Cost-utility analysis of clinic-based deroofing versus local excision for hidradenitis suppurativa

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Background: Deroofing and local excision are common clinic-based surgical options for hidradenitis suppurativa. Evidence suggests deroofing may have lower rates of adverse events (AEs), defined as disease recurrence or postsurgical complications.

Objective: This cost-utility analysis evaluates the economic and health-related impacts of clinic-based deroofing vs excision for hidradenitis suppurativa, comparing direct medical costs and quality-adjusted life-years (QALYs).

Methods: A Markov model was developed based on a literature review of clinical outcomes, EQ-5D utilities, and resource utilization. Patients began in a preprocedural state and transitioned monthly among 3 health states: responders (no AEs), nonresponders (≥1 AE), and death. The model assessed cost-effectiveness over a 2-year horizon from the U.S. healthcare system perspective.

Results: Deroofing provided an additional 0.19 QALYs at a cost of USD$311.39 per patient relative to excision, yielding a favorable incremental cost-effectiveness ratio of USD$1677.10/QALY, below the USD$50,000/QALY threshold.

Limitations: Methodological constraints from limited published data were addressed through multiple sensitivity analyses. Cost-effectiveness was sensitive to AE rates, secondary costs, and utility values.

Conclusion: When clinically appropriate, deroofing is more cost-effective than excision for clinic-based procedural management of HS, offering improved quality of life at a modest incremental cost. (J Am Acad Dermatol 2025;92:773-80.)

Key words: cost-utility; economic evaluation; health utility; hidradenitis suppurativa; quality of life; surgery; value assessment.

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INTRODUCTION

Hidradenitis suppurativa (HS) affects ~4% of people worldwide.[1] It presents as deeply seated nodules, abscesses, fistulas, and extensive scarring in apocrine gland-bearing regions (*eg,* axillae, groin, perianal, and inframammary areas).[2] The chronic nature of the disease along with the physical limitations (*eg,* pain, disfigurement, malodor, drainage, and contractures) lead to social isolation and decreased health-related quality of life (HRQoL) and emotional wellbeing.[3,4]

HS treatment is primarily guided by the severity/extent of the disease, classified using the Hurley staging system.[5] No single effective treatment exist for any stage of HS, thereby the management involves a combination of lifestyle modifications, wound care, medical therapies, and surgical interventions.[1,6] Novel immunomodulatory treatments offer promising outcomes in HS, but they do not remove scarring.[7] Deroofing and excision are clinic-based surgical options targeting HS scarring, fistulas and sinus tracts.[8] Excision involves removal of all affected tissue (*ie,* down to dermis or subcutaneous tissues) with a margin of surrounding unaffected skin, followed by secondary intention healing or primary closure with sutures.[9,10] Deroofing, or unroofing, removes all (or most) of overlying skin and gelatinous material within the sinus tract and down to the mid-dermis, allowing the wound base to heal by secondary intention.[10,11] Deroofing has shown superior results in terms of higher cure rates and lower rates of adverse events compared to limited excision, although few comparative studies have been published.[12] Unfortunately, there are no specific reimbursement codes for deroofing, which limits its use in clinical setting.

With rising healthcare expenditure and limited resources, there is heightened focus on the economic implications of treatment decisions. Understanding the direct costs of treatments relative to the utility provided to patients are increasingly important in the shift to value-based care, aiming to enhance patient outcomes cost-effectively.[13] Utility is measured by quality-adjusted life-year (QALY), which helps to compare the cost-effectiveness of interventions, enabling decision-makers to prioritize treatments that provide the greatest benefit relative to their costs.

The primary objective of this cost-utility analysis was to compare the costs and QALYs associated with clinic-based deroofing and local excision to identify the more cost-effective clinic-based procedural intervention for managing HS.

CAPSULE SUMMARY

- This cost-utility analysis integrates existing clinical evidence on deroofing and local excision to demonstrate that deroofing is more cost-effective for clinic-based procedural management of hidradenitis suppurativa.
- The findings support the broader adoption of deroofing in clinical practice and the development of specific reimbursement codes for the procedure.

METHODS

This study is reported in accordance with the Consolidated Health Economic Evaluation Reporting Standards. A glossary of commonly used cost-utility analysis terms can be found in Table I.

Model type

The Markov model was selected due to its capacity to clearly represent multiple health states and was developed using Microsoft Excel 2024. The study focused on adult patients with mild to severe HS (Hurley stages I-III) who have not adequately responded to pharmacotherapy. The base case simulated a cohort of HS patients undergoing their first office-based surgical procedure on a single lesion in the unilateral axilla. The cohort was modeled with a mean starting age range of 31-37 years, aligning with the demographics of the cohort studies used to derive transition probabilities and intended to approximate the general adult population.[14-16]

The developed Markov model consists of 4 mutually exclusive health states: preprocedural, responder, nonresponder, and death (Fig 1). All patients start in the preprocedural state at cycle 0. Patients can transition to the death state at any time, where they remain without incurring further costs or health utilities. Following either clinic-based local excision or deroofing, surviving patients move into either the responder or non-responder state at cycle 1. Patients in the nonresponder state experience one or more adverse events during the cycle. An adverse event, defined as a recurrence or post-surgical complication, typically results in unintended healthcare costs and decreased HRQoL. Recurrence is defined as newly developed disease adjacent to or within the previously operated area. Postsurgical complications include delayed or heavy bleeding, infection, contracture, hypertrophic or keloid scarring, complicated wound healing, prolonged pain. Patients in the responder state do not experience any adverse events during the cycle. Each cycle was set to 1 month, reflecting the average time required for wound healing for both procedures.[12]

Abbreviations used:

CPT:	Current Procedural Terminology
EQ-5D:	EuroQoL-5 dimensions
HRQoL:	health-related quality of life
HS:	hidradenitis suppurativa
ICER:	incremental cost-effectiveness ratio
QALY:	quality-adjusted life year
THESEUS:	Treatment of Hidradenitis Suppurativa Evaluation Study
TLR:	targeted literature review
USD:	United States Dollar
WTP:	willingness-to-pay

Time horizon

A 2-year horizon was chosen for the base case, as the primary clinical and economic benefits directly associated with a single clinic-based deroofing or excision are expected to manifest within this time frame. This is based on the natural progression of scar maturation and clinical experience suggesting the low probability of complications arising beyond this timeframe.

Perspective

This study adopts the perspective of the U.S. healthcare sector, encompassing costs pertinent to insurers. By excluding indirect costs, the payer perspective reduces potential for error relative to analyses from a societal perspective.

Outcomes

Cost-effectiveness results are reported as additional costs per QALY gained, expressed by the primary outcome of the incremental cost-effectiveness ratio (ICER). This metric allows for comparison against a willingness-to-pay (WTP) threshold of USD$50,000, considered the lower limit of acceptability in the United States.[17] Deterministic sensitivity analyses were performed to assess the impact of model settings on the ICER.

Data collection

A targeted literature review (TLR) was conducted in Medline using controlled vocabulary and relevant keywords (Supplementary Table I, available via Mendeley at https://data.mendeley.com/datasets/mrxthswngt/1). The purpose of the TLR was to gather insights in 5 key areas in the context of HS: (i) clinical outcomes of deroofing and local excision, (ii) health utility studies, (iii) all-cause mortality rates, (iv) healthcare resource utilization and costs, and (v) existing economic evaluations. The searches were conducted by 2 researchers (SH, JC), from January 1, 2000 until May 15, 2024. Abstracts were screened and reviewed by SH and JC in accordance with the inclusion and exclusion criteria (Supplementary Table II, available via Mendeley at https://data.mendeley.com/datasets/mrxthswngt/1).

Transition probabilities

Transitions among model health states were based on literature identified through the TLR. A systematic review with a moderate overall risk of bias (AMSTAR 2) provided the adverse event rates in the base case.[18] This was the only study offering data on recurrence and complication rates with a mean follow-up period for both clinic-based deroofing and local excision. The improvement rate for both procedures, which denotes the rate at which nonresponders transition to responders, was informed by data from a retrospective cohort study detailing clinical outcomes following secondary repair surgery in HS patients.[15] Mortality rates were sourced from a population-based cohort study that reported all-cause mortality for HS patients who underwent surgical procedures.[16] The clinical studies used to inform parameters for the base case of the Markov model were evaluated using the ROBINS-I tool (Supplementary Table III, available via Mendeley at https://data.mendeley.com/datasets/mrxthswngt/1) and were determined to be of sufficient quality.

Health utilities

Utility values were sourced from the Treatment of Hidradenitis Suppurativa Evaluation Study prospective cohort study (the only source that provided EQ-5D-5L index values for deroofing and excision).[14] These aggregate values were used to estimate utility over time for the responder groups. The EQ-5D-5L is a validated generic HRQoL instrument for HS patients.[19]

Although the literature suggests significant improvements in HRQoL with modern HS therapies, data comparing outcomes between responders and nonresponders for HS procedural interventions are limited.[20] The available data quantifying the difference in utility improvements between treatment responders and nonresponders in HS patients pertain to Adalimumab pharmacotherapy, as reported in the PIONEER II trial.[21] Utility values from this trial were averaged to 0.750 for responders, 0.529 for nonresponders, and 0 for deceased patients.[22] In our Markov model, a multiplier of $0.529/0.750 \approx 0.71$ was applied to the responder utility values from the Treatment of Hidradenitis Suppurativa Evaluation Study (Supplementary Table IV, available via Mendeley at https://data.mendeley.com/datasets/mrxthswngt/1) to derive the nonresponder utility values for both procedures.[14] Although comparative studies are lacking, the

Table I. Brief glossary of commonly used terms in health economic analyses

Cost-utility analysis (CUA)	An economic evaluation in which the incremental cost of an intervention from a particular perspective is compared to the incremental health improvement expressed in the unit of quality-adjusted life-years.
Perspective	The viewpoint adopted to define the types of costs and outcomes to consider in the analysis.
Quality-adjusted life-year (QALY)	A metric combining the quantity and quality of life lived, representing the additional years of life that a treatment provides, adjusted for the quality of those years. One QALY equates to 1 year of life in perfect health.
Incremental cost-effectiveness ratio (ICER)	The cost per QALY gained by one intervention compared to another. The formula for our study is given as: $ICER = \frac{Cost_{Deroofing} - Cost_{Excision}}{QALY_{Deroofing} - QALY_{Excision}}$
Dominant choice	An intervention that is both more effective and less costly than the alternative, making it the preferred option.
Willingness-to-pay (WTP) threshold	The maximum amount a health system or entity is willing to pay for a gain of 1 QALY. Interventions with a cost at or below this threshold are generally considered cost-effective.
Transition probability	The probability of moving from one defined health state to another within a given cycle of a Markov model.
Health utility	A preference value from 0 to 1 that reflects a patient's preference for a specific health state, where a value of 0 equates to death and 1 represents perfect health.
Direct costs	Expenditures attributable to material/human resources required for disease management.

CUA, Cost-utility analysis; *ICER*, incremental cost-effectiveness ratio; *QALY*, quality-adjusted life-year; *WTP*, willingness-to-pay.

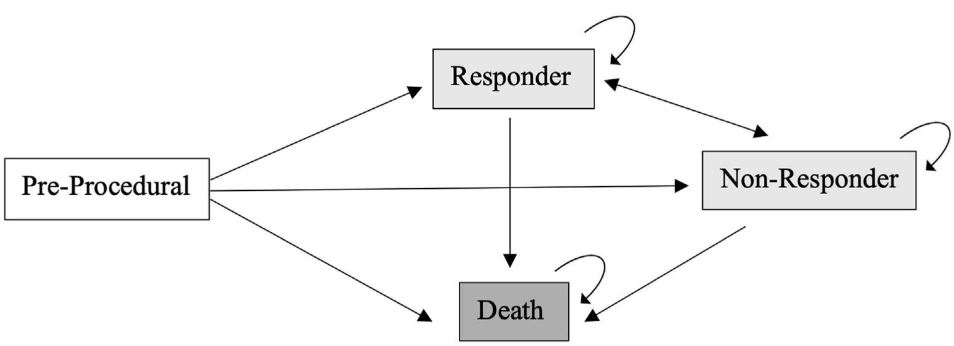

Fig 1. Markov model structure illustrating transitions among 4 health states for hidradenitis suppurativa patients undergoing clinic-based deroofing or local excision.

difference in utility values between responders and nonresponders for surgical interventions may surpass that observed with medical treatments. Surgical treatments may offer greater utility improvements for responders due to more definitive disease control but may also carry higher disutility from adverse events.

Cost and healthcare resource use data

The evaluation includes treatment acquisition costs and healthcare services including inpatient stays, outpatient visits, and emergency department visits. Primary treatment costs were sourced from Medicare procedural billing codes.[23] Healthcare utilization patterns and associated costs were derived from a retrospective analysis of U.S. health insurance claims data for HS patients with and without indicators of non-curative HS surgery.[24] Annual costs were used independently of the treatment but were assigned to either responders or non-responders. These costs were adjusted for inflation and expressed in 2023 USD (Supplementary Table V, available via Mendeley at https://data.mendeley.com/datasets/mrxthswngt/1). A standard 3% discount rate was applied to future costs and effects.[25]

RESULTS

Targeted literature review

The TLR identified 38 articles (Supplementary Fig 1, available via Mendeley at https://data.mendeley.

Table II. Per patient base case results from the Markov model comparing clinic-based deroofing and local excision for hidradenitis suppurativa over a 2-year period

Procedure	Total costs (USD$)	Total QALYs	Incremental costs (USD$)	Incremental QALYs	ICER (USD$/QALY)
Deroofing	$14,145.52	1.51	$311.39	0.19	$1677.10
Local excision	$13,834.13	1.32	—	—	—

ICER, Incremental cost-effectiveness ratio; *QALY*, quality-adjusted life-year; *USD$*, United States Dollar.

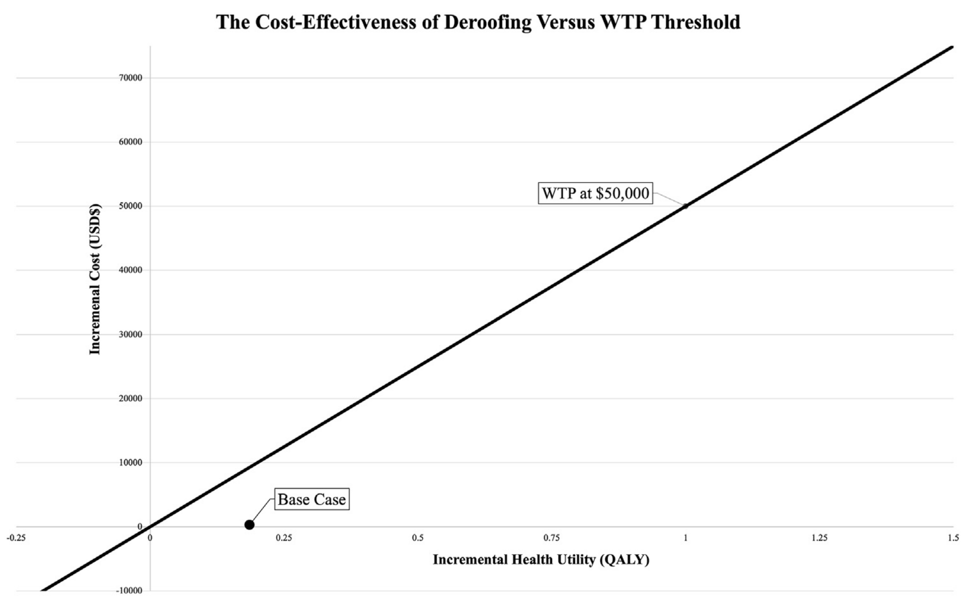

Fig 2. Cost-effectiveness threshold analysis of the base case Markov model, comparing deroofing for hidradenitis suppurativa to the standard WTP threshold. The x-axis represents the incremental health utility, measured in QALYs, that deroofing provides compared to local excision. The y-axis represents the incremental cost in USD$ associated with deroofing relative to local excision. The diagonal line represents the WTP threshold of USD$50,000 per QALY gained. Any point below this line indicates that deroofing is considered cost-effective, as the cost per QALY is below the threshold. The "Base Case" point represents the cost-effectiveness of deroofing in the base case scenario. In this scenario, deroofing is associated with an incremental cost of USD$311.39 and an incremental health utility of 0.19 QALYs compared to local excision. The position of the base case point below the WTP threshold line indicates that deroofing is cost-effective, as the incremental cost per QALY gained is well below USD$50,000. *QALY*, Quality-adjusted life-year; *USD$*, United States Dollar; *WTP*, willingness-to-pay.

com/datasets/mrxthswngt/1). In the base case, 3 studies from the TLR provided key input data for transition probabilities (Supplementary Tables VI and VII, available via Mendeley at https://data.mendeley.com/datasets/mrxthswngt/1).[15,16,18] Additionally, 2 studies informed the utility data and one study provided the cost data.[14,22,24] The TLR did not reveal any published health economic evaluations of surgical procedures for HS.

Base case analysis

Base case results demonstrated a total cost of USD$14,145.52 for deroofing and USD$13,834.13 for excision over a 2-year horizon. Deroofing provided an additional 0.19 QALY at an incremental cost of USD$311.39 per patient compared to excision (Table II). This resulted in a favorable ICER of USD$1677.10/QALY, well below the WTP threshold of USD$50,000/QALY (Fig 2).[26]

Deterministic sensitivity analyses

In the one-way sensitivity analyses, each cost, utility, and transition probability parameter was varied over a range determined by the maximum and minimum values reported in the literature (Supplementary Table VIII, available via Mendeley at https://data.mendeley.com/datasets/mrxthswngt/1), expert opinion (SG and DC), or a ±30% adjustment when reliable ranges were unavailable.[27,28] The deterministic sensitivity analyses (Fig 3) showed that ICER

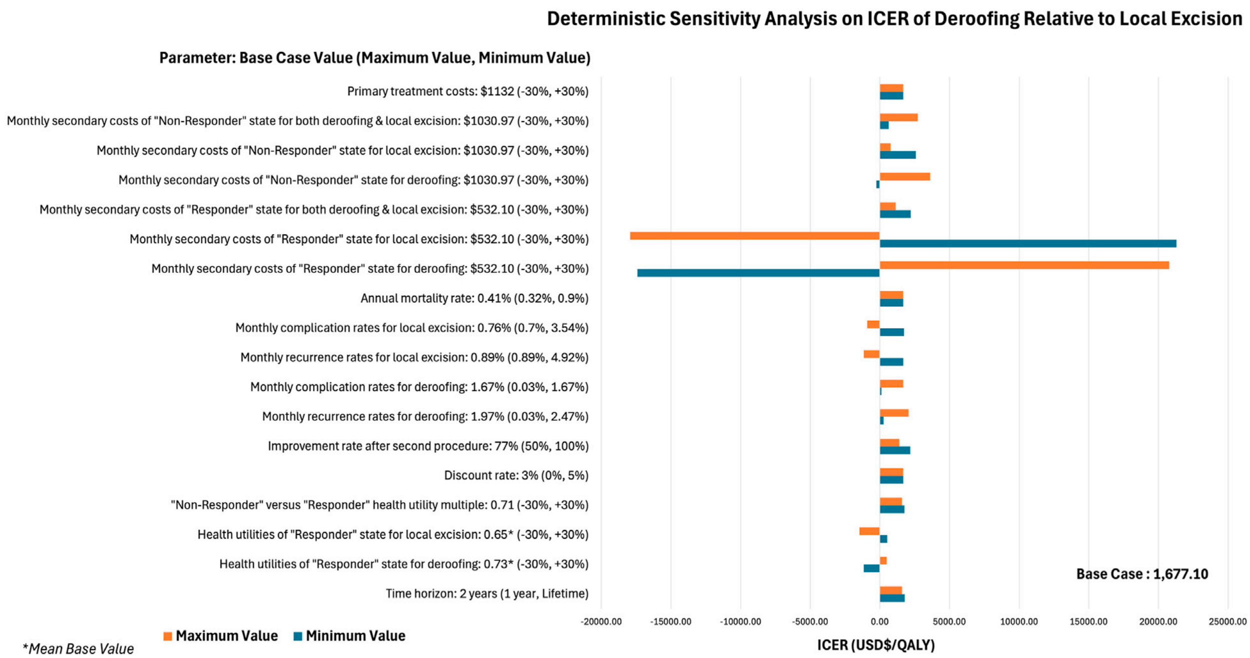

Fig 3. Tornado diagram depicting the results of the 1-way sensitivity analyses on the ICER for clinic-based deroofing vs local excision in the treatment of hidradenitis suppurativa. The analysis assesses the impact of varying key model parameters on the ICER, which is expressed in USD$ per QALY gained. The base case ICER is USD$1677.10/QALY. The y-axis lists the various parameters of the Markov model that were varied in the sensitivity analysis. Each parameter is associated with a base case value, which is varied to its minimum and maximum values (shown in parentheses). The x-axis represents the ICER values. Positive ICER values indicate the additional cost per QALY gained for deroofing compared to local excision. Negative ICER values indicate that one of the procedures is the dominant choice, meaning it has both lower costs and higher QALYs relative to the other. The horizontal bars indicate the variation in ICER when the corresponding parameter is adjusted to its minimum (*blue bars*) and maximum (*orange bars*) values. *ICER*, Incremental cost-effectiveness ratio; *QALY*, quality-adjusted life-year; *USD$*, United States Dollar.

values remained below the standard WTP threshold of USD$50,000/QALY (range: −USD$17,947.35/QALY to USD$21,301.55/QALY). The model was sensitive to variations in health utility values (range: −USD$1475.16/QALY to USD$534.64/QALY), adverse event rates (range: −USD$1165.94/QALY to USD$2065.40/QALY), and secondary costs (range: −USD$17,947.35/QALY to USD$21,301.55/QALY).

The most favorable ICER (−USD$17,947.35/QALY) was observed with a +30% adjustment to secondary costs for responders undergoing local excision. While a +30% adjustment to secondary costs for responders undergoing deroofing yielded a higher ICER (USD$20,764.91/QALY), it still remained below the willingness-to-pay threshold.

Deroofing remained cost-effective across most sensitivity analyses, except when parameters were adjusted to reflect the maximum responder utility values for excision (−USD$1475.16/QALY) or the minimum responder utility values for deroofing (−USD$1167.17/QALY). In these unlikely scenarios, excision was the dominant choice. The results of the sensitivity analyses are presented in terms of costs and health effects in Supplementary Figs 2 and 3, available via Mendeley at https://data.mendeley.com/datasets/mrxthswngt/1, respectively.

DISCUSSION

In this cost-effectiveness study of clinic-based deroofing vs local excision as procedural treatment for HS, deroofing yielded a favorable ICER of USD$1677.10/QALY in the base case. Economically justifiable price analyses revealed a positive relationship between the incremental cost of deroofing and its incremental health utility. This suggests that while deroofing may incur an additional cost of USD$311.39, the gain of 0.19 QALYs renders it economically justifiable.

Deroofing's cost-effectiveness is primarily driven by its incremental health utility, as deroofing showed significantly higher EQ-5D-5L index values over time compared to excision. Its cost-effectiveness was limited by (1) absence of specific billing code for deroofing; and (2) higher secondary costs from adverse events. In the absence of specific reimbursement code, the same code is typically used for both procedures (authors' opinion) and was considered in this study. The shared code may inflate the primary treatment cost of deroofing, as it fails to capture its lower time requirements, reduced material usage, and lesser surgical expertise demands compared to excision.[29] Therefore, the lack of a billing code likely understates the cost-effectiveness of deroofing, particularly if adverse event costs are lower than estimated.

We set deroofing to have approximately 2.2 times the monthly adverse event rates relative to excision for the base case. This is a highly conservative approach as other studies suggest that deroofing may have similar/lower complication rates to standard excision with complication rates as low as 1% and recurrence rates of 4%.[11,12,18,29,30] When these complication and recurrence rates were applied, the ICER (USD$117.20/QALY and USD$270.74/QALY, respectively) showed deroofing to be significantly more cost-effective than the base case. Further sensitivity analyses revealed that when the highest reported adverse event rates for excision were applied, deroofing emerged as the dominant choice, offering lower costs and higher QALYs. Therefore, the base case likely represents a conservative ICER estimate.

Sensitivity analyses reinforced deroofing as the cost-effective option across most parameter variations, except under 2 scenarios strongly favoring excision. The model's high face validity is attributed to a thorough literature review that informed decision criteria and inputs. This validity was enhanced by a description of data sources, underlying assumptions, and the modeling rationale. However, model cross-validation remains challenging due to the absence of comparable economic models in the literature.

The 2-year time period precludes definitive conclusions on the long-term cost-effectiveness of deroofing. Ideally, cost-effectiveness for chronic diseases should be evaluated over a lifetime horizon. However, the lack of mature data restricts the reliable extension of the model's time horizon. Our sensitivity analyses suggested that a lifetime horizon would yield a comparable ICER (USD$1583.88/QALY).

The study's findings are likely generalizable beyond the base case. While the cost inputs are U.S. specific, the clinical outcomes reflect diverse patient populations. Fundamental elements of clinic-based deroofing and excision, including techniques and outcomes, are expected to exhibit broad consistency across settings. However, regional differences in healthcare policies, cost structures, and health utility value sets should be considered when extrapolating these results. The ICER presented does not aim to reflect individual-level outcomes. Variations may arise due to provider-specific characteristics, as the efficacy of deroofing is operator-dependent. Patient-specific factors, such as higher risks of dyspigmentation and keloid scarring among patients of color, may also influence clinical outcomes and preferred surgical technique.[31] Therefore, while the study provides an estimate of cost-effectiveness, individual and regional results may exhibit variability.

Deroofing is likely to be the most cost-effective for patients with mild to moderate HS, particularly when tunnels or sinus tracts are present. The tissue-conserving nature of deroofing and its effectiveness for these lesion types makes it a favorable option for patients who may experience disutility from extensive excisions. Deroofing should be performed when patients are not experiencing an acute HS flare, as this can exacerbate inflammation and complicate wound healing.

Limitations

Utility values from the Treatment of Hidradenitis Suppurativa Evaluation Study were reported as aggregate scores, without differentiating between responders and nonresponders. To estimate nonresponder utility scores, we used clinical trial data on drug therapy in HS patients, under the assumption that the difference in utility values between health states for medical therapy is comparable to surgical procedures. Additionally, baseline disease severity was uncontrolled, which may have impacted comparability as local excision is typically reserved for larger, invasive HS lesions. Primary studies may have also overstated long-term recurrence rates if new lesions near surgical scars were misclassified as recurrences. Inherent Markov model limitations, including memory less assumption of disease states and fixed cycle lengths, may underrepresent the complexity of HS progression.

CONCLUSION

This study demonstrates that when clinically appropriate deroofing is more cost-effective than excision for clinic-based procedural management of HS, offering improved HRQoL at a modest incremental cost if both procedures are equally reimbursed. These findings support the broader adoption of deroofing in clinical practice and advocate for the development of specific reimbursement codes for this procedure. Future research should aim to provide more comprehensive data on health utilities, adverse event rates, and the costs of surgical interventions for HS to enhance the reliability of economic evaluations in this area.

Conflicts of interest

None disclosed.

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