larization was noted on the melasma lesions at baseline compared with perilesional skin using VISIA-CR RXB Red subsurface analysis and laser confocal microscopy. However, no decrease in vascularization was observed on the laser-treated side between the baseline and posttreatment visits. At the final visit, no changes in vascularization were noted between the 2 sides. No scarring or postinflammatory hyperpigmentation was noted.

Discussion | Our results show that Kligman formula combination cream is more effective than the copper bromide laser for treating melasma. At the 6-month follow-up, no difference was observed between the 2 approaches and, in both cases, the MASI scores were similar to those observed before treatment. Neither procedure prevented relapse despite the use of sunscreen in all the patients. The lack of changes in vascularization observed via both RXB Red subsurface analysis and laser confocal microscopy between the topical cream- and laser-treated groups suggests that the copper bromide laser did not effectively target the vascular component of melasma. These results show that Kligman formula combination cream remains the most effective treatment for melasma and show the crucial need for prospective randomized studies with long-term follow-up, compared with Kligman formula combination cream, to confirm the effectiveness of any new approach in treating melasma.

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Topical Drug Innovation From 2000 Through 2014

Topical medications account for $2.6 billion in yearly over-the-counter spending,1 while the total dermatology prescription market exceeds $22 billion per year.2 However, the state of innovation surrounding topical medications, a class of therapeutics most used by dermatologists, remains poorly understood.

Methods | The US Food and Drug Administration’s database3 was mined for topical approvals designed for local action on skin, hair, nails, and mucosal surfaces from January 1, 2000, through December 31, 2014. Using solely publicly available data, this study is exempt from institutional review board approval at Presence Saint Joseph Hospital. Tentative approvals, supplements, and generic approvals were excluded. Transdermal, ocular, intrathalinal, and intranasal products were also excluded. Approvals were classified by the US Food and Drug Administration designation (standard, priority, and orphan) and class (analgesics, anti-infective agents, anti-inflammatory, immunomodulators and chemotherapeutics, retinoids, corticosteroids, and others). The time of approval was determined from

Table. Comparison of the Change in MASI Scores for Each Treatment Group

<table>
<thead>
<tr>
<th>Treatmenta</th>
<th>Baseline (n = 17)</th>
<th>Treatment Conclusion (n = 17)</th>
<th>Follow-up (n = 16)</th>
<th>Change Conclusion from Baseline (n = 17)</th>
<th>Change Follow-up from Baseline (n = 16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kligman formula combination cream</td>
<td>7.29 (4.11)</td>
<td>6.58 (3.30)</td>
<td>7.50 (4.39)</td>
<td>−0.71 (2.05)</td>
<td>−0.02 (1.06)</td>
</tr>
<tr>
<td>Kligman formula combination cream followed by laser treatment</td>
<td>7.66 (5.11)</td>
<td>7.81 (4.58)</td>
<td>7.69 (5.16)</td>
<td>0.15 (1.73)</td>
<td>−0.23 (0.76)</td>
</tr>
<tr>
<td>P value</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>.006</td>
<td>.33</td>
</tr>
</tbody>
</table>

Abbreviations: MASI, Melasma Area and Severity Index; NA, not applicable.

a Data are given as mean (SD) scores. Treatment conclusion indicates values recorded at the end of treatment; follow-up, 6 months after treatment completion.

b Details of treatment regimens are in the Methods section.

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the date of the investigational new drug application to the approval date. The primary submitting entity was also determined.

**Results** Topical approvals fell by 45%, from 44 approvals in both the 2000 through 2004 and 2005 through 2009 periods to 24 approvals from 2010 through 2014 (Figure). The year 2000 had the highest number of approvals (n = 19), including the highest number of priority designations (n = 4). In total, 5 new topical medications have been designated for priority review, with the last designation awarded in 2001 for topical mesalamine. By class, anti-infective agents were the most commonly approved, with a peak of 27 approvals from 2000 through 2004 to 10 approvals from 2010 through 2014. Topical corticosteroids were second, with 15 approvals from 2000 through 2014. The median approval time of 306 days remained consistent for the past 15 years. Topical analgesics were an outlier, requiring a median approval time of 723 days (range, 58-4112 days).

Of 112 total new approvals, 14 represented new molecular entities (NMEs), or active ingredients not marketed before in the United States (Table). Four topical NMEs were approved in both the 2000 through 2004 and 2005 through 2009 periods. From 2010 through 2014, six topical NMEs were approved. Most approvals were for dosage changes (64 approvals), new combinations (18 approvals), and new formulations (15 approvals).

The most common indications were for the treatment of acne, tinea infections, psoriasis, and atopic dermatitis. Galderma and Valeant Pharmaceuticals represented the 2 most active companies during the study period, representing 20% of all approvals. In all, there were 57 entities responsible for topical approvals, with 46 companies accounting for 2 or fewer approvals.

**Discussion** We chose to include all new topical approvals in addition to NMEs. Topical therapeutics are often developed after the active ingredient has been approved in oral or injectable forms. Changes in dosing, delivery mechanism (eg, ointment to gel), and combinations can represent important innovations for topical applications. Prior studies focusing solely on NMEs for the entire pharmaceutical industry show...
that approximately 20 to 30 NMEs were approved each year from 2000 through 2013. Topical NMEs are developed at a much lower rate (0.9 NMEs per year). These findings are consistent with prior studies illustrating the underrepresentation of all drugs developed for primarily dermatological uses.

Dermatological illnesses are not often fatal and may be considered lower priority by policymakers. Priority designations are assigned by the US Food and Drug Administration to new drugs that represent significant improvements over existing options and command more resource investment and regulatory attention. Only 5 total topical applications and 1 topical NME were given the priority review designation compared with 45% of all pharmaceutical and biological NMEs from 2000 through 2009. Beyond being considered lower priority, traditional metrics of blood and urine drug levels often do not apply to topical therapies. The lack of accepted surrogate endpoints may explain why the median approval time for topical medications is comparable with oral and intravenous therapies despite representing a lower systemic risk. Given these regulatory challenges, the low number of active companies with the necessary expertise to develop topical therapeutics likely contributes to the continued high cost and low availability of these drugs.

Prior studies on medical innovation of devices, small molecules, and biotechnology suggest a multifaceted approach to spur future development. Strategies most likely to succeed include continued research funding to study diseases that are likely to be responsive to topical therapeutics and increased collaboration between academic and industry professionals. In the short term, adoption of more surrogate endpoints reduces the regulatory burden and may encourage companies to invest more resources in this underserved area.

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Author Contributions: Drs Xu and Walter had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Xu.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: All authors.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Xu.

Administrative, technical, or material support: All authors.

Study supervision: Xu.

Conflict of Interest Disclosures: None reported.


Feasibility and Acceptability of Google Glass for Emergency Department Dermatology Consultations

Emergency department (ED)-based teledermatology has become more common in recent years because patients who present to the ED with skin concerns often require prompt diagnosis and treatment. Skin concerns make up 3.3% of ED visits; most of these patients wait months to see a dermatologist. Recent studies have demonstrated the feasibility of using mobile telephones for ED teledermatology.

Google Glass, a pair of eyeglasses with a computer, camera, and microphone built into the frame, is a wearable form of mobile video communication introduced in 2012. Despite significant media attention related to the use of Glass in health care settings, its value for patients and physicians has not been established. This study aimed to assess the feasibility and acceptability of Glass as a communication tool for ED dermatology consultations.

Methods | This was a prospective cohort study of patients who presented to our urban academic ED with a chief concern of rash from March 1, 2014, through July 4, 2014. Patients were eligible for participation if they were aged between 18 and 89 years, spoke English, were able to provide consent, and presented with a dermatosis that required a dermatology consultation. The protocol was approved by Lifespan–Rhode Island Hospital Institutional Review Board.

Study investigators obtained written informed consent. Participants had an initial standard dermatology consultation (a telephone call and, when necessary, a static photograph of the rash) with the dermatology consultation resident. Patients were then evaluated by a separate teledermatologist (the dermatology chief resident) through a real-time video link using Glass and running a third-party, Health Insurance Portability and Accountability Act–compliant video platform (Pristine IO; Pristine). The video link was sent to the teledermatologist through a Google Nexus 7 tablet (Google). After completing the 2 consultations, patients completed a brief survey on attitudes and beliefs regarding this teledermatology experience.

Results | A total of 348 patients presented to the ED with a chief concern of a rash during the study; 41 patients required a dermatology consultation (Figure). Thirty-nine patients were eligible for the study and 31 patients consented. Most participants (18 of 31 [58%]) had never seen a dermatologist. Most participants (28 of 31 [90.3%]) did not have a dermatologist with whom they could follow up.