with a sharp cutoff at the wrist. In addition, there could be no personal or family history of typical chronic plaque psoriasis lesions elsewhere on the body, no history of atopic dermatitis, and no relevant positive findings on patch testing. Patients were considered to have palmoplantar psoriasis if they presented with well-demarcated, symmetric, indurated, and hyperkeratotic plaques on the palms with a sharp cutoff at the wrist. Patients were considered to have typical chronic plaque psoriasis if lesions were distributed on the extensor elbows, knees, scalp, nails, or trunk. All patients had chronic disease present for at least 6 months and all had not had topical therapy for at least 2 weeks and systemic therapy for at least 4 weeks.

Tissue samples were obtained by 4-mm punch biopsy specimens taken from lesional skin of patients with HHD (n = 4), palmoplantar psoriasis (n = 4), and chronic plaque psoriasis (n = 6) and nonlesional skin of patients with psoriasis (n = 6). Frozen tissue sections were prepared, and slides were incubated in 10% methanol for 10 minutes, in 3% hydrogen peroxide for 10 minutes, and then in blocking solution for 1 hour. Antibodies directed against human IL-23 (Biolegend, San Diego, California) were then applied at a concentration of 1:50 overnight at 4°C. Vectastain Elite ABC-Peroxidase kits and Vector VIP peroxidase substrate kits (Vector Laboratories, Burlingame, California) were used for visualizing cells. Positive cells were counted in 8 high-power fields, and the average number of labeled cells was calculated. A 1-way, between-subject analysis of variance was conducted to compare the expression level of IL-23 in the 4 groups. A paired t-test was used in post hoc analysis to individually compare each of the 4 groups against one another.

**Results.** There was a significant difference in the number of IL-23–positive cells in the 4 groups of patients (F1,36 = 6.68) (P < .05 for each group). Post hoc comparisons showed markedly increased IL-23–staining cells in HHD, palmoplantar psoriasis, and lesional psoriasis compared with nonlesional psoriasis (Figure and Table) (P < .05 for each disease type). There were no significant differences in the number of IL-23–positive cells between the 3 disease groups (data not shown). Positively stained cells were found in the tips of the dermal papilla, and they demonstrated dendritic morphologic characteristics (Figure).

**Comment.** Our data demonstrate that IL-23 is upregulated in both HHD and palmoplantar psoriasis, similar to what has been previously reported in chronic plaque psoriasis. 2 Palmoplantar psoriasis and HHD are diseases associated with considerable morbidity and are often difficult to treat. 1–3 Topical therapy is notoriously inadequate, and patients often move to other therapies such as acitretin or biological agents with varying success. 3 Ustekinumab is a new biological drug that targets the shared p40 subunit of IL-23 and IL-12 and has shown excellent clinical responses in patients with chronic plaque psoriasis. 4–5 We predict that by targeting IL-23, these agents may be effective in individuals with HHD or palmoplantar psoriasis.

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Accepted for Publication: February 6, 2010.

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**Financial Disclosure:** Dr Blauvelt is a consultant and investigator for Abbott and Centocor and has consulted for Lilly. He has also received honoraria from Abbott, Centocor, and Lilly.

**Funding/Support:** This research was supported in part by a Veterans Affairs Merit Award and National Institutes of Health grant 1 R21 AR054495-01A1 (Dr Blauvelt).

**Additional Contributions:** Frances J. Storrs, MD, helped to clinically defined HHD for this study and provided patients for the HHD cohort.


**A Cost-effectiveness Comparison of Liquor Carbonis Distillate Solution and Calcipotriol Cream in the Treatment of Moderate Chronic Plaque Psoriasis**

The cost of medications for the treatment of chronic conditions such as psoriasis can be overwhelming to patients and the health care system. Patients with mild to moderate psoriasis are generally offered topical medications, ranging in cost from $0.80/g to $7.45/g for the betamethasone dipropionate/calcipotriol ointment Taclonex (Leo Pharma A/S, Ballerup, Denmark) as first-line and often second-line therapy. 2
A new addition to the psoriasis armamentarium is an over-the-counter (OTC) product, PSORENT Psoriasis Topical Solution (NeoStrata Company Inc, Princeton, New Jersey) that contains 15% liquor carbonis distillate (LCD) solution (2.3% coal tar, US Pharmacopeia) and costs $0.26/g. Liquor carbonis distillate is a well-known, effective, and inexpensive ingredient for treating psoriasis, shown to be as beneficial as calcipotriol ointment\(^5\) and calcipotriol cream\(^6\) in previous clinical studies.

Herein, we report the findings of a cost-effectiveness comparison between the new LCD solution and calcipotriol cream during a randomized, active-controlled, investigator-blinded, clinical trial conducted at the Clinical Unit for Research Trials in Skin, Massachusetts General Hospital, Boston, between December 2006 and November 2008.\(^7\)

### Methods

**Study Design.** The study protocol was approved by Partners Human Research Committee, Boston, between December 2006 and November 2008.\(^7\)

**Blinded Investigators.** Blinded investigators evaluated patients using a modified Psoriasis Area and Severity Index (PASI) from 0 to 64.8 (with the head excluded) at weeks 0 (baseline), 2, 4, 8, 12 (end of treatment), and 18 (end of posttreatment follow-up). Medication containers were weighed during the study to monitor usage and adherence.

**Cost-effectiveness Model.** The PASI scores from week 12 (with last observation carried forward for missing scores) and week 18 (from study completers only) were used in the analyses. The cost-effectiveness of each treatment was based on the model described by Hankin et al\(^8\) for systemic treatments of moderate to severe psoriasis. Cost-effectiveness was calculated on a “per gram” and “containers needed for optimal treatment”\(^9\) basis at weeks 12 and 18. Calculation methods are summarized in **Table 1**; PASI changes in **Table 2**; and medication cost assumptions and results in **Table 3**.

### Results

**Patients.** Sixty patients with moderate plaque psoriasis were enrolled. Fifty-five completed treatment, and 43 returned for the 18-week follow-up visit (Table 2).

**Third-Party Payer Analysis.** The LCD treatment produced greater improvement in PASI score (58.2%) at less cost ($0.92 per 1% improvement in PASI, or “PASI-1”) than calcipotriol treatment (36.5% at $35.42 per PASI-1) after 12 weeks of treatment. After treatment and 6 weeks of follow-up (at week 18), the cost of PASI-1 was $1.01 in the LCD group and $58.11 in the calcipotriol group because the LCD group maintained PASI improvement (52.5%), while PASI in the calcipotriol group significantly worsened (to 22.2%). Furthermore, the expected costs for achieving PASI-50 and PASI-75 with each therapy choice were also less for LCD than for calcipotriol (Table 3).

**Patient-Payer Analysis.** For a patient choosing between LCD solution ($45 retail price) and calcipotriol cream (an estimated $25 copayment), the predicted cost of successful therapy was lower with LCD than with calcipotriol owing to better clinical response with LCD solution (Table 3). From an insured patient’s perspective, the copayment for prescribed calcipotriol cream would have to drop to less than $20 per tube to match the cost-effectiveness of the OTC LCD solution.

**Containers Needed for Optimal Treatment.** Patients would need twice as many tubes of calcipotriol cream as bottles of LCD solution for 12 weeks of successful treatment and might need 1 to 3 additional tubes of calcipotriol cream to sustain a PASI-75 response for 18 weeks (Table 3).

**Model Testing.** To test the model, cost-of-treatment calculations were repeated with data from successfully treated patients. The actual cost of PASI-75 in the calcipotriol group could not be calculated owing to lack of responders, but PASI-75 achievers in the LCD group used 258.3 g (2-3 bottles) of LCD solution at an average treat-

---

### Table 1. Cost-effectiveness Calculations Used for Both Study Groups

<table>
<thead>
<tr>
<th>Measure</th>
<th>Calculation Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost per gram of drug</td>
<td>Product price/amount in grams in container of product</td>
</tr>
<tr>
<td>Treatment cost per patient</td>
<td>Each patient’s usage in grams × cost per gram of drug</td>
</tr>
<tr>
<td>Mean treatment cost per patient-1 cost</td>
<td>$\left(\frac{\text{Treatment cost per patient, $}}{\text{No. of patients in group}}\right)$</td>
</tr>
<tr>
<td>PASI-50 cost</td>
<td>Mean treatment cost per patient/%ΔPASI</td>
</tr>
<tr>
<td>PASI-75 cost</td>
<td>PASI-1 cost × 50</td>
</tr>
<tr>
<td>Containers for =PASI-50, No.</td>
<td>PASI-50 cost/product price</td>
</tr>
<tr>
<td>Containers for =PASI-75, No.</td>
<td>PASI-75 cost/product price</td>
</tr>
</tbody>
</table>

### Table 2. PASI Comparisons Between Study Groups

<table>
<thead>
<tr>
<th>Measurement Interval</th>
<th>LCD</th>
<th>Calcinopril</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline(a)</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Psoriasis %BSA, mean (range)</td>
<td>7.75 (1.5-19.0)</td>
<td>7.79 (2.4-14.5)</td>
</tr>
<tr>
<td>Modified PASI score, mean</td>
<td>7.30</td>
<td>7.07</td>
</tr>
<tr>
<td>Week 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients, No.</td>
<td>27(^b)</td>
<td>28(^b)</td>
</tr>
<tr>
<td>Modified PASI score, mean (%ΔPASI)</td>
<td>3.04 (−58.2)</td>
<td>4.44 (−36.5)</td>
</tr>
<tr>
<td>Week 18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients, No.</td>
<td>23(^c)</td>
<td>20(^c)</td>
</tr>
<tr>
<td>Modified PASI score, mean (%ΔPASI)</td>
<td>3.15 (−52.2)</td>
<td>4.85 (−22.2)</td>
</tr>
</tbody>
</table>

### Abbreviations:

- LCD: liquor carbonis distillate; PASI: Psoriasis Area and Severity Index (modified to exclude the head); %ΔPASI: mean percentage improvement in baseline PASI score for the group; PASI-1, PASI-50, and PASI-75, improvements of 1%, 50%, and 75%, respectively, in the group’s baseline PASI score.
- %BSA: percentage of body surface area affected.
- OTC: over-the-counter.

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\(^{a}\)All costs and prices are measured in US dollars.

\(^{b}\)There were no statistical differences between the groups at baseline.

\(^{c}\)Patients who completed entire 18 weeks of study.
the number of subjects (n=60), including the planned was not powered to detect uncommon safety issues, but ment over a single 18-week episode of psoriasis. The study cited sample of patients with 3% to 15% BSA involve-
calculated based on usage and clinical outcomes in a lim-
patient.

demonstrating a superior and longer-lasting therapeutic
treatment option than calcipotriol cream in this study, 
The LCD solution was a more cost-effective 
Comment. The LCD solution was a more cost-effective 
treatment option than calcipotriol cream in this study, 
the LCD solution treated moderate plaque psoriasis at a lower cost with a smaller amount of medication 
needed to achieve significant and persistent improve-
ments in disease severity compared with calcipotriol cream. Over-the-counter 15% LCD solution can be a cost-
effective, clinically acceptable, and easily accessible treat-
ment option for patients with psoriasis, regardless of their 
health insurance coverage.

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Author Contributions: Drs Alora-Palli and Kimball had full access to all of the data in the study and take responsi-
ability for the integrity of the data and the accuracy of the data analysis. Study concept and design: Alora-Palli, 
Brouda, Green, and Kimball. Acquisition of data: Alora-
Palli and Kimball. Analysis and interpretation of data: Brouda and Kimball. Drafting of the manuscript: Alora-

Table 3. Predicted Cost-effectiveness of LCD Solution and Calcipotriol Cream Therapya

<table>
<thead>
<tr>
<th>Product Use/Patient</th>
<th>LCD Solution, 85-g Bottle</th>
<th>Calcipotriol Cream, 120-g Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containers used, mean, No.</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Usage, mean (range), g</td>
<td>201.2 (27.6-554.4)</td>
<td>337.1 (58.5-1029.6)</td>
</tr>
</tbody>
</table>

Cost of Therapy/Patient

<table>
<thead>
<tr>
<th>Product price/container</th>
<th>Third-Party Payerb</th>
<th>Insured-Patient Payer</th>
<th>Third-Party Payerb</th>
<th>Insured-Patient Payer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost/gram of drug</td>
<td>22.50 (AWP)</td>
<td>45.00 (Retail)</td>
<td>460.08 (AWP)</td>
<td>25.00 (Rx copayment)</td>
</tr>
<tr>
<td>Cost of received treatment/patient, mean</td>
<td>53.26</td>
<td>106.52</td>
<td>1292.41</td>
<td>70.23</td>
</tr>
</tbody>
</table>

Cost-effectiveness

<table>
<thead>
<tr>
<th>Cost-effectiveness</th>
<th>Week 12</th>
<th>Week 18</th>
<th>Week 12</th>
<th>Week 18</th>
<th>Week 12</th>
<th>Week 18</th>
<th>Week 12</th>
<th>Week 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASI-1 cost</td>
<td>0.92</td>
<td>1.01</td>
<td>1.83</td>
<td>2.03</td>
<td>35.42</td>
<td>58.11</td>
<td>1.92</td>
<td>3.16</td>
</tr>
<tr>
<td>PASI-50 cost</td>
<td>45.75</td>
<td>50.71</td>
<td>91.50</td>
<td>101.41</td>
<td>1771.15</td>
<td>2905.52</td>
<td>96.24</td>
<td>157.88</td>
</tr>
<tr>
<td>PASI-75 cost</td>
<td>68.63</td>
<td>76.06</td>
<td>137.25</td>
<td>152.12</td>
<td>2656.72</td>
<td>4358.28</td>
<td>144.36</td>
<td>236.82</td>
</tr>
<tr>
<td>Containers for PASI-75, No.</td>
<td>2-3</td>
<td>2-3</td>
<td>2-3</td>
<td>2-3</td>
<td>4-6</td>
<td>6-9</td>
<td>4-6</td>
<td>6-9</td>
</tr>
</tbody>
</table>

20% dropouts, was sufficient to detect statistical differences in efficacy between the groups. The cost-
effectiveness analysis did not take into account the cost of clinic visits or adverse reactions; however, since the adverse reactions were minor, it is unlikely that the cost of managing adverse reactions would substantially change the results.

The LCD solution treated moderate plaque psoriasis at a lower cost with a smaller amount of medication needed to achieve significant and persistent improvements in disease severity compared with calcipotriol cream. Over-the-counter 15% LCD solution can be a cost-effective, clinically acceptable, and easily accessible treatment option for patients with psoriasis, regardless of their health insurance coverage.

![Figure](Figure). Actual per-patient costs of successful study treatment. Averaged wholesale costs of therapy among patients with a 50% improvement in Psoriasis Area and Severity Index (modified to exclude the head); %ΔPASI, mean percent improvement in baseline PASI score for the group; PASI-1, PASI-50, and PASI-75, improvements of 1%, 50%, and 75%, respectively, in the group’s baseline PASI score; Rx, prescription.

Abbreviations: AWP, average wholesale price; LCD, liquor carbonis distillate; PASI, Psoriasis Area and Severity Index (modified to exclude the head); %ΔPASI, mean percent improvement in baseline PASI score for the group; PASI-1, PASI-50, and PASI-75, improvements of 1%, 50%, and 75%, respectively, in the group’s baseline PASI score; Rx, prescription.

a All prices and costs are measured in US dollars.

b Third-party payer costs are based on the manufacturer’s wholesale price for LCD solution (PSORENT Psoriasis Topical Solution; NeoStrata Company Inc, Princeton, New Jersey) and an average wholesale price from the 2008 Red Book for calcipotriol, 0.005%, cream (Dovonex Cream; Warner Chilcott Inc, Rockaway, New Jersey). Patient costs are based on the manufacturer’s suggested retail price of $45 for LCD solution and an estimated pharmacy copayment of $25 for calcipotriol cream.

Figure. Actual per-patient costs of successful study treatment. Averaged wholesale costs of therapy among patients with a 50% improvement in Psoriasis Area and Severity Index (PASI-50) (18 of 27 in the liquor carbonis distillate [LCD] group [67%]; 10 of 28 in the calcipotriol group [36%]) and with PASI-75 (11 of 27 in the LCD group [41%]; 0 of 28 in the calcipotriol group). *P<.05.
An Internet-Delivered Video Intervention for Skin Self-examination by Patients With Melanoma

Patients with melanoma are at high risk for disease recurrence and for the development of additional primary lesions. Little is known about interventions that affect patients’ skin cancer risk-reducing behavior; we found no published video or Internet interventions. Our interdisciplinary team developed a video, evaluated the feasibility of delivering it via the Internet, and tested its effect on skin self-examination (SSE) performance, knowledge, and self-efficacy in patients with melanoma.

Methods. The University of Arizona institutional review board approved the study. The 13-minute video addressed skin cancer seriousness and detection and demonstrated SSE techniques. Eight community volunteers previewed the video and were satisfied with the content, images, graphics, and sounds.

To test the video, we used a nonexperimental, 1-group, pretest-posttest design. We recruited adult patients from our cutaneous oncology program who self-reported good Internet and e-mail proficiency. Study patients saw a dermatologic, medical, and/or surgical oncologist during their visit. These specialists deferred skin cancer prevention and detection instruction to a health educator, who met with our participants after the study.

At the time of enrollment, we asked participants to log on to our Web site within the next 2 weeks to complete the pretest questionnaire and view the video. Immediately after enrollment, we sent participants an encrypted e-mail containing unique login information for Web site access to the pretest questionnaire.

We measured SSE knowledge by evaluating patient responses to 10 questions about melanoma warning signs (score of 1 for each correct answer). We measured SSE self-efficacy by calculating the mean scale score of a 6-item scale (1, very low, to 4, very high). Self-efficacy items addressed confidence in (1) performing SSE, (2) recognizing an unusual mole, (3) finding skin cancer early, (4) SSE extending life, and (5) SSE facilitating self-care (scale α = .70).

To measure SSE performance, we used the method detailed by Weinstock et al, querying how often during the previous 2 months participants had examined their skin on 7 specific body areas from head to toe. Examination of all 7 areas constituted a thorough SSE (score, 1). Any areas looked at 0 times constituted no SSE (score, 0).

After completing the pretest questionnaire, participants accessed the video link to a secure streaming server requiring a broadband connection. Participants clicked on another link to update a counter that tracked whether the video had been opened but did not track whether the entire video had been watched. Three months later, participants completed a posttest questionnaire using the same procedure.

Results. Sample characteristics are listed in the Table. We enrolled 120 participants. Of those, 34 never accessed the study Web site after being sent an e-mail reminder, and 86 opened the video and completed the pretest questionnaire. Forty-five participants did not complete the posttest questionnaire, citing as reasons problems with broadband and keeping track of the video. Thirty months later, participants completed a posttest questionnaire using the same procedure.