A relative value unit–based cost comparison of treatment modalities for nonmelanoma skin cancer: Effect of the loss of the Mohs multiple surgery reduction exemption

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Background: The incidence of skin cancer has increased dramatically, with as many as 2.8 million skin cancers treated in 2005. In an era of decreasing reimbursement, insurer policy changes, and increasing pressure to deliver cost effective care, physicians should understand the total cost of different skin cancer treatment modalities in order to determine which yields the best value for patients.

Objective: To estimate the costs of treating nonmelanoma skin cancers by multiple modalities based on their assigned relative value unit (RVU) values.

Methods: The cost analysis was performed for the treatment of two skin cancer examples, a basal cell carcinoma (BCC) on the central cheek and a squamous cell carcinoma (SCC) on the forearm of varying sizes. The estimated costs of treatment of each of the skin cancers was calculated for treatment with electrodessication and curettage (EDC), imiquimod immunotherapy, Mohs micrographic surgery, traditional surgical excision with permanent section margin evaluation in an office setting (with immediate repair or with repair delayed until clear margins are confirmed), surgical excision with frozen section margin control in both an ambulatory surgery center and hospital-based setting, and radiation therapy. The effect of the loss of exemption from multiple surgery reduction on the cost of Mohs surgery is also examined.

Results: Our estimation of costs for each of the treatment modalities reveals that EDC is the least expensive option, with average costs of $471 (BCC cheek) and $392 (SCC arm). Imiquimod treatment and office-based excision with immediate repair of the surgical defect have similar total average costs of $959 (BCC cheek) and $931 (SCC arm) and $1006 (BCC cheek) and $907 (SCC arm), respectively. If repair of the defect is delayed until negative surgical margins are confirmed by permanent section, the cost of excision increases to $1170 and $1041. The average cost of Mohs micrographic surgery is $1263 (BCC cheek) and $1131 (SCC arm). Mohs surgery's recent loss of multiple surgery reduction exemption has decreased the cost of Mohs surgery by 9% to 25%. Excision with frozen section margin control in an ambulatory surgery center results in costs of $2334 (BCC cheek) and $2200 (SCC arm). However, if the excision is performed in a hospital operating room, the procedure is substantially more expensive, at $3085 and $2680. The cost of radiation therapy treatment is $2591 to $3460 for the BCC of the cheek and $2559 to $3431 for the SCC of the arm, depending on the fractional dose used.

Limitations: These are cost estimates based on literature examples and 2008 RVU values; variations related to individual practices and procedure valuations by private insurers are expected.

Conclusion: Tumor destruction by EDC or imiquimod and office-based procedures, such as traditional surgical excision or Mohs surgery, are the lowest cost options for treatment of nonmelanoma skin cancer. (J Am Acad Dermatol 2009;61:96-103.)

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Skin cancer is the most common malignancy in the United States, with significant associated morbidity and mortality.[1] Many studies have documented dramatic increases in skin cancer rates for both melanoma and nonmelanoma skin cancers (NMSCs).[2-6] According to statistics from the American Cancer Society, the annual incidence of skin cancer in the United States is now estimated at more than one million cases and thus approximately equals all other cases of human malignancies combined.[1] Recent data puts the number of skin cancers treated in 2005 at more than 2.8 million and increasing by almost 6% each year.[7]

The cost to treat skin cancer has also risen dramatically. Medicare claims data from 1992 to 1995 show that NMSC accounted for more than 4.5% of all Medicare cancer costs and more than 0.7% of the Medicare budget for physician services in 1995. Further, these costs are rapidly increasing (41% between 1992 and 1995).[8,9] Given that the number of skin cancers treated increased by 68% between 1993 and 2005, the overall costs to Medicare today are likely much higher.[7]

Cost effective treatment of skin cancers is critical. Previous studies comparing the costs of excisional surgery with Mohs micrographic surgery have come to differing conclusions. Cook and Zitelli[10] compared the actual reimbursements for Mohs surgery with calculated reimbursements for standard excision and concluded that Mohs surgery was similar in cost to excision with permanent section margin control ($1243 vs. $1167). However, excision with frozen section margin control was significantly more expensive ($1400 in an office setting, $1973 in ambulatory surgery facility) than Mohs surgery.[10] Bialy et al[11] examined the costs to treat primary NMSC of the face and ears and concluded that Mohs surgery was less costly ($937) than either traditional surgical excision with permanent sections ($944-$1029) or traditional surgical excision with frozen sections ($1399). Essers et al[12] and Otley[13] reported on the resource costs of surgical excision versus Mohs surgery for basal cell carcinoma of the face in a perspective randomized clinical trial and concluded that Mohs micrographic surgery used significantly (30%-33%) more resources than excision.

Some authors have advocated radiation therapy as first line treatment of NMSC because of the lack of surgical procedure, high cure rate, and good cosmesis.[14-16] However, two studies have calculated the costs of a course of radiation therapy at $3625 and $4558.[10,17] These figures are 267% to 316% more expensive than the cost of Mohs surgical treatment in these studies.

While physicians attempt to balance therapeutic efficacy and patient needs with the costs of different skin cancer treatment modalities, insurers have instituted policies to control cost and utilization. Most recently, the Centers for Medicare & Medicaid Services (CMS) decreased reimbursement for Mohs micrographic surgery on the trunk and extremities and revoked Mohs surgery's exemption from multiple surgery reduction. Given these recent changes in reimbursement, we wanted to examine the estimated costs of treating NMSC by different modalities.

METHODS

In order to estimate and compare the costs to the health care system of treating NMSC, two typical skin cancer cases (a basal cell carcinoma [BCC] of the central cheek and a squamous cell carcinoma [SCC] on the forearm) of varying sizes were selected for evaluation. The tumor sizes selected for analysis are 0.6, 1.1, 2.1, and 3.1 cm. Insurance-based reimbursement of medical procedures is dependent on the relative value units (RVU) values assigned to the individual medical, surgical, and/or laboratory codes that go into performing that procedure and any applicable facility charges. For this study, the total medical expenditure of each evaluated skin cancer treatment was estimated from the 2008 Resource-Based Relative Value Scale (RBRVS) RVU values for each surgical component (office- or facility-based).[18] Multiple surgery reduction was applied to all applicable codes with 100% reimbursement of the surgical code with the highest RVU value and 50% discount of any lower valued codes, excluding add-on codes. The RVU values of the procedure codes were then added together and multiplied by the conversion factor of $38 per RVU to estimate a total cost of the skin cancer treatment (adding additional facility/supply/laboratory charges, if applicable). The $38 per RVU conversion factor is the national average.[19] Reimbursable facility charges were derived from Ingenix Billing Expert publication.[20] The specific calculations of each procedure cost are available at www.theskincancercenter.net/images/Cost%20Calulations.pdf.

For Mohs micrographic surgery, it is assumed that 24% of cases are cleared with one Mohs stage, and that 76% require an additional stage for margin clearance.[10,11,21] The figure of 1.76 Mohs stages per case was determined by using the 2007 Relative Value Update Committee database, which indicates that 0.76 second/subsequent Mohs stage codes were billed to Medicare per first stage code.[22] The Mohs long-term recurrence rate is 1%.[23] All recurrences are treated by Mohs surgery, the cost of which is the estimate for the cost of treating a primary lesion at that site. All Mohs surgery is assumed to occur in the office setting (<3% of Mohs surgical procedures are

performed in an ambulatory surgery center [ASC] or hospital[22]). Mohs surgical costs are determined by adding the RVUs associated with the surgical code for each Mohs layer performed and the repair (reducing either the first Mohs layer or repair by 50%, whichever is of lower value). Of note, second Mohs stages are "add-on" codes and thus exempt from multiple surgery reduction. All charges for surgical supplies and pathology services are included (bundled) in the Mohs surgery procedure fees. Before 2008, Mohs surgery procedure codes were exempt from multiple surgery reduction (therefore, lower valued procedure codes and Mohs codes for second surgical sites would not be reduced by 50%). However, in 2008, the CMS removed the multiple surgery reduction exemption.[24] In calculation of Mohs costs without multiple surgery reduction, no reduction of first stage Mohs codes or repair code RVUs is performed. No preoperative labs are ordered for Mohs surgery.

For traditional surgical excision with permanent section margin evaluation, it is assumed that the skin cancers are excised with 4 mm margins for BCC and 6 mm for SCC in an office setting. The rate of positive margins after initial excision is 11%, and the long-term recurrence rate is 10%.[25-34] Initially positive margins are re-excised with another 4 to 6 millimeter margins, resulting in clear histology. All recurrences are treated with Mohs surgery, the cost of which is the estimate for the cost of treating a primary lesion at that site. For excisions, whether office or facility based, the procedure cost is estimated by adding the RVUs associated with the excision, repair, and pathology (for the excision and re-excision of any recurrences or initially positive margins), reducing the less expensive surgical codes on any given date of service by 50%. If a flap repair is performed, there is no reimbursement of the excision code(s).

For traditional surgical excision with frozen section margin evaluation, the rate of positive margins after initial excision is 21%.[35,36] Re-excision of initially positive margins results in clear histology. The long-term recurrence rate is 10%; recurrences are treated by re-excision with frozen section margin control (the cost of which is the estimated cost of treating a primary lesion at that site).[10,37] The pathologist splits each excised specimen into four pieces for frozen section evaluation. The pathologist then submits the excised tissue for permanent formalin section confirmation of the previous results. For surgery in a hospital operating room, preoperative labs are required (complete blood cell count, prothrombin time/partial thromboplastin time, basic metabolic panel, chest radiograph, and electrocardiogram); the cost of the lab work is $191.[18] The costs of medications and supplies for the hospital operating room are estimated at $200. For facility-based excisions, procedure costs are calculated in a similar manner to office-based excisions but, in addition, facility charges for each surgical code are added, applying multiple surgery reduction on the less expensive codes.

The repair of all excision defects is accomplished in a consistent manner for a given tumor size and location (unless otherwise stated). For BCC of the cheek, the defect from excision of the 0.6-cm tumor is repaired by 1/2 layered, 1/2 linear complex closures. The 1.1- and 2.1-cm lesions are repaired by 1/3 layered, 1/3 linear complex, and 1/3 flap closures. The 3.1-cm lesion is repaired by 1/2 flap, 1/2 graft closures. For SCC of the forearm, the excision defects from the 0.6- and 1.1-cm tumors are repaired by 1/2 layered, 1/2 linear complex closures. The 2.1-cm arm SCCs are repaired by 1/3 layered, 1/3 linear complex, and 1/3 flap closures; the 3.1-cm tumors are repaired by 1/2 flap, 1/2 graft closures. For Mohs surgery, it is assumed that 18% of surgical wounds are allowed to heal by second intention. In a study of national Mohs surgery practices, 18% of Mohs defects are healed by granulation.[38] The remaining 82% of defects are repaired in the proportions for size and location as indicated above.

There is no standard radiation therapy treatment regimen for NMSC with varying fractional dose and number cited in studies.[14-16,39] For this analysis, an average total dose of 61 Gray (Gy) with 3.5 or 5 Gy fractions is used (total number of fractional treatments is 12.2 or 17.4).[15] Pretreatment consultation, radiation planning, radiation treatments, and monitoring during treatment and associated hospital facility charges are included in the calculation. Radiation treatment failure rate is 7%.[15] The long-term recurrence rate is 10%.[15] Radiation treatment failures and recurrences are treated by Mohs micrographic surgery.

For electrodessication and curettage (EDC), three passes of EDC are performed with tissue destruction 3 to 4 mm beyond the clinical margin. Long-term recurrence rates are 20%, and all recurrences are treated with Mohs surgery, the cost of which is the estimate for the cost of treating a primary lesion at that site.[23,40,41]

For imiquimod treatment, Aldara cream (Graceway Pharmaceuticals, Bristol, TN) is applied once a day, five times a week for 6 weeks, requiring 30 satchels of Aldara ($648 at a local pharmacy).[42] The initial treatment failure rate (lack of complete clinical response) is 5%, and the long-term recurrence rate is 20%.[42,43] Treatment failures and recurrences are treated by

Table I. Estimated costs for treatment of BCC on the cheek by different modalities

Treatment modality	0.6 cm	1.1 cm	2.1 cm	3.1 cm	Average
Electrodessication and curettage*	$389	$426	$495	$573	$471
Imiquimod†	$929	$942	$950	$1013	$959
Mohs micrographic surgery‡	$1122	$1174	$1296	$1460	$1263
Excision/permanent/immediate repair§	$807	$860	$1088	$1270	$1006
Excision/permanent/delayed repair§	$900	$1019	$1232	$1528	$1170
Excision/frozen/ASC‖	$2125	$2195	$2349	$2667	$2334
Excision/frozen/hospital OR‖	$2543	$2856	$3048	$3893	$3085
Radiation therapy (5 Gy fractionation)¶	$2562	$2572	$2598	$2631	$2591
Radiation therapy (3.5 Gy fractionation)¶	$3431	$3441	$3467	$3501	$3460

ASC, Ambulatory surgery center; *BCC*, basal cell carcinoma; *permanent*, formalin permanent section margin control; *frozen*, frozen section margin control; *OR*, operating room.
*20% recurrence rate.
†5% initial incomplete clinical response, 20% recurrence rate.
‡1% recurrence rate.
§11% initially positive histologic margins, 10% recurrence rate.
‖21% initially positive histologic margins, 10% recurrence rate.
¶7% initial treatment failure rate, 10% recurrence rate.

Mohs surgery, the cost of which is the estimate for the cost of treating a primary lesion at that site.

RESULTS

Our cost analysis of NMSC treatments reveals that EDC is the least expensive treatment modality examined (Tables I and II). The average cost for EDC is $471 (BCC cheek) and $392 (SCC arm). Imiquimod and office-based excision with permanent sections and immediate repair have approximately equal average costs of $959 (BCC cheek) and $931 (SCC arm) versus $1006 (BCC cheek) and $907 (SCC arm), respectively. At smaller lesion sizes, excision is less expensive than imiquimod, with 0.6-cm lesion excisional costs of $807 (BCC cheek) and $639 (SCC arm) versus imiquimod's costs of $929 and $896. However, as lesion sizes increase, excision becomes comparatively more expensive. Of note, if repair of office-based excisional defects is delayed until negative margins are confirmed by permanent section, the cost increases by about 16% over immediate repair (average cost, $1170 and $1041), because the multiple surgery reduction does not apply to excision/repair codes on different dates of service. Mohs micrographic surgery is somewhat more expensive than office-based traditional surgical excision with average costs of $1263 (BCC cheek) and $1131 (SCC arm), which is about 25% more expensive than excision with immediate repair and only 8% more expensive than excision with delayed repair. As the lesion size increases, the cost of Mohs surgery becomes much closer to the excision costs.

When a facility-based approach to skin cancer removal is examined, traditional surgical excision with frozen section marginal control (ASC-based) results in average costs of $2334 (BCC cheek) and $2200 (SCC arm). These figures are 76% to 87% higher than Mohs surgery and 132% to 143% higher than office-based excision. If the surgical setting is shifted to a hospital operating room with intravenous sedation, the average costs increase to $3085 and $2680 (128%-132% more than Mohs and 195%-207% more than office-based excision).

The calculated costs of radiation therapy for BCC of the cheek are $2587 for 5 Gy fractional treatments and $3456 for 3.5 Gy treatments; the SCC of the arm costs $2560 for 5 Gy treatments and $3432 for 3.5 Gy treatments. These costs range from 95% to 192% higher than those for Mohs micrographic surgery.

The effects of the loss of the Mohs multiple surgery reduction exemption were examined using a BCC of the cheek as the case lesion (Table III). For one stage of Mohs surgery, the decrease in cost related to multiple surgery reduction is 18.5%. However, as the number of stages in a particular case increases, the percent effect of multiple surgery reduction diminishes. With a four-stage Mohs case, multiple surgery reduction is responsible for an 8.8% decrease in cost. For a given number of stages, as the complexity of the repair increases, so does the percentage decrease related to multiple surgery reduction (-10.2% for a layered closure, -18.6% for a flap repair). If two lesions are treated on the same day, the total reimbursement for the procedures is 24.5% lower than before loss of the multiple surgery reduction exemption.

DISCUSSION

This study evaluates the cost to treat two skin cancer examples of varied initial clinical size and

Table II. Estimated costs for treatment of SCC on the arm by different modalities

Treatment modality	0.6 cm	1.1 cm	2.1 cm	3.1 cm	Average
Electrodessication and curettage*	$323	$360	$414	$472	$392
Imiquimod†	$896	$903	$939	$985	$931
Mohs micrographic surgery‡	$992	$1018	$1163	$1349	$1131
Excision/permanent/immediate repair§	$639	$710	$951	$1326	$907
Excision/permanent/delayed repair§	$729	$794	$1093	$1551	$1041
Excision/frozen/ASC‖	$1921	$2028	$2243	$2609	$2200
Excision/frozen/hospital OR‖	$2166	$2237	$2902	$3413	$2680
Radiation therapy (5 Gy fractionation)¶	$2530	$2538	$2560	$2608	$2559
Radiation therapy (3.5 Gy fractionation)¶	$3402	$3410	$3432	$3480	$3431

ASC, Ambulatory surgery center; *permanent*, formalin permanent section margin control; *frozen*, frozen section margin control; *OR*, operating room; *SCC*, squamous cell carcinoma.
*20% recurrence rate.
†5% initial incomplete clinical response, 20% recurrence rate.
‡1% recurrence rate.
§11% initially positive histologic margins, 10% recurrence rate.
‖21% initially positive histologic margins, 10% recurrence rate.
¶7% initial treatment failure rate, 10% recurrence rate.

location with different therapeutic modalities and clinical settings. EDC is the least expensive treatment option at all tumor sizes examined, with costs about 64% lower than Mohs surgery and 55% lower than office-based excision. Imiquimod therapy has average total costs approximately equal to office-based excision but is more expensive than excision at smaller lesion sizes. Mohs surgery is about 25% more costly than office-based excision with smaller differences seen as the lesion size increases. Facility-based excision with frozen section margin control and radiation therapy are substantially more expensive than office-based procedures and treatments.

EDC, with its simplicity and low cost, has been advocated as first-line therapy for BCCs and SCCs.[40] The authors concede that in selected, superficial cases, EDC is the treatment of choice. However, there are important limitations and reservations to consider when employing EDC to destroy tumors. NMSC with mixed superficial and infiltrative histology has been well documented in 40% of tumors, and the histology of a superficial diagnostic shave biopsy may not be representative of the deeper tumor characteristics.[44] Because of this, it is very difficult to know which tumors are best suited for EDC treatment without first excising the area for complete histologic examination. Moreover, recurrences after EDC are frequently very large with significant subclinical extension and residual infiltrative tumor seeding the entire treatment scar.[45] EDC is inappropriate in areas and tumors at high risk of recurrence, particularly in aggressive and infiltrating tumor types and in immunocompromised patients.[40] Moreover, EDC has been associated with inferior cosmetic outcome compared to excisional treatments.[46]

Table III. Effect of loss of multiple surgery reduction exemption on the cost of Mohs surgery

	MSR applied	MSR exempt	Percent change
1 Mohs stage*	$863	$1060	−18.5
2 Mohs stages*	$1256	$1452	−13.5
3 Mohs stages*	$1648	$1844	−10.7
4 Mohs stages*	$2040	$2236	−8.8
2 Mohs stages (layered linear repair)†	$1177	$1311	−10.2
2 Mohs stages (complex, linear repair)†	$1304	$1564	−16.1
2 Mohs stages (flap repair)†	$1423	$1749	−18.6
0.6 cm, 1.76 stages‡	$1111	$1273	−12.7
1.1 cm, 1.76 stages‡	$1161	$1357	−14.5
2.1 cm, 1.76 stages‡	$1282	$1486	−13.7
3.1 cm, 1.76 stages‡	$1445	$1714	−15.7
2 BCC, 1 and 2 stages§	$2009	$2661	−24.5

MSR, Multiple surgery reduction.
*1.1 cm BCC on the cheek repaired as per Materials and Methods section.
†1.1 cm BCC on the cheek repaired as indicated.
‡BCC on the cheek of indicated size, repaired as per Materials and Methods section.
§2 BCCs on the cheek, one repaired by complex linear closure and one by flap closure.

Imiquimod has been touted as a relatively inexpensive, nonsurgical treatment for NMSC.[47] However, this treatment also has many limitations to its general use. Imiquimod is as expensive as office-based excision and has a higher recurrence rate. This medication has not been extensively studied for safety and efficacy in nonsuperficial BCCs or invasive SCCs. Imiquimod has not been studied in immunocompromised patients, in whom the

lowered immune status may inhibit its action. Lastly, imiquimod's slow time course of action would make this treatment suboptimal for rapidly growing tumors. In this study, calculations of imiquimod therapy cost for invasive SCCs and large BCCs have been included for completeness, but the authors do not advocate its use in these tumor examples.

Any single skin cancer case cannot be treated by multiple techniques for cost comparison; therefore, certain assumptions regarding recurrence rates and positive margins (based on literature examples) must be employed. Studies examining the rates of positive surgical margins and recurrence rates for traditional surgical excision of NMSC have yielded varied results. Six studies of traditional surgical excision with permanent section margin control revealed rates of initial surgical margin involvement by NMSC from 6.3% to 25.4%.[25-30] Evaluations of NMSC recurrence rates after traditional surgical excision with permanent section margins had rates of 2% to 14% at 5 years postsurgery.[29,31-34] The body of data regarding traditional surgical excision with frozen section margin control is smaller, with cited initial positive margins of 9% to 21%[35,37] and recurrence rates of 2.1% to 10%.[10,37] The rates of initially positive margins and recurrence of 11% and 10% (for traditional surgical excision with permanent sections) and of 21% and 10% (for traditional surgical excision with frozen sections), respectively, were chosen for comparison because these percentages were used in Zitelli's initial study of Mohs cost.[10] Of course, different rates of initially positive margins or recurrence will yield different total costs in our analysis, but given the literature precedents, we feel that our conservative estimates are reasonable. Most importantly, shifting the recurrence rates of any of the analyzed excisional modalities would only change the procedure cost by up to 10% and not change the overall conclusions of the study.

There is a misperception in the medical community that Mohs surgery is a very expensive procedure. Mohs surgery is the only procedure that includes all surgery, pathology, and supply expenses in the payment for the primary code(s). With Mohs surgery, a single payment is made to a single provider. When a patient is treated for skin cancer by facility-based excision, reimbursement is spread out to the operating room, surgeon, pathologist, and laboratory. The result is that the overall cost for excision appears much lower than for Mohs surgery and is more difficult for insurers to track.

With the loss of the multiple surgery reduction exemption, the cost of Mohs micrographic surgery has decreased by 9% to 25%. Although Mohs surgery is still slightly more expensive than office-based excision, the Mohs surgery approach has numerous important advantages over traditional surgical excision for skin cancer removal. Mohs surgery has a lower recurrence rate and no second excision for initially positive margins, resulting in fewer patient visits. After all, no patient wants a one in five chance of having to undergo another surgical procedure for the same skin cancer (immediately for positive surgical margins or later for delayed recurrence). Mohs surgery has a smaller surgical defect with a likely simpler repair.[48] Moreover, there is no geometric distortion or difficulty with locating surgical landmarks because of a previous repair.

Some authors advocate fractionated radiation as first-line therapy in the treatment of NMSC, particularly in those patients in whom health concerns preclude surgical treatment.[14-16] However, we feel there are very few health conditions that do not allow a patient to undergo office-based surgery with a local anesthetic. There are also other important reservations to the use of radiation therapy. Primarily, the procedure is very expensive, and the number of treatments is high, requiring ten to 20 visits. Surgical treatments like Mohs only necessitate two visits (one for the surgery itself and one for suture removal). Moreover, although initial cosmesis after radiation therapy is generally very good, significant delayed worsening of the appearance of the treatment area has been noted.[49-53] A significant number of treated skin cancers may also ulcerate with prolonged healing, sometimes requiring surgical intervention.[14,53]

As patients become more savvy consumers of health care, many are seeking the best value and quality for their health care dollar. EDC, imiquimod, and office-based excision are generally the least expensive options for skin cancer treatment, but their use has significant limitations and drawbacks. Although studies show excellent cure rates and cosmetic results with traditional surgical excision with frozen section margin control, the use of this surgical modality in surgical facilities and unbundled pathology codes make it quite expensive.[32] It appears that Mohs micrographic surgery is an outstanding example of a procedure that is not only cost effective but also enhances quality of care and adds great value for the patient with skin cancer. As health care costs explode and insurers attempt to contain costs and decrease health care use, it is important to realize that office-based procedures, such as EDC, traditional surgical excision with permanent section margin control, and Mohs surgery are the most affordable options and are very safe.[54] Attempts to restrict or limit the use of office-based surgery will only result in higher overall costs.

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