness, erythema, discomfort, post-inflammatory hyperpigmentation, cost, and maintenance; reassess after three to four sessions using lesion counts, standardized photographs, and patient-reported tolerability; and continue maintenance therapy after improvement.

LIMITATIONS OF CURRENT EVIDENCE

The current evidence base is promising but limited. Many studies are small, single-center, split-face, open-label, or retrospective. Sham-controlled data are limited. Protocols vary widely in pulse duration, fluence, spot size,

repetition rate, cooling, number of passes, treatment interval, and concomitant therapy. Outcome measures are inconsistent, and validated acne-specific quality-of-life instruments are rarely used.

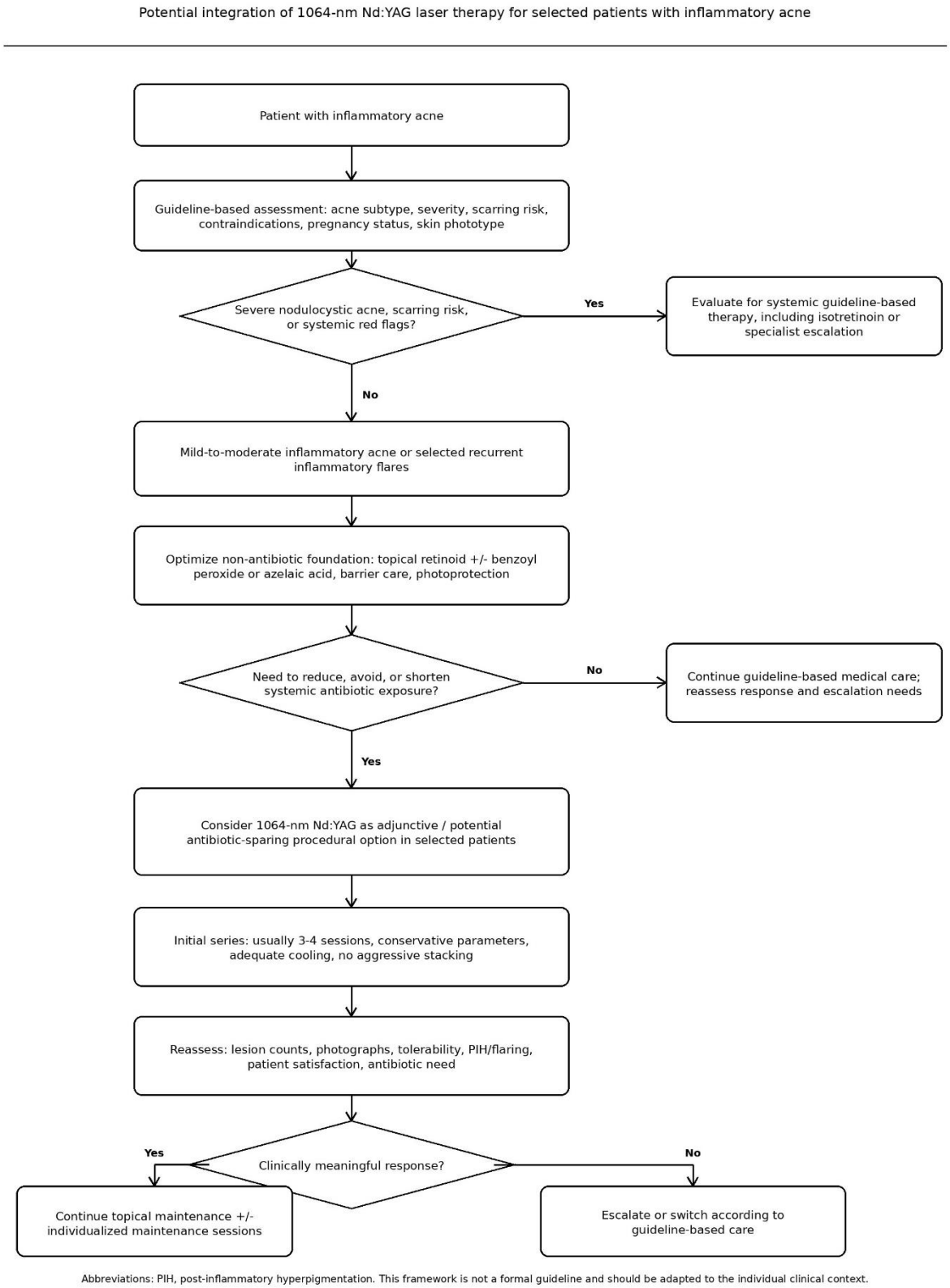

Figure 1: Evidence-informed practical treatment framework.

The most important limitation for this manuscript's central premise is that antibiotic-sparing outcomes have not been prospectively tested. Future studies should measure cumulative systemic antibiotic exposure, time to antibiotic initiation, antibiotic-free remission, recurrence, maintenance requirements, adverse events by Fitzpatrick

skin type, and cost-effectiveness. Device dependency is another major limitation; parameters from one 1064-nm platform cannot be assumed to transfer safely or effectively to another device.

CONCLUSION

1064-nm Nd:YAG laser therapy is a plausible adjunctive and potential antibiotic-sparing procedural option for selected patients with inflammatory acne. Its most defensible role is not as a replacement for guideline-based pharmacologic care, but as part of individualized multimodal management when reducing antibiotic exposure is clinically desirable. The literature supports improvement in inflammatory acne across several 1064-nm protocols, with the strongest protocol-specific data for 650-usec microsecond-domain treatment and additional support from long-pulsed comparative studies.

Clinical use should remain conservative and transparent. Microsecond-domain, long-pulsed, Q-switched, and carbon-assisted protocols should not be conflated. Patient selection, skin phototype, cooling, post-inflammatory hyperpigmentation prevention, concomitant topical care, cost, and maintenance needs must be addressed. Future controlled studies should directly evaluate antibiotic-sparing endpoints before stronger claims can be made.

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