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ORIGINAL ARTICLE

Delphi consensus on melasma management by international experts and pigmentary disorders society

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Abstract

Background: Melasma, an acquired hyperpigmentation disorder, affects individuals of all ethnicities. Its multifactorial aetiology, high recurrence rates and psychosocial impact complicate management and necessitate comprehensive, evidence-based recommendations.

Objectives: The objective was to develop an international consensus on the diagnosis and management of melasma by synthesizing expert opinions and the latest scientific evidence.

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use of hydroquinone-based triple combination creams as the gold standard, and alternatives such as topical azelaic acid, kojic acid and oral tranexamic acid. Adjunctive procedural therapies, such as chemical peels and microneedling, were suggested to enhance topical efficacy, while lasers were reserved for refractory cases.
Conclusion: These recommendations aim to improve the outcomes of melasma patients globally by integrating expert opinion and evidence-based strategies. Future research should focus on evaluating emerging therapies and optimizing long-term maintenance strategies.

KEYWORDS
consensus, dermatology, disease management, hyperpigmentation, melanosis

INTRODUCTION

Melasma is an acquired disorder of hyperpigmentation that affects individuals across all ethnicities, although its prevalence is particularly pronounced in darker skin types and photoexposed populations.[1] While the condition can occur in men, at least 90% of cases are seen in women, underscoring sex-based predisposition.[2] Beyond its physical manifestation, melasma considerably impacts emotional and psychological well-being, often leading to deterioration in the quality of life.[3]

Despite its widespread prevalence and psychosocial impact, melasma is often perceived as a mere cosmetic defect, leading to underdiagnosis and treatment.[4] The pathogenesis of melasma is multifactorial, involving various clinical and histological features that reflect the interplay of several underlying mechanisms. Common triggers include prolonged sun exposure, genetic predisposition, hormonal fluctuations during pregnancy or therapy and the use of medications, such as oral contraceptives, hormone replacement therapy and antiepileptic drugs.[2] The overlapping features with other hyperpigmentation disorders complicate diagnosis, potentially delaying appropriate treatment. This highlights the importance of differentiating melasma from other hyperpigmentation disorders.[5]

The chronic nature and high recurrence rates of melasma require a comprehensive and long-term approach. Treatment options include photoprotection, topical skin-lightening agents, chemical peels, lasers or energy-based devices and systemic therapies. However, the variable response to these modalities and the lack of prospective randomized trials for many therapeutic approaches complicate the choice of the most effective regimen.[6] Moreover, recent insights into vascular, inflammatory and barrier-defect mechanisms have shifted therapeutic targets beyond melanogenesis alone, which need to be reflected in recommendations. The variability underscores the necessity for ongoing research and updated clinical recommendations, which can provide a structured approach. An updated, internationally applicable consensus based on the appraisal of recent evidence and the collective experience of pigmentary disorders experts remains essential to harmonize diagnosis, stratify first- and second-line choices and integrate adjunctive procedures within a practical therapeutic ladder. This consensus brought together an international panel of experts in collaboration with the Pigmentary Disorders Society (PDS) to address the need for updated, comprehensive and evidence-based recommendations for managing melasma. In light of recent evidence, this was an extension of the previous consensus published by PDS with an extended geographical coverage and a larger panel.[7] The objectives were to analyse current clinical practices, evaluate existing recommendations and develop a consensus-based framework to optimize diagnosis and treatment strategies. By identifying best practices and highlighting evidence gaps, this consensus aims to step toward standardizing care, improving patient outcomes and providing a clear research agenda for future prospective trials.

Why was the study undertaken?

- To develop comprehensive, evidence-based recommendations for melasma management by synthesizing expert opinions and scientific literature, addressing the lack of standardized global guidelines for this complex, recurrent pigmentary disorder.

What does this study add?

- It presents the first international consensus on melasma management using a modified Delphi method, incorporating input from 40 dermatologists across 11 countries. Key recommendations were drafted after a thorough review of the literature and discussion among experts.

What are the implications of this study for disease understanding and/or clinical care?

- The study provides a globally relevant, practical framework for melasma diagnosis and treatment, emphasizing photoprotection, evidence-based topical and oral therapies and cautious use of procedures—guiding clinicians and informing future research directions.

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METHODS

This study was conducted to develop international consensus-based recommendations for managing melasma, focusing on recent advancements in the field. A modified Delphi approach was employed. Figure 1 shows an overview of the workflow. While this study was not prospectively registered, it adhered to a transparent process in alignment with established consensus development practices.

The Core Group and selection of members for voting

The core group comprised two senior members from the PDS with extensive experience in dermatology and melasma research. Their responsibilities included designing, moderating and overseeing the consensus process. A diverse panel of 20 members from PDS, along with 18 international dermatology experts (38 total) from various clinical and geographic backgrounds, was invited to participate in the process (Table S1). These experts were selected based on their contributions to melasma research, clinical experience and publications on this topic of interest. The core group did not participate in the voting to avoid potential bias.

Literature search

A search of the PubMed database was conducted to identify studies published between 2014 and 2024. The search strategy included structured queries focused on topics such as melasma management, diagnosis and treatment (as outlined in Table S2). Studies were screened for inclusion based on methodological rigor, prioritizing randomized controlled trials (RCTs), systematic reviews, cohort studies and meta-analyses. Articles meeting these criteria were graded using the Oxford level of evidence framework (2009). A summary of the literature search was shared with the expert panel as a pre-read.

Review of evidence and formulation of consensus statements

The literature review helped identify evidence-based practices and knowledge gaps in melasma management. Broad domains, such as diagnosis, treatment options and maintenance strategies, were determined. Consensus statements were drafted, which underwent several revisions based on expert feedback.

Administering the questionnaire, gathering responses and aggregating results

A questionnaire was developed to collect expert opinions and administered to the panel using an online survey platform. Responses were gathered anonymously on a 5-point Likert scale (strongly agree, agree, neither agree nor disagree, disagree and strongly disagree). Responses were quantified based on predefined levels: high agreement (≥75% of respondents voted agree/strongly agree or disagree/strongly disagree), moderate agreement (55%–74%)

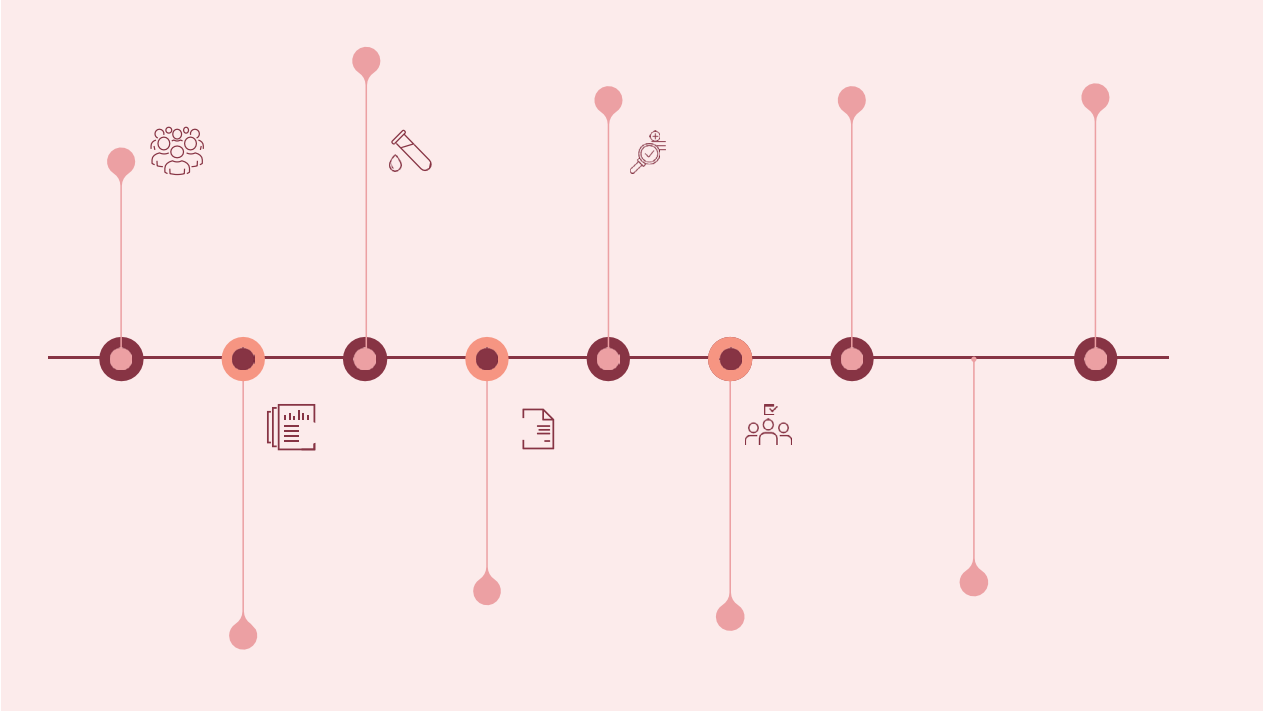

FIGURE 1 Overview of the workflow for the consensus-building process.

and low agreement (<55%). Statements were retained, revised or removed based on feedback. Consensus statements that did not receive high or moderate agreement and had a substantial number of 'neither agree nor disagree' responses were identified as areas where evidence remains inconclusive, highlighting the need for further research. The study materials and survey instruments were designed to be clear and focused. Separate piloting prior to dissemination was not conducted.

Consensus development process

The consensus development process followed a modified Delphi methodology involving voting and discussions. The first round involved voting on the initial set of consensus statements. A virtual meeting was then convened to discuss

TABLE 1 Finalized consensus statements.

Sl. no.	Finalized consensus statement	Level of evidence	Finalized in round	Final level of consensus
Diagnostic and monitoring tools				
1	Wood's lamp remains a favoured method for determining the extent and severity of melasma	5	3	High
2	Dermoscopic examination is an accepted non-invasive tool that can facilitate the differential diagnosis of melasma from similar conditions	2b, 5	2	High
3	Treatment monitoring with reflectance confocal microscopy enables the objectification of pigment variations after treatment and the identification of prognostic factors for different treatment modalities	2a	2	Moderate
4	Occasionally, melasma may appear like another hyperpigmentary condition. In such cases, a skin biopsy with histopathological examination is needed to confirm the diagnosis	5	1	High
Photoprotection				
5	The characteristics of an ideal sunscreen should include broad-spectrum coverage with protection against UVA, UVB and visible light, an optimal sun protection factor and cosmetic acceptability	4, 5	3	High
6	The addition of active ingredients such as antioxidants, depigmenting and moisturizing agents to sunscreen can increase its efficacy in managing melasma and enhance the skin's tolerability to topical treatments	5	2	Moderate
Topical agents				
7	Triple combination therapy (hydroquinone, tretinoin and fluocinolone acetonide) is the gold standard for the management of melasma and may be used as a first-line option	1b, 1a	2	High
8	Unsupervised use of triple combination therapy is not recommended, and proper precaution should be used	5, 5	2	High
9	The duration of intensive daily treatment with triple combination cream (TCC) can be up to 12 weeks. However, treatment variations may be patient-dependent	2b	2	High
10	The twice-weekly regimen of triple combination cream is effective for melasma and can be followed by tapering to other topical agents after the initial period of treatment	1b	1	High
11	Azelaic acid can serve as an effective treatment option for melasma patients with concerns about the adverse effects of hydroquinone	1a	1	High
12	Antioxidants such as topical vitamin C can be beneficial in managing melasma	1a	1	High
13	Combinations with ingredients such as kojic acid, arbutin, vitamin E and other botanical ingredients may be used as additional options	2b	3	High
Oral agents				
14	Oral tranexamic acid is effective in the management of melasma	2b, 5	3	High
15	Oral antioxidants, in combination with other appropriate treatment modalities, can serve as an option for the management of melasma	1b, 2b, 4	3	High
Chemical peels				
16	Glycolic acid is the most studied peel and shows superior outcomes compared to others. Other options include salicylic acid peels, retinoic acid peels, trichloroacetic acid (TCA) peels (low concentration) and Jessner's peels	2a	2	High
17	Glycolic acid and salicylic–mandelic acid peels have comparable efficacy and are well tolerated	1b	2	Moderate
18	Some of the refractory melasma can be treated by using a combination of a depigmenting agent (4% hydroquinone/TCC) and a peeling agent	4, 1b, 1b	1	High
19	Combination peels may be used as an additional option for the treatment and maintenance of melasma	2b	2	High
Energy-based devices and procedural treatments				
20	A low-fluence Q-switched Nd:YAG laser can be a suitable option for refractory cases of melasma	2a, 5	2	High
21	Vascular abnormalities have been implicated in melasma. There is promising evidence supporting the use of tranexamic acid and laser/light therapies to target the vascular component of melasma	2a	2	High

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TABLE 1 (Continued)

Sl. no.	Finalized consensus statement	Level of evidence	Finalized in round	Final level of consensus
22	Microneedling can serve as an effective procedure to improve the penetration of topical agents into the skin and the quality of the dermis	1a	2	Moderate
23	Microneedling can serve as an additional procedural option for treating melasma	2a	3	High
24	Platelet-rich plasma can be an adjunctive therapy in the management of melasma	2a, 2a, 1b	3	Low
Alternative therapies and emerging treatment options				
25	Newer non-hydroquinone-based options can serve as choices for patients who are intolerant to or do not respond to first-line agents, those who have contraindications, or when patients move into the maintenance phase of therapy	1b, 1b, 2a, 1b, 1b, 1a, 5	2	High
Adjunct therapies and skincare				
26	Moisturizers are beneficial in reducing treatment-associated dryness and thus enhance patient satisfaction	5, 5	3	High

in melasma include inappropriate activation of melanocytes, aggregation of melanin and melanosomes in both the dermis and epidermis, increased mast cell count and solar elastosis, altered basement membrane integrity and increased vascularization.[2] Understanding these pathophysiological mechanisms is critical for selecting appropriate treatment modalities.

Diagnosis and monitoring (Statements 1–4 in Table 1)

The diagnosis of melasma can be challenging due to its clinical resemblance to other hyperpigmentation disorders. The panel agreed that Wood's lamp remains a favoured method for determining the extent and severity of melasma, but the constraints in accurately determining melanin depth may limit its use.[8] Although the utility of dermoscopy in the determination of depth has been contested, the expert panel felt that it is an accepted and non-invasive tool that can facilitate the differential diagnosis.[9,10] Though some authors suggest considering the intradermal component of melasma during diagnosis and treatment planning,[11] the panel discussion highlighted that therapeutic choice depends not so much on the depth as on the severity of melasma. The limited availability of reflectance confocal microscopy outside of research establishments was pointed out. However, its utility, when available, was acknowledged. A skin biopsy may be needed to confirm melasma in cases with close differential diagnosis. Histopathological findings typically show epidermal hyperpigmentation with hypertrophied melanocytes, increased melanin and mature melanosomes. The dermis can exhibit melanin-laden macrophages along with mononuclear infiltrates, increased vascularity, mast cells and elastosis.[12]

Treatment

Photoprotection (Statements 5, 6 in Table 1)

Photoprotection remains the cornerstone of melasma management, as high-energy visible light and ultraviolet radiation are significant contributors to its pathogenesis.[13] However, poor adherence to photoprotection, more so among high-risk groups, remains a challenge.[13,14] Cosmetic elegance and tone compatibility have been indicated as important considerations for sunscreen recommendations.[15,16] Broad-spectrum sunscreens containing iron oxide, zinc oxide and titanium dioxide, with optimal sun protection factors, are recommended for their protective and cosmetic benefits.[13] Tinted sunscreens with iron oxide reduce visible light transmittance effectively.[16] Zinc oxide has a broad UVA–UVB absorption curve, while titanium dioxide provides better UVB protection.[17] Tinted sunscreens suitable for different skin tones can also enhance adherence while providing camouflage.[18] There was moderate agreement on the inclusion of active ingredients, such as antioxidants, depigmenting agents and moisturizers, in sunscreens to enhance their effectiveness, emphasizing the potential opportunity to leverage the advantages.[19] Visible light exposure can contribute to nearly 50% of reactive oxygen species generation in melasma, surpassing UVB (4%) and UVA (46%).[20] Addition of antioxidants like vitamins C and E to sunscreens can mitigate visible light and infrared radiation damage, which standard sunscreens do not address.[20,21] Melasma-afflicted skin, despite normal hydration, exhibits impaired barrier function, potentially leading to pigmentation.[22] Moisturizers aid in restoring the skin barrier, supporting treatment.[23] Sunscreens with depigmenting agents such as niacinamide, lactic acid and licorice extract offer effective, patient-friendly options, simplifying management and improving outcomes.[24]

Topical agents (Statements 7–13 in Table 1)

Hydroquinone is often combined with other agents to enhance efficacy but requires close supervision due to rare but significant risks like exogenous ochronosis.[25,26] Hydroquinone is available in 2% and 4% formulations as a topical depigmenting agent. It can be used as monotherapy or as a component of triple combination creams

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(TCCs). It is often combined with other agents to enhance efficacy but requires close supervision due to rare yet significant risks like exogenous ochronosis. Hydroquinone can be applied evenly over the affected areas and used concurrently with sunscreen to protect from damaging UV light, which increases pigmentation. If there are no results after 3 months, hydroquinone should be discontinued. It is prudent to stop hydroquinone-containing creams for a few months before restarting to decrease the risk of side effects. It can also be used during weekends only or three times a week for more extended maintenance therapy with minimal complications. TCC, incorporating hydroquinone (4%), tretinoin (0.05%) and fluocinolone acetonide (0.01%), is regarded as the gold standard for melasma treatment and remains a first-line therapy. Although 4% is the standard, the use of TCC with a lower concentration of hydroquinone (2%) has also been reported. TCC formulations using different corticosteroids have shown efficacy. However, it has been indicated that fluorinated steroids (e.g., fluocinolone acetonide) are more effective and safer than non-fluorinated steroids.[27] TCC containing fluocinolone acetonide 0.01% has been shown to be as effective as mometasone furoate 0.1% with fewer side effects.[28] Treatment typically lasts up to 12 weeks, followed by a maintenance regimen, though the duration may vary. A twice-weekly regimen after intensive treatment and tapering to other topicals was suggested.[29] The expert panel emphasized that the TCC should only be used under clinical supervision, and proper precautions should be taken. Although TCC is recommended as first-line treatment, the expert panel agreed on azelaic acid as an option for those with concerns about adverse effects. Azelaic acid exhibits anti-inflammatory properties, making it a promising alternative to treatments that primarily target melanin production without addressing inflammation.[30] Azelaic acid-containing creams at concentrations of 15%–20%, twice daily for 6 months, have been recommended.[31] There was high consensus on the use of topical antioxidants, such as vitamin C, for melasma management. The benefits of topical vitamin C in the management of melasma and photoaging have been reported.[32] Such a dual role is noteworthy in light of evidence on pathophysiology suggesting melasma as a photoaging disorder.[33] For reasonable results, it has been suggested that a vitamin C concentration higher than 8%

Chemical peels (Statements 16–19 in Table 1)

Chemical peels increase epidermal exfoliation and also target the dermal component of melasma by inducing phagocytosis of melanin granules. The expert panel agreed that, among other peels, glycolic acid is the most studied and shows superior outcomes.[52] This recommendation augments the previous Latin American consensus, which suggests a lack of clear evidence of superiority, but is in line with the Chinese consensus that supports the effectiveness of alpha hydroxy acid peels.[31,40] Serial glycolic acid peels enhance the efficacy of the topical regimen with a more rapid initial response and overall lightening of the skin.

In trials, glycolic acid has most commonly been used at 30%–50% concentrations, with higher strengths (up to 70%) also reported.[53–56] Higher concentrations may be suited for spot peels only under expert supervision. The utility of other options, such as salicylic acid (20%–30%),[54] retinoic acid (1%–10%),[57,58] trichloroacetic acid (low concentration of 10%–35%)[59] and Jessner's peels, was also acknowledged. Combining depigmenting agents such as 4% hydroquinone or TCC with chemical peels can enhance treatment outcomes for refractory melasma. Chemical peels promote controlled exfoliation, facilitating deeper penetration of topical agents and improving skin texture.[60,61] However, it has been recommended that medium-depth peels should be avoided.[31] The panel was also in favour of combination peels as an additional option for the treatment and maintenance of melasma. The agreement was moderate regarding whether glycolic acid and salicylic–mandelic acid peels have comparable efficacy. Some evidence reports that glycolic acid and salicylic–mandelic acid (20% salicylic/10% mandelic acid) peels are equally effective and provide better outcomes than phytic acid combination peels.[62] However, the scarcity of studies with head-to-head comparisons of different peels was pointed out.

Laser or energy-based devices and procedural treatments (Statements 20–24 in Table 1)

Laser treatment of melasma is at best a third-line therapy. Q-switched Nd:YAG laser (1064 nm) in toning mode is preferred for its selective melanin targeting with minimal complications.[63,64] Laser or energy-based devices, including Q-switched Nd:YAG lasers, picosecond lasers, intense pulsed light (IPL), pulsed dye laser (PDL) and radiofrequency, show efficacy but carry risks of relapse and adverse effects.[6] Though effective, the panel expressed that laser therapies require careful patient selection and are best reserved for refractory cases.[63–66] The expert consensus emphasized laser therapy as an adjunct rather than monotherapy, supported by meta-analysis data.[65] The potential of lasers to improve the delivery of topical agents to the target site has been reported.[65,67] There was high consensus that TA can be combined with laser/light therapies to treat the vascular component of melasma.[68]

Microneedling improves transcutaneous drug delivery and can be considered a step-up option before invasive procedures.[69] The discussion highlighted that microneedling promotes collagen production and remodelling of the dermal matrix and can serve as an additional procedural option. Evidence from an RCT suggests that both microneedling and TA improve the performance of TCC, with microneedling providing sustained remission.[70] Studies have shown that microneedling with 5% TA is effective.[45] The findings from a systematic review and meta-analysis also suggest that among various routes of TA delivery, intradermal injection and microneedling can be effective alternatives for melasma treatment.[71] However, the expert panel expressed the need for more studies confirming improvements in transcutaneous drug delivery, and the statement reached a moderate consensus. Several studies and RCTs suggest that 4 mg/mL TA injections are an effective treatment for melasma. Intralesional injections are more invasive; hence, they are recommended to be used as an adjuvant to topical medications in difficult-to-treat melasma.[38] TA injections using different concentrations, including 4 mg/mL, 10 mg/mL and even 100 mg/mL, with frequency ranging from weekly to monthly, have been studied.[38,72] Platelet-rich plasma therapy, either alone or combined with microneedling or microinjections, has also gained attention.[72] Microinjections of platelet-rich plasma in combination with topical hydroquinone have been reported to have better efficacy than topical hydroquinone alone.[73] However, the panellists expressed the need for more conclusive studies on the use of platelet-rich plasma, although, at present, it is best to be used as an adjunct to topical and oral treatments.

Alternative therapies and emerging treatment options (Statement 25 in Table 1)

Emerging therapies, such as topical Thiamidol®, cysteamine, malassezin, metformin and 2-mercaptonicotinoyl glycine (2-MNG), have demonstrated efficacy as adjuncts or alternatives to hydroquinone.[74–81] These newer non-hydroquinone-based options may offer viable alternatives for managing melasma, especially in patients who are intolerant to first-line agents, have contraindications or require maintenance therapy. These agents target distinct pathways in melanogenesis, contributing to their effectiveness. The expert panel discussion outlined that these agents may expand the therapeutic options for melasma, particularly for patients needing alternatives to hydroquinone-based therapies. However, their use is limited by their availability, which may vary due to regulatory approvals, market accessibility and regional prescribing preferences. Glutathione is another agent with reported melanopenic and antioxidant properties. A systematic review of evidence on the use of glutathione revealed that

include glutathione in this consensus, but clinicians should be prepared to counsel patients on its uncertain effectiveness and IV-related safety concerns.

Adjunct therapies and skincare (Statement 26 in Table 1)

Cosmeceuticals enriched with bio-actives, plant extracts, and hydrating agents can improve tolerability and compliance.[22,83] Skin care products often contain ingredients that help repair the skin barrier, which is crucial as impairment of the skin barrier can exacerbate melasma. When combined with treatments such as chemical peels or lasers, they can enhance efficacy and patient satisfaction. Moisturizers help restore the compromised skin barrier in melasma. While transdermal epidermal water loss in melasma lesions is similar to the surrounding skin, the barrier recovery rate in lesional skin is significantly slower, leading to reduced moisturizing capabilities and forming a vicious cycle.[22]n7.2 (i)-9.6 (s)-6.8 (5)-20.3 (u)-21.1 (r)-19.8 2iz7ers hepac (h a)-1.8 (f)]-20.7 2i l.7 (d)0.5 ( )]TJ0.0(er)-5.10.7 (Tw 0 -1.23 -1.2 (t335a)-26.5 (n)6

management of melasma, drawing on the latest evidence and expert opinions. By integrating these guidelines, dermatologists can optimize outcomes and improve patients' quality of life. A simplified algorithm summarizing the outcomes from the panel discussion is presented in Figure 3. Future research is needed to validate therapies and reduce recurrence.

AUTHOR CONTRIBUTIONS

All authors made substantial contributions to the conception or design of the work and participated in the critical review and editing of the manuscript for important intellectual content. Additionally, data curation and formal analysis were conducted by Dr. Rashmi Sarkar and Dr. Seemal R. Desai. All authors approved the final version of the manuscript to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or iigris oap1-2.2 (a)-24.6 (r)-30.4 (s o)7.7 (f t)830.9 (h)4.8 (e f)9.2 (8)7.7 (r)3.4.2 (a)-24.6(er)5.9 (s a)3 (p)3.4 (p)10.6 (r)35ep

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DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analysed in this study.

ETHICAL APPROVAL

No ethical approval was required because this Delphi-based study involved only expert opinions via questionnaire rounds. No patient data, human biological samples or clinical interventions were involved.

ETHICS STATEMENT

All participants were informed about the study's purpose and provided consent prior to initiating the Delphi process. All panellists received an email invitation and completed the questionnaire only after providing informed consent via a consent statement embedded at the beginning of the survey. In surveying professional experts, no personal or sensitive data were collected.

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