Application for Subspecialty Certificate
(for a subspecialty new to the Boards Community)

Upon completion, please forward this application for a new or modified subspecialty certificate to Richard E. Hawkins, MD, ABMS President and Chief Executive Officer, in care of David B. Swanson, PhD, at dswanson@abms.org. If you need any assistance with the completion of this application, please contact Paul Lawlor, Manager, Program Review and services, at plawlor@abms.org.

Board: American Board of Dermatology
Contact Name: Elysia McGowan
Email: emcgowan@partners.org
Phone: 617-435-1503

1. Provide the name of the proposed new or modified subspecialty certification:

Micrographic Dermatologic Surgery (MDS)

2. State the purpose of the proposed new or modified subspecialty certification in one paragraph or less:

The purpose of certifying diplomates of ABD in MDS is to assure that patients with advanced skin cancer can identify and access physicians with this subspecialty expertise. The subspecialty and its training programs have been in existence for 50 years and have evolved from a unique surgical technique to a subspecialty with a broad body of knowledge and tools through a merger of specialized clinical, pathological and surgical dermatology skills to manage the epidemic of skin cancer. ABD seeks to recognize and confirm the competence of dermatologists certified by the ABD who have completed one year of fellowship training in the subspecialty accredited by the ACGME since 2004. To do this, ABD will administer a secure, psychometrically valid examination and create a program for maintenance of certification. In addition, a practice pathway for subspecialty ABD certification of those trained in comparable programs prior to ACGME accreditation, as well as for those who have gained this experience in practice, is also proposed.

3. Document the professional and scientific status of this special field by addressing (a) through (e) below.

a. In the space provided, please describe how the existence of a body of scientific medical knowledge underlying the proposed new or modified subspecialty area is in large part distinct from, or more detailed than, that of other areas in which certification is offered:

The discipline integrates knowledge and skills in clinical dermatology, surgical dermatology, dermatopathology, and basic science related to carcinogenesis and cancer treatment, building on competencies developed during dermatology residency training, but expanded in scope, complexity, and experience. This unique body of scientific medical knowledge for educational purposes is described in the ACGME program requirements, for which the title Micrographic Surgery and Dermatologic Oncology (MSDO) is used (ATTACHMENT 1). The Journal of the American Academy of Dermatology recently published a history of its practice, education and research including key milestones, prominent contributions by individuals and textbooks (ATTACHMENT 2) which documents the evolution of the subspecialty to be distinctly different than that of other specialties/subspecialties. The journal Dermatologic Surgery has been published monthly since 1974 with an impact factor of 2.351 which currently ranks 22/62 in dermatology and 72/198 in surgery. This journal published a report documenting the growth of peer reviewed research in this subspecialty from 1994 to 2013 (ATTACHMENT 3). http://journals.lww.com/dermatologicsurgery/pages/default.aspx

b. Explain how this proposed new or modified subspecialty addresses a distinct and definable patient population, a definable type of care need or unique care principles solely to meet the needs of that patient population:

The unique value of this subspecialty results from the merger of clinical, dermatologic surgical and dermatopathology skills performed by one specialist in an outpatient setting that is highly effective as well as cost effective. The patient population addressed by this subspecialty consists of patients with skin cancer who would uniquely benefit from surgical removal that spares normal tissue, utilizes specialized tissue processing and histologic techniques that afford the highest chance for cure, and incorporates surgical repairs that maximize functional restoration and minimize deformity (ATTACHMENT 4). Included in this population are patients who have: cancers located near functionally important structures such as the eye, nose, mouth and ears; cancers with a high risk for recurrence based on histologic type, location, size, or immunosuppression; cancers in areas where maximal preservation of normal tissue is most desirable; and cancers that may benefit from multidisciplinary care. Patients benefit not only from improved outcomes with optimal cure rates and tissue sparing, but also from the ability to have the entire process, from removal to repair, occur in one location, typically in one day, with associated cost savings to patients and the system.
Patients with complex conditions, such as organ transplantation, or patients requiring associated sentinel lymph node biopsy or reconstruction by colleagues in related specialties, benefit from the multidisciplinary, team-based management in which those who would be certified in MDS are specifically trained.

c. To provide COCERT with information about the group of physicians concentrating their practice in the proposed new or modified subspecialty area, please indicate the following:

i. The current number of such physicians (along with the source(s) of the data):

The largest professional group of practicing fellowship-trained surgeons are members of the American College of Mohs Surgery (ACMS - http://www.mohscollege.org/) which was established in 1967. ACMS reports a professional membership of approximately 1,400 surgeons whose practice is dedicated to the treatment of skin cancer.

Membership in this society requires completion of a one-year ACGME-accredited fellowship after an ACGME-accredited dermatology residency, as well as submission of a case log for review. Fellowship programs started in 1970 and were initially approved by a committee of the ACMS. In 2004 the fellowship accreditation process was transitioned to the ACGME. Currently there are 76 ACGME-accredited programs with 86 slots (ATTACHMENT 5). Since inception, the ACMS reports there have been 1,538 (surgical) fellowship-trained diplomates of ABD. The ACMS annual scientific meeting, which is dedicated to quality care, education and research for the treatment of skin cancer and related conditions, had a registration of 855 physicians in 2017. At that meeting ACMS formally requested the ABD seek certification in this subspecialty (ATTACHMENT 6).

It is difficult to know the exact number of physicians practicing in this field because only 20% of ABD certified dermatologists perform micrographic surgery while almost all treat skin cancer in some way (Source: CMS website: https://data.medicare.gov/data/physician-compare). In 2014 CMS reported that 2,205 dermatologists billed CPT code 17311 (stage one micrographic surgery for malignancy on the face) at least 10 times, a number which most closely estimates the number of active practitioners in this field. CMS also reported that 98% of all bills for micrographic surgery were submitted by dermatologists, indicating that the combination of skills required is relatively unique to dermatology.

Some dermatologists who practice in this field have not taken a fellowship. This includes those who trained before fellowships were widely available, were unable to spend an extra year in training or who did not match to a fellowship program. The American Society for Mohs Surgery (ASMS) was established in 1990 to provide post-residency CME education for those who did not take a fellowship. Full membership in ASMS requires completing their CME course and submitting 75 cases for review. ASMS reports on their website a professional membership of approximately 800. Finally, many non-dermatologists also treat skin cancer. However, using CMS claims data, dermatologists perform more skin cancer surgery, especially more micrographic surgery, than any other specialty (ATTACHMENT 7).

ii. The annual rate of increase of such physicians in the past decade (along with the source(s) of the data):

From 2007 to 2017 ACMS membership has increased from 696 to 1333; a total increase of 92%, with an annual average increase of 9%. (ATTACHMENT 8).

iii. The current geographic distribution of this group of physicians, its projected spread in the next five (5) years, and an explanation of how you arrived at this projection:

ACMS data (ATTACHMENT 9) demonstrates that the distribution of fellowship-trained dermatologists is uniform across the USA. As expected, most are located in larger metropolitan areas since it normally requires 4-5 full time clinical dermatologists to generate sufficient referrals for a dermatologist to practice micrographic surgery full time. Based on many studies (see ATTACHMENTS 10 and 11) skin cancer is epidemic, and on the rise, in the USA and many other countries; as such the demand for services provided by fellowship-trained surgeons will likely increase significantly in the foreseeable future.

d. For COCERT, please identify the existing national societies, the principal interest of which is in the proposed new or modified subspecialty area:
American Academy of Dermatology (AAD)
American College of Mohs Surgery (ACMS)
Association of Professors of Dermatology (APD)
American Society of Dermatologic Surgery (ASDS)
American Society of Mohs Surgery (ASMS)

i. Indicate the existing national societies’ size and scope, along with the source(s) of the data:

The AAD, founded in 1938, is the largest dermatology organization in the US and the most inclusive in its requirements for membership. Approximately 94% of ABD diplomates are members of AAD.

The ACMS, founded in 1967, has a professional membership of more than 1400 fellowship-trained physicians whose practice is dedicated primarily to the evaluation and surgical treatment of high risk skin cancer. Membership in this society requires completion of a one-year fellowship after dermatology residency. The ACMS established and provided oversight of fellowships in the US in 1970 until accreditation was transitioned to ACGME in 2004. The ACMS is a co-sponsor of the journal Dermatologic Surgery. (Source: https://www.mohscollege.org/)

The APD is an organization of academic dermatologists with a mission to promote education in dermatology. APD members include department chairs, residency and fellowship program directors, and other academic dermatologists with a special interest in education. The Dermatologic Surgery Section of APD consists of dermatologic surgery division heads, fellowship directors, and other academic dermatologic surgeons involved in resident and fellow training.

The ASDS, founded in 1970, currently has a membership of approximately 4600, not including trainees. The area of interest of ASDS has overlap with that of ACMS and ASMS but is much broader, notably including those who practice general dermatologic surgery, light and laser-based procedures, and medical and surgical cosmetic dermatology. Fellowship training is not required to be a member. The ASDS is a co-sponsor of the journal Dermatologic Surgery. (Source: https://www.asds.net/About.aspx)

The ASMS, established in 1990, currently has a membership of approximately 800 physicians. ASMS fellow and affiliate membership includes ABD and ABOD certified dermatologists, as well as members who are not dermatologists or physicians. ASMS founders envisioned the organization as a provider of professional and educational support for residency-trained dermatologists who practice Mohs surgery. (Source: http://www.mohssurgery.org/about-asms/)

ii. Indicate the distribution of academic degrees held by their members, along with the source(s) of the data:

AAD
Fellow (Initial Certification ABD): ~10,000
All Membership Categories including international and non-MD: 15,604
(Source: AAD website)

ACMS
MD/DO: ABD certified, ACGME fellowship-trained: over 1400
(Sources: ACMS website; Thomas Stasko, MD, Past-President)

APD
MD/DO: 170
(Source: APD Online Directory)

ASDS
Fellow (ABD- or RCPSC-certified dermatologist): ~4500 Associate (Board eligible): N/A
Trainee: ~1500 (Trainees are enrolled automatically in ASDS)
iii. Indicate the relationship of the national societies’ membership with the proposed new or modified subspecialty area:

The AAD, representing individuals with a wide variety of practices including administrative, pharmaceutical and international, most of which do not overlap with MDS, has not taken a position on certification in MDS.

The ACMS, whose members are fellowship trained, has formally requested that ABD establish certification in MDS to recognize individuals with advanced training and practice in this area. (ATTACHMENT 6)

The Dermatologic Surgery Section of APD, representing academic dermatologic surgeons, has formally requested that ABD establish certification in MDS. (ATTACHMENT 12).

The ASDS, representing individuals with a wide variety of practices, many of which do not overlap with MDS, has not taken a position on certification in MDS.

The ASMS, whose members are, with some exceptions, not fellowship trained, is opposed to certification in MDS.

e. For the entities described below, please provide the number of those who have a primary educational effort devoted to the proposed new or modified subspecialty area, along with their geographic locations and the source(s) of the data:

i. Medical schools:

See below.

ii. Hospital departments:

See below.

iii. Divisions:

See below.

iv. Other (please specify):

MDS is an outpatient subspecialty. Fellowship programs have an ACGME-accredited sponsoring institution with GME oversight and may be associated with a medical school and/or hospital department or division, but are not always hospital-based. Of the 76 accredited fellowship programs, 57 are associated with medical schools while the remaining programs are associated with hospitals in academic medical centers.

Exposure to MDS curricula typically begins in dermatology residency. All ACGME-accredited dermatology residency programs’ curricula must include exposure, either through direct observation or as an assistant, to Mohs micrographic surgery and complex closures, including flaps and grafts; training in the diagnosis and management of skin cancers; and training and experience in dermatopathology. All ACGME-accredited dermatology residency programs must have a surgical director who is fellowship-trained in MDS and offer residents exposure to MDS at a fundamental level.
ACGME-accredited fellowships build upon the fundamentals learned in residency, as illustrated in ACGME Milestones (ATTACHMENT 13). In 2016-2017, there were 76 ACGME-accredited fellowship programs widely distributed across the US (ATTACHMENT 5).

4. Please list the number and names of institutions providing residency and other acceptable educational programs in the proposed new or modified subspecialty area:

76 ACGME-accredited fellowship programs as of December 2017 (ATTACHMENT 14).

a. Indicate the total number of trainee positions available currently (along with the source(s) of the data):

86 fellowship positions
(Source: ACGME)

b. Provide the number of trainees completing the training annually (along with the source(s) of the data):

<table>
<thead>
<tr>
<th>Year</th>
<th>#Trainees</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>63</td>
</tr>
<tr>
<td>2014</td>
<td>67</td>
</tr>
<tr>
<td>2015</td>
<td>73</td>
</tr>
<tr>
<td>2016</td>
<td>78</td>
</tr>
<tr>
<td>2017</td>
<td>85</td>
</tr>
<tr>
<td>2018</td>
<td>86</td>
</tr>
</tbody>
</table>
(Source: San Francisco Match)

c. Describe how the numbers of training programs and trainees are adequate to:

i. Sustain the area of subspecialization:

The number of available positions and number of applicants has been rising each year for several years. (See above tables.) Over 25% of the 2017 dermatology residency graduating class applied for an ACGME-accredited fellowship, and 40% did not match. (Source: San Francisco Match).

<table>
<thead>
<tr>
<th>Year</th>
<th>Applicants registered in San Francisco Match</th>
<th>Applicants participating in match</th>
<th>Applicants matched</th>
<th>Taken outside the match</th>
<th>Total taken inside + outside the match</th>
<th>Applicants unmatched</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>99</td>
<td>77</td>
<td>49</td>
<td>14</td>
<td>63</td>
<td>28</td>
</tr>
<tr>
<td>2014</td>
<td>101</td>
<td>86</td>
<td>53</td>
<td>14</td>
<td>67</td>
<td>33</td>
</tr>
<tr>
<td>2015</td>
<td>108</td>
<td>95</td>
<td>60</td>
<td>13</td>
<td>73</td>
<td>35</td>
</tr>
<tr>
<td>2016</td>
<td>117</td>
<td>104</td>
<td>52</td>
<td>26</td>
<td>78</td>
<td>52</td>
</tr>
<tr>
<td>2017</td>
<td>137</td>
<td>108</td>
<td>58</td>
<td>27</td>
<td>85</td>
<td>50</td>
</tr>
</tbody>
</table>
(Source: San Francisco Match)

It is estimated that in 2012 there were 5.4 million basal cell and squamous cell carcinomas diagnosed in the US, and rates have been consistently increasing (ATTACHMENT 10 and https://www.cancer.org/cancer/basal-and-squamous-cell-skin-cancer/about/key-statistics.html). Melanoma rates doubled from 1982 to 2011 (MMWR Morb Mortal Wkly Rep 2015; 64:591). Improved overall survival of patients with organ transplantation has resulted in an increased number who develop skin cancers, primarily cutaneous squamous cell carcinomas (SCC). The risk for cutaneous SCC in solid organ transplant recipients is about 65-100 times greater than that of the general population. (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4484997/). Rarer types of skin cancer, often managed by an interdisciplinary team which includes an MDS dermatologist, were responsible for more than 3,500 deaths in a...
Thus, there has been an increasing supply of trainee positions, an increasing demand for trainee positions, an increasing number of skin cancers, and an increasing number of complex skin cancers with significant morbidity and mortality requiring this unique expertise.

ii. Allow for a sustained critical mass of trainees necessary for trainee testing validity and training program accreditation:

It is anticipated that there will be 80-100 new graduates per year, based on the current number of trainees and the trend for the number to increase yearly.

5. Please provide the number and type of additional educational programs that may be developed based on this proposed new or modified subspecialty area. Please indicate how you arrived at that number:

For academic year 2018-2019 there are 76 ACGME-accredited fellowship programs compared with 39 in the academic year 2009-2010, an increase of 92% over the 8-year period. The increasing demand for training and number of patients with skin cancers, including complex cancers, suggest that educational program numbers will continue to rise for many more years, although to what degree is yet not known. It is anticipated that both the number of programs and number of positions available per program will increase in the foreseeable future.

6. Please provide responses to (a) through (d) below regarding the duration and curriculum of existing programs:

a. The goals and objectives of the existing programs:

Train fellows in ACGME-accredited programs in the evaluation and management of cutaneous malignancies, with an emphasis on complex and high-risk cancers, micrographic surgical techniques, routine and complex histopathologic evaluation of surgical sections, and repair of the defects resulting from tumor removal. See ACGME Program Requirements for GME (ATTACHMENT 1), Milestones (ATTACHMENT 13), and Comprehensive Objectives for Micrographic Dermatologic Surgery (ATTACHMENT 15).

b. The expected competencies that will distinguish this subspecialist from other subspecialists in the areas of cognitive knowledge, clinical and interpersonal skills, professional attitudes and practical experience:

The competencies are detailed in the ACGME Program Requirements (ATTACHMENT 1). Development of proficiency during training is detailed in the Milestones (ATTACHMENT 13).

c. The scope of practice:

Details are in the ACGME Program Requirements for this program; Section Int. B (ATTACHMENT 1), in the Milestones (ATTACHMENT 13), and in the Comprehensive Objectives (ATTACHMENT 15). Briefly, the scope includes evaluation and management of complex and high-risk cutaneous cancers, micrographic surgical excision of cutaneous cancers, histologic evaluation of surgical sections, and repair of the defects resulting from removal of tumors. Coordination of multidisciplinary care for the optimal management of these patients is also a key competency.

d. The body of knowledge and clinical skills required and whether it is broad enough to require at least 12 months of training:
Please see ATTACHMENT 15, Comprehensive Objectives for Micrographic Surgery and Dermatologic Oncology. The ACGME has already determined that this body of knowledge should be learned over a 12-month span.

7. Please provide a projection and the methodology used for the projection of the annual cost of the required special training:

The cost for training a PGY5 fellow in one of the available 76 ACGME programs already in existence includes the salary, benefits and indirect support costs. Funding sources are typically from institutional clinical revenue with oversight by a GMEC rather than hospital based CMS slots. Indirect costs may be also funded by the established practices of these programs since, among other things, an ACGME-accredited program must demonstrate a practice of at least 1000 total surgical cases per fellow per year.

a. As the sponsoring Member Board, do you have, or access to, the resources to conduct a regular certification and MOC program in this specialty?

Yes, the ABD possesses the infrastructure, resources and experience to conduct regular certification exercises and institute an MOC program for MDS.

b. Do you plan to ask for ACGME accreditation for this new program?

ACGME already accredits these programs.

c. If these programs are not accredited by the ACGME, please document the accrediting body for this program and whether you have the resources to review these programs in a fashion comparable to ACGME.

N/A

8. Please outline the qualifications required of applicants for certification in the proposed new or modified subspecialty area, as it pertains to the following:

a. Possession of an appropriate medical degree or its equivalent:

MD or DO degree is required.

b. General certification by an approved primary specialty Board:

ACGME accredited dermatology training and eligibility for a general dermatology certificate awarded by the ABD will be a prerequisite for certification in MDS.

i. Will diplomates from other ABMS Member Boards be allowed to apply for this subspecialty certificate?
Yes  
No

If "yes," but only specific ABMS Member Board diplomates would be allowed to apply for this subspecialty certificate, please list those Member Boards:

N/A

If "yes," would you require diplomates to maintain their primary certificate?

☐ Yes  Note: ABD diplomates will be required to maintain their primary certificate.  
☐ No

c. Completion of specified education and training or experience in the subspecialty field:

A practice pathway to certification will exist for 5 years. During this period, any dermatologist certified by the ABD, in good standing and up to date in MOC (if applicable) will be allowed to sit for the examination provided that s/he attests that MDS comprises some portion of practice. After the 5-year window, only ABD-certified dermatologists who have successfully completed ACGME-accredited fellowship program will qualify to take the examination to become certified.

d. Additional qualifications:

N/A

9. Please describe how candidates for certification in the proposed new or modified subspecialty area will be evaluated. In your response, include a description of the method(s) of evaluation (e.g., written, oral, simulation) and the rationale behind the method(s) used in the evaluation process:

A written, psychometrically-valid examination will be administered to candidates for certification. The ABD employs Arbet Consulting to aid in item acquisition and editing, form construction, examination administration and analysis. As is the case for all other ABD examinations, standard setting will be used to inform item analysis and subsequent pass / fail determinations.

10. For (a) through (d) below, please project the need for and the effect of the proposed new or modified subspecialty certification on the existing patterns of subspecialty practice. Please indicate how you arrived at your response.

a. How the Member Board will evaluate the impact of the proposed new or modified subspecialty certificate:

i. On its own primary and subspecialty training and practice:

We do not anticipate any impact of this certificate on existing training patterns. ACGME-accredited fellowship training has already been in place since 2004 and does not appear to have adversely affected the educational experience of general dermatology trainees. Certification in MDS is not anticipated to affect other subspecialty areas within dermatology as the fields of study are sufficiently distinct.
There is concern among some non-fellowship-trained dermatologists who perform micrographic surgery that reimbursement could be restricted to those trained in (and perhaps eventually certified via) formal fellowship programs. We are not aware that such restriction of reimbursement has been experienced to date. Moreover, historically, fellowship training and certification in dermatopathology since 1974 and pediatric dermatology since 2004 have not had a major impact on the ability of the general dermatologist to be reimbursed for dermatopathology or pediatric dermatology services.

ii. On the primary training and practice of other Member Boards:

MDS does not form a part of training in other ACGME-approved programs and therefore, is not anticipated to adversely affect either the educational experience or practice patterns of physicians certified by other member boards. Based on claims data from CMS, 98% of the procedures specific to this field are performed by dermatologists (Source: CMS website: https://data.medicare.gov/data/physician-compare). To the contrary, much of the skin cancer practice in MDS requires the cooperation of and consultation with other specialists such as otolaryngology, ophthalmology, plastic surgery, general surgery, clinical dermatology, dermatopathology, medical and radiation oncology. Trainees in these specialties interact on a regular basis with fellows, which results in increased knowledge and experience.

b. The value of the proposed new or modified subspecialty certification on practice, both existing and long-term (in health care, value is typically defined as quality divided by cost), specifically:

i. Access to care (please include your rationale):

Access to care has improved with the establishment of this subspecialty and awareness by the public should be improved by certification in MDS. The incidence of skin cancer is growing at a significant rate and uncomplicated skin cancers will continue to be treated by general dermatologists as before. Certification in MDS should strengthen the subspecialty, helping to expand the number of fellowship trained physicians, and improving access to care for those patients requiring treatment of advanced skin cancer by the various techniques covered in current training programs. It is anticipated that cost will remain the same or decrease as more MDS-certified physicians enter practice and quality will improve, leading to added value. For high-risk cancers, micrographic surgery has been reported to be more cost-effective than standard surgical excision, in part due to fewer costly operations for recurrent cancers. (Ravitskiy L, Brodland DG, Zitelli JA: Cost Analysis: Mohs micrographic surgery. Dermatol Surg 2012; 38:585-94)

ii. Quality and coordination of care (please include your rationale):

Improved recognition of and access to dermatologists certified in MDS will aid in referral of patients who require more specialized care for advanced skin cancers. Cost aside, quality will improve based upon shorter wait times to access care thus, improving value.

iii. Benefits to the public (please include your rationale):

The public value of this subspecialty results from the merger of clinical, dermatologic surgical and dermatopathology skills performed by one specialist in an outpatient setting that is highly effective and cost effective. The higher cure rate for micrographic surgery also contributes to lower morbidity and cost savings.

c. Please explain the effects of the proposed new or modified subspecialty certification on:

i. Immediate costs and their relationship to the probable benefits (please indicate your methodology):
Cost is anticipated to remain the same or decrease based upon the expanding number of physicians with ACGME training. Any market changes referable to advanced training already exist and certification is not anticipated to affect the value proposition.

ii. Long-term costs and their relationship to the probable benefits (please indicate your methodology):

We do not foresee a trend toward increasing long-term costs or the value equation with the exception that all reliable epidemiologic studies suggest the incidence of skin cancer will increase in the foreseeable future (ATTACHMENT 10 and 11).

d. Please explain the effects if this subspecialty certification is not approved:

MDS is one of the few subspecialties with ACGME-accredited training programs that lacks a corresponding certification by an ABMS member board. To the extent that we believe that ABMS certification, followed by entry in MOC provides for the highest standards and best care for patients, not approving certification in MDS will hinder optimal patient care over time due to the inability of a dermatologist trained in an ACGME-accredited fellowship to demonstrate competence by certification and will diminish the impact of physicians practicing in this area.

11. Please indicate how the proposed new or modified subspecialty will be reassessed periodically (e.g., every five years) to assure that the area of clinical practice remains a viable area of certification:

Aided by the ACGME practice of reassessing program requirements in its accredited fields, the ABD will perform its own needs assessment in parallel, assuring analysis of the continued need for and impact of MDS within the field of dermatology.

12. Please list key external public stakeholders that COCERT may solicit for possible public comment on the proposed new or modified subspecialty area:

American Academy of Dermatology
American College of Mohs Surgeons
American Dermatologic Association
American Society for Dermatologic Surgery
American Society for Mohs Surgery
Association of Professors of Dermatology

NOTE: When submitting this application, please attach the following items:

☐ Copy of proposed application form for the candidates for certification
☐ A written statement indicating concurrence or specific grounds for objection from each Primary and Conjoint Board having expressed related interests in certifying in the same field
☐ Written comments on the proposed new or modified subspecialty area from at least two (2) external public stakeholders
A copy of the proposed certificate for ABMS records
REQUESTED ATTACHMENT A:
Copy of proposed application form for the candidates for certification

Below is a rendering of a proposed application form to be made available to applicants on ABDerm.org.

APPLICATION
20XX Micrographic Dermatologic Surgery (MDS)
Subspecialty Certification Examination

Name: ______________________________________

ABD ID: ____________________________________

Email: _____________________________________

Click here to update your ABD profile data.

Click here to add medical license data.

STATEMENT BY APPLICANT TO QUALIFY FOR THE EXAMINATION

Please attest to your qualifications for the examination:

☐ I completed an ACGME-approved fellowship in Micrographic Surgery and Dermatologic Oncology.
   Name of Institution: ________________   Date of Completion: ___________________

☐ I will soon complete an ACGME-approved fellowship in Micrographic Surgery and Dermatologic Oncology.
   Name of Institution: ________________   Expected Date of Completion: ___________________

☐ I currently perform Micrographic Surgery in my practice.

STATEMENT BY APPLICANT TO ABIDE BY ABD HONOR CODE

I, the undersigned, understand that this examination and all test questions have been copyrighted by the American Board of Dermatology, Inc. (ABD) and are the exclusive property of the ABD. I will not, without the written consent of the ABD, retain, copy, reproduce, disclose, discuss, share, reveal, or distribute any questions or any other part of this examination, including memorized, reconstructed, and partially or fully recalled items. Likewise, I will not circulate any proposed or otherwise suggested answers to these questions for exam preparation or any other purpose without the written consent of ABD. I will also not disrupt, or threaten to disrupt, any ABD examination in any way.
I attest that all statements that I make to the ABD concerning my training, licensure, eligibility to take the examination, and other relevant facts have been truthful and non-misleading. I further attest that I will notify ABD in writing (a) if I become the subject of any disciplinary action by a State Board of Medicine, (b) if I am charged with criminal conduct, (c) if I am barred or suspended from participation in any federal health care program, or (d) if any other development occurs which might reasonably call into question my entitlement to Board certification.

I agree to disqualification from examination, to denial of issuance of a document of Certification to me, and to forfeiture and redelivery of any document of Certification granted me by the ABD in the event (a) that any of the statements made by me are false, misleading, or materially incomplete, (b) that I fail to cooperate with the ABD in any investigation, or (c) that I violate any of the rules and policies of the ABD.

I understand that if, after investigation, ABD has good reason to believe that I have engaged in cheating or irregular behavior in connection with the examination, whether or not such behavior had an effect on my performance, ABD may invalidate my examination, revoke my certification, and bar me from retaking the examination in the future. I also understand that ABD may require me to retake one or more portions of the examination if the ABD is presented with evidence that the security of the examination has been compromised, notwithstanding the absence of any evidence of my personal involvement in such activities.

I will report to ABD or to the proctor at the examination any incident that I suspect may involve cheating or an attempt to cheat on the examination.

For exams for which study guides are provided: I understand that study guides, including test questions and digital images, provided by ABD for exam preparation are copyrighted by the ABD and are the exclusive property of the ABD. The ABD grants exam candidates permission to download the study guides for their personal use for study and exam preparation only. Questions in the study guides may be discussed with other exam candidates. I understand that any other use, reproduction, or distribution of the study guides is prohibited without the written consent of the ABD. I will maintain downloaded study guides in a secure manner to prevent unauthorized access or distribution. I understand that giving unauthorized access to, or distribution of, study guides to others as a result of my negligence or my deliberate action may constitute copyright infringement.

I hereby hold the ABD, its members, examiners, officers, and agents free from any complaint, claim, or damage arising out of any action or omission by any of them in connection with my application, any examination given by the Board, any grade relating thereto, the failure to issue me any Certificate, or any demand for forfeiture or redelivery of such Certificate. I understand that the decision as to whether I am eligible to sit for an examination or qualify for a certificate is within the sole discretion of the ABD. I further agree that any suit that I may bring against the ABD or its members, examiners, officers, or agents will be brought in a court located in Cook County, Illinois, and I hereby agree to service of process upon me out of a court in Cook County.

For exams taken during training or for initial certification: I understand that my training director may receive selected results of the examination and/or other information relating to the examination. I hereby authorize the release of my results and other information.

I understand that on the day of the examination, I may be required to reaffirm that I agree to the above statements and conditions, and that if I do not, I will not be allowed to proceed to the examination.

I HAVE READ THIS HONOR CODE, ACKNOWLEDGE THAT I HAVE HAD THE OPPORTUNITY TO ASK QUESTIONS ABOUT IT, AND AGREE TO BE LEGALLY BOUND BY IT.

By clicking SUBMIT, I hereby certify that the information stated above is accurate, and that I have read and agree to the honor code.
REQUESTED ATTACHMENT B:

A written statement indicating concurrence or specific grounds for objection from each Primary and Conjoint Board having expressed related interests in certifying in the same field.

Currently there are not any other Boards with related interests in certifying in Micrographic Dermatologic Surgery.
REQUESTED ATTACHMENT C:

Written comments on the proposed new or modified subspecialty area from at least two (2) external public stakeholders.

C: Item # 1: Letter of request from the American College of Mohs Surgery

American College of Mohs Surgery
Fellowship trained skin cancer
and reconstructive surgeons

April 28, 2017

Stanley J. Miller, MD
President, American Board of Dermatology
2 Wells Avenue
Newton, Massachusetts 02459

Dear Dr. Miller,

As the President of the American College of Mohs Surgery and the Chair of the Executive Committee of the Board of Directors I represent over 1,400 fellowship-trained Mohs surgeons. Mohs Surgery and Dermatologic Oncology has evolved over the past decades into a mature subspecialty of Dermatology with widespread ACGME accredited fellowships and a well-established, defined curriculum representative of a progressively expanding body of knowledge.

On behalf of the American College of Mohs Surgery, I respectfully request that the American Board of Dermatology explore the development and establishment of certification in Mohs Surgery and Dermatologic Oncology to recognize individuals with advanced training and practice in this area. This action would be consistent with the certification offered by the American Board of Dermatology for Dermatopathology and Pediatric Dermatology.

I would be pleased to discuss the matter in greater detail, if desired.

Sincerely,

Thomas Stasko, MD

Cc: Thomas D. Horn, MD, MBA
ASSOCIATION OF PROFESSORS OF DERMATOLOGY
3301 C St, #1400
Sacramento, CA 95816
Phone: (916) 997-6346
Fax: (916) 734-6795
Email: dbeisen@ucdavis.edu

January 17, 2018

Daniel B. Eisen, MD,
Professor of Clinical Dermatology
Department of Dermatology
University of California Davis Medical Center
3301 C St, #1400
Sacramento, CA 95816
Phone: (916) 997-6346
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Email: dbeisen@ucdavis.edu

Janet A. Fairley, MD
President, American Board of Dermatology
2 Wells Avenue
Newton, Massachusetts 02459

Dear Dr. Fairley,

The Dermatologic Surgery Section of the Association of Professors of Dermatology represents the academic dermatologists involved in the education of dermatology residents and fellows in all aspects of surgical dermatology and the treatment of cutaneous malignancies. As such we have observed and participated in the evolution of Mohs Surgery and Dermatologic Oncology into a mature sub discipline of Dermatology with widespread ACGME accredited fellowships and a well-established, strongly defined curriculum representative of a progressively expanding body of knowledge.

On behalf of the Dermatologic Surgery Section of the Association of Professors of Dermatology, we respectfully request that the American Board of Dermatology continue with the development and establishment of certification in Mohs Surgery and Dermatologic Oncology to recognize individuals with advanced training and practice in this area. Just as with residency programs, a Board exam is an opportunity for those who have undergone specialty training to demonstrate competence in their field of study. This action would be consistent with the certification offered by the American Board of Dermatology for Dermatopathology and Pediatric Dermatology. Recognizing additional advanced training in Mohs Surgery and Dermatologic Oncology will serve the public by clarifying the role of all dermatologists in the diagnosis and treatment of cutaneous malignancies and leading patients to the best, most cost-effective treatment and serve Dermatology by formalizing the specialty’s expertise and leadership in the field.

We would be pleased to discuss the matter in greater detail, if desired.

Best regards,

Daniel B. Eisen, MD
Chair, Dermatologic Surgery Section of the Association of Professors of Dermatology
C: Item # 3: Article and Response Letter from Dermatology News

The following article appeared in the September 2016 issue of Dermatology News. Dr. Brett Coldiron wrote in favor of subspecialty certification in Micrographic Surgery and Dermatologic Oncology.

The February 2017 issue of Dermatology News featured a response from Dr. James Shiro who voiced opposition to subspecialty certification in Micrographic Surgery and Dermatologic Oncology.

COLD IRON TRUTH

Should we pursue board certification in Mohs micrographic surgery?

Publish date: September 16, 2016

Author(s): Brett M. Coldiron, MD

The medical director was direct and blunt: “You’ve got a problem with two very different levels of training in Mohs surgery. This is a big problem for your specialty.”

The remarks came at a medical director summit that I was attending to speak on the value of dermatology. I was explaining to medical directors how including small dermatology practices in their plans would realize cost savings when treating skin cancer in the office setting. An awkward silence followed the medical director’s remarks. Then I uttered a lame “we may have a board certification someday.”
My interview with the New York Times reporter before the meeting quickly became adversarial. “What about these guys who do Mohs after a 3-day course?” I explained that there is more involved than just the 3-day course, that there is a preceptorship and case reviews. Plus, some of “those guys” wrote some of the best Mohs textbooks. The reporter wasn’t buying it, and the rest of the interview went downhill.

And the training issues surrounding Mohs surgery are playing out in practice. One dermatologist wrote me complaining that an insurer will no longer let him bill for Mohs because “he can’t document his residency training in Mohs and did not do a fellowship.” Another wrote me saying he can no longer teach Mohs surgery at the VA or the medical school “because he didn’t do a formal Mohs fellowship.”

The issue of who is qualified to perform Mohs surgery is coming to a head. There are more than 2,500 dermatologists billing Medicare for Mohs, and insurers are groaning at the expense. They are looking for any possible reason to exclude dermatologists from billing for Mohs surgery.

A possible solution is a board certification in Mohs surgery. Osteopathic dermatologists have had this option for 20 years. Unfortunately, allopathic dermatologists cannot sit for the osteopathic exam. A new certification exam for allopathic dermatologists who have successfully completed a dermatology residency accredited by the Accreditation Council for Graduate Medical Education (ACGME) seems worthy of a discussion.

Downsides of certification include the likely $1,000 or more cost of a test, the costs of preparing for the test, and the risk of failing a test. A new certification would give the Maintenance of Certification (MOC) haters another reason to complain, since about 600 lifetime certified, board-exempt dermatologists would be dragged back into MOC to maintain a Mohs surgery subspecialty certification. Some of the current fellowship-trained Mohs surgeons will not like being grouped with the nonfellowship-trained surgeons, whom they consider their inferiors and who will now have the opportunity to be board certified.

The name of the fellowship, which is “micrographic surgery and dermatologic oncology,” also has some paranoid types fearing that they will lose the right to treat skin cancer if such a subspecialty is created. That shouldn’t be an issue, since all dermatologists are trained in residency to treat skin cancer. The formal fellowships already exist. There are already 1,600 fellowship-trained Mohs surgeons out there, and they have not cornered the market on skin
cancer. The situation should not change since general dermatologists remain the gatekeepers – and entry point – for most skin cancer patients. Certification exams in dermatopathology and pediatric dermatology have not had a negative impact on general dermatologists, who still read their own slides and see kids for skin disease. In fact, having dermatopathology as a certified part of dermatology has been a huge benefit in our struggle to maintain the right to read our own slides.

Developing a certification exam would take at least 2 years if the American Board of Dermatology decided to do it. There would be no “grandfathering” automatic certification. Everyone would have to take the same exam – young, old, formally trained, or not.

Members of the American Board of Dermatology explained the qualifiers to sit for an exam (if there was an exam) at a summit I held in Cincinnati in 2015. They are interested in including all ABD dermatologists who currently practice Mohs surgery, fellowship trained or not. Suggested parameters included any ABD fellow whose practice is 20% Mohs and reconstructive surgery (by volume or income), or anyone who performs Mohs once a week. Fellowship-trained micrographic surgeons could be eligible, and this would be a self-attestation! There would be no case log reviews, no visits by inspectors, no secret questions or passwords. This pathway would remain open for 5 years as were the exams for dermatopathology and pediatric dermatology. After that point, only ACGME fellowship–trained Mohs surgeons would be eligible to take the exam.

Upsides to this approach include decreasing divisiveness in the specialty, creating a better brand, and elevating the specialty. A board certification will help in obtaining a Medicare specialty designation, which will help stop the delisting of Mohs surgeons from insurance networks based on their average charges compared with general dermatologists. This action would particularly help small practices.

The American Academy of Dermatology board of directors sent this issue to the education committee to inform and poll the membership. You should expect to hear more about the proposed process. As an AAD member, you will get to express your opinion so make sure you are well informed. The AAD membership opinion will be important in whether or not the American Board of Dermatology decides to pursue this. Remember, this is an American Board of Dermatology decision, not an AAD decision.

More reasons for a board certification include that the ACGME expects its fellowships to develop a board exam at some point (although not all have). The 1,000 ACGME fellowship–trained micrographic surgeons deserve a chance to be board certified, which is the medical profession’s way to demonstrate competence to the public.

Having all Mohs surgeons board certified would heal a huge rift in the house of dermatology, and give us a united, consistent face to present to other specialties, the Congress, and the media. Physicians are judged by their training and credentials. Love them or hate them, the ACGME is the gold standard. Perhaps the greatest beneficiaries would be those practicing Mohs who did not
complete a formal fellowship. I think a board exam is overdue, and will be a boon to all of dermatology.

Dr. Coldiron is a past president of the American Academy of Dermatology. He is currently in private practice, but maintains a clinical assistant professorship at the University of Cincinnati. He cares for patients, teaches medical students and residents, and has several active clinical research projects. Dr. Coldiron is the author of more than 80 scientific letters, papers, and several book chapters, and he speaks frequently on a variety of topics.

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MSDO Certification will create ‘the ultimate divide’ (letter)


The number of Mohs surgeons cited is incorrect. The definitive database to validate the number of Mohs surgeons would be the most recent, publicly available, 2014 Medicare claims database. It indicates that there were exactly 2,207 (not “more than 2,500”) physicians who billed Medicare for Mohs surgery in 2014. Of that number, 1,141 (not “1,600”) are, or were at one time, affiliated with the American College of Mohs Surgery. The remaining non-fellowship trained Mohs surgeons would fall into the derogatory “those guys” category.

“Those guys”, as well as the majority of dermatologists who do not use Mohs surgery to treat skin cancers, hold a very different opinion about the value of a board subspecialty certification in Micrographic Surgery and Dermatologic Oncology (MSDO). First of all, they are board certified dermatologists. By virtue of this board certification, they have proved that they have acquired the knowledge to competently treat skin cancers, perform dermatologic surgery, and examine pathologic specimens of skin, among many other skills. Mohs surgery requires an individual to function as both the surgeon and the margin examination pathologist; both are within the skill set of board certified dermatologists.

Dr. Coldiron contends that an MSDO certification will decrease divisiveness within dermatology, create a better brand, and elevate the specialty. It is unclear how having an MSDO certification can be viewed this way. The American Academy of Dermatology has done an excellent job of elevating the profile of dermatology in the house of medicine over the many years. In a recent
communication, AAD President Abel Torres states that “dermatology ‘owns’ the treatment of skin cancer” and now there is a need to solicit vignettes demonstrating that we do more for patients than just treat skin cancer. How can certifying a minority of dermatologists in MSDO be positive for the perception of the majority of board certified dermatologists who will not be certified in the MSDO subspecialty? It will create the ultimate divide between those certified in “surgery and dermatologic oncology” and those who are not, despite the indisputable fact that dermatologic oncology is central to every dermatology practice.

Regarding the statement that the Accreditation Council for Graduate Medical Education (ACGME) expects fellowships to develop board certifications, there are many examples of ACGME fellowships that do not have board certifications. Orthopedic surgery has nine ACGME fellowships but only two subspecialty certifications in fields that overlap with other American Board of Medical Specialties (ABMS) boards, a system the protects the certificate holders of both ABMS boards. Currently, the two certified subspecialties in dermatology are dermatopathology, which overlaps with pathology, and pediatric dermatology, a field that does not have an ACGME fellowship by is consistent with the fact that most ABMS boards have a pediatric subspecialty certification. If only dermatologists practice Mohs surgery, there is no requirement for the American Board of Dermatology (ABD) to create an MSDO subspecialty certification. The ABD is creating confusion with a Residents and Fellows webpage listing MSDO as a “Fellowship without certification”, a unique type of listing among ABMS boards.

Dr. Coldiron mentions that osteopathic dermatologists have had a board certification option open to them for 20 years. What he fails to say is that there have been fewer than 50 of those certifications issued. The osteopathic board created the certification to ensure parity when the ABD first tried to create a Mohs surgery board certification many years ago.

I am aware, as Dr. Coldiron states, that a number of dermatologists have faced difficulty renewing medical staff privileges or with insurance reimbursement with respect to Mohs surgery. When the credentialing entities were educated fully about what is included in a dermatology board certification, they reversed their decision.

When asked for the documentation on which they based their denial, they could provide none. Dr. Coldiron states that circumstances like these don’t warrant concern from general dermatologists. It is entirely justifiable to express concern over unnecessary regulations and the unintended consequences that may result from them.

Lastly, Dr. Coldiron states that the MSDO certification would particularly help small practices because it “will help stop the delisting of Mohs surgeons from insurance networks based on their average charges compared to general dermatologists”.
The insurance companies know who is billing for Mohs surgery because they own and analyze the claims data. Full-time or part-time Mohs surgeons are easily identified by their claim profiles. Being delisted is not due to the fact that they are being compared to general dermatologists, it is done to save money by restricting the supply of physicians.

Restricting the future supply of Mohs surgeons to those who are fellowship trained may change delistings in the future but at what cost to patient access to care? The geographic distribution of fellowship vs. non-fellowship-trained Mohs surgeons demonstrates a high concentration of fellowship trained individuals in metropolitan areas and those without fellowship training in rural areas (map available on request). Will future fellowship trainees, after an extra year of training be willing to locate in rural areas where they will be unable to practice Mohs surgery full-time and reimbursement is significantly less than in urban areas?

There is a definite need for fellowship training in the dermatology education system. Fellowship should be a pathway to train our future educators, not one to restrict the supply of dermatologists competent to perform Mohs surgery. A board certification in MSDO requiring all candidates to be fellowship trained would do just that. Is this prudent in the midst of a skin cancer epidemic?

The responsible answer to these questions is to do what is best for patients, not for the desires of a minority within dermatology. An MSDO certification will degrade the training of future dermatologists by limiting to the Mohs Fellow the hand-on Mohs surgery training in dermatology residency programs, create problems with patient access to care, and lead to the mistaken public perception that all board-certified dermatologists are not fully competent in dermatologic oncology.

NOTE:
1. “Academy to firmly establish breadth and depth of specialty with robust campaign” accessible at aad.org.

James A. Schiro, MD, FAAD
Hagerstown, MD

Dr. Coldiron replies:

I AGREE that there are 2,207 physicians billing for micrographic surgery in the Medicare database. Last I heard, 17% of physicians do not participate in Medicare, so 2,500 in the United States performing micrographic surgery seemed a reasonable estimate.

On Jan 12, there were 1,538 fellowship-trained micrographic surgeons in the United States (personal communication Rebecca Brant, American College of Mohs Surgery). There are some
physicians who completed a formal fellowship, who are not known to the ACMS, so again, an estimation of 1,600 seemed reasonable. The point I was making is that there is no shortage of Mohs micrographic surgeons in the United States.

When the America Society for Mohs Surgery (ASMS) was created, there were few micrographic surgeons, and only about 10 formal fellowship slots, so an argument for an alternative route for micrographic surgery could be made. Today, there is no such shortage, and there are about 85 fellowship slots a year, some of which go empty.

In my October column, I made it clear that the New York Times reporter used the term “these guys” who only do a 3-day course, not me. As president of the American Academy of Dermatology, I defended the abilities of “those guys” to my own, and I think to the AAD’s detriment and loss of credibility. I wonder if future AAD presidents will be as quick to do so.

The point here is that the media are on to the quick easy way to learn Mohs, and are not going to leave it alone. It is unreasonable to ask the AAD, or anyone, to claim the training is equivalent. A board exam gives all a chance to prove their additional self-taught abilities, before they are routed andouted by the media. A certification also eliminates many of the differences between the two groups and unifies dermatology.

Dr. Schiro correctly states that there are a few specialties in medicine with few subspecialties. The Accreditation Council for Graduate Medical Education (ACGME) bylaws and policies article 2, section 2, and policies and procedures 11.00/11.10 do, however, describe training requirements that lead to recognition of the specialty (such as a board exam). In addition, the training requirements in orthopedic surgery overlap their subspecialties. There is no proficiency requirement for micrographic surgery in dermatology residency, just an observational requirement. Furthermore, the existence of laggards is not much of an argument to become one.

The number of osteopathic board-certified Mohs surgeons is irrelevant. I asked the president of the American Osteopathic College of Dermatology (AOCD), who denied knowing an exact number. The existence of such a certification for many years demonstrates a certification is doable. The existence of such an exam for osteopaths, and the osteopathic dermatologist’s board of directors’ current opposition to a certification for allopathic physicians, is reprehensible. It is also contrary to the recent vote of the allopathic AAD fellows to accept osteopaths as full AAD members. Are we all equal now, but a few more equal than others? Perhaps this bylaws change should be reconsidered?

No physician, or group of physicians, is going to restrict the ability of any physician to bill for micrographic surgery. That is called an antitrust violation. Small micrographic surgery practices are being delisted because the software used to define “quality” is wholly based on average
charges. Insurers are also well aware of the two routes to micrographic surgery training and are eager to and are already eliminating non-fellowship trained dermatologists in the name of quality. This is ongoing, and saying it isn’t so won’t change it. A board certification exam will.

In my column, I called for education of the membership, then a survey. If you are a non-fellowship trained Mohs surgeon you should speak up, and grab this opportunity, before you are embarrassed by the media and eliminated from insurance panels.

Dr. Schiro came to my stakeholders meeting in Cincinnati to discuss a Mohs board exam. He explained that he is a rural general dermatologist in Hagerstown, MD, about 70 miles from the US capital.

He then explained that he performs only 120 Mohs cases a year, and wouldn’t qualify to take the exam under the once a week, or Mohs and reconstruction being 20% of practice qualifier, even though it is a self-attestation. He claimed there were many non-fellowship trained (ASMS) members who perform fewer cases than he does.

An overwhelming number of papers in the literature clearly show that outcomes are better when a physician does a procedure frequently. A physician trained in an ACGME-approved 1-to-2-year fellowship is exposed to a minimum of 1,000 cases, has been the primary surgeon on at least 400 Mohs cases and 300 repairs – whether he performs 120 cases a year or 1,500 cases a year in practice, and is better prepared than is a physician who has attended a 4-day course and can document a minimum of 75 cases (proctored primary surgeon on 3, no more credit than for 45 from residency), over the ensuing years.

It will be better for all micrographic surgeons and dermatology to have a path to board certification.
REQUESTED ATTACHMENT D: A copy of the proposed certificate for ABMS records.

The American Board of Dermatology

INcorporated in 1932

Atteststo That

Jane A. Sample, MD

Has met all the specific standards and qualifications of the certification process, has passed the examination and is hereby certified in the subspecialty of

Micrographic Dermatologic Surgery

This certification will remain in effect for ten years, commencing on January 1, 20XX and is valid through December 31, 20XX contingent upon participation in and completion of maintenance of certification (MOC).
ACGME Program Requirements for
Graduate Medical Education
in Micrographic Surgery and Dermatologic Oncology

ACGME approved major revision: September 28, 2014; effective: July 1, 2015
Revised Common Program Requirements effective: July 1, 2015
Revised Common Program Requirements effective: July 1, 2016
Revised Common Program Requirements effective: July 1, 2017
ACGME Program Requirements for Graduate Medical Education
in Micrographic Surgery and Dermatologic Oncology

One-year Common Program Requirements are in BOLD

Where applicable, text in italics describes the underlying philosophy of the requirements in that section. These philosophic statements are not program requirements and are therefore not citable.

Introduction

Int.A. Residency and fellowship programs are essential dimensions of the transformation of the medical student to the independent practitioner along the continuum of medical education. They are physically, emotionally, and intellectually demanding, and require longitudinally-concentrated effort on the part of the resident or fellow.

The specialty education of physicians to practice independently is experiential, and necessarily occurs within the context of the health care delivery system. Developing the skills, knowledge, and attitudes leading to proficiency in all the domains of clinical competency requires the resident and fellow physician to assume personal responsibility for the care of individual patients. For the resident and fellow, the essential learning activity is interaction with patients under the guidance and supervision of faculty members who give value, context, and meaning to those interactions. As residents and fellows gain experience and demonstrate growth in their ability to care for patients, they assume roles that permit them to exercise those skills with greater independence. This concept--graded and progressive responsibility--is one of the core tenets of American graduate medical education. Supervision in the setting of graduate medical education has the goals of assuring the provision of safe and effective care to the individual patient; assuring each resident’s and fellow’s development of the skills, knowledge, and attitudes required to enter the unsupervised practice of medicine; and establishing a foundation for continued professional growth.

Int.B. Definition and Scope of Subspecialty

Micrographic surgery and dermatologic oncology is the subspecialty of dermatology concerned with the study, diagnosis, and surgical treatment of malignancies of the skin and adjacent mucous membranes, cutaneous appendages, hair, nails, and subcutaneous tissue. A particular emphasis is the surgical and medical management of patients with high risk cutaneous malignancies. Micrographic surgery and dermatologic oncology is broadly categorized into the following areas:

Int.B.1. Cutaneous oncologic surgery, which incorporates medical, surgical, and dermatopathological knowledge of cutaneous malignancies. An essential technique is Mohs micrographic surgical excision, which is used for certain cancers of the skin and incorporates education in clinical
Cutaneous reconstructive surgery, which includes the repair of skin and subcutaneous defects that result from the surgical removal of tumors or other skin disease, scar revision, and restoration of the skin following skin surgery to its best possible appearance. This is based upon knowledge of cutaneous anatomy, wound healing, cutaneous repair techniques, and aesthetic procedures that improve the appearance of the skin following surgery.

Dermatologic oncology, which incorporates knowledge of the clinical and pathologic diagnosis, staging, and treatment options for patients with cutaneous malignancies. This incorporates knowledge of cutaneous cancer syndromes and optimal management of cutaneous malignancies both surgical and non-surgical.

The educational program in micrographic surgery and dermatologic oncology must be 12 months in length. (Core)*

I. Institutions

I.A. Sponsoring Institution

One sponsoring institution must assume ultimate responsibility for the program, as described in the Institutional Requirements, and this responsibility extends to fellow assignments at all participating sites. (Core)

The sponsoring institution and the program must ensure that the program director has sufficient protected time and financial support for his or her educational and administrative responsibilities to the program. (Core)

I.B. Participating Sites

I.B.1. There must be a program letter of agreement (PLA) between the program and each participating site providing a required assignment. The PLA must be renewed at least every five years. (Core)

The PLA should:

I.B.1.a) identify the faculty who will assume both educational and supervisory responsibilities for fellows; (Detail)

I.B.1.b) specify their responsibilities for teaching, supervision, and formal evaluation of fellows, as specified later in this document; (Detail)

I.B.1.c) specify the duration and content of the educational experience; and, (Detail)
I.B.1.d) state the policies and procedures that will govern fellow education during the assignment. (Detail)

I.B.2. The program director must submit any additions or deletions of participating sites routinely providing an educational experience, required for all fellows, of one month full time equivalent (FTE) or more through the Accreditation Council for Graduate Medical Education (ACGME) Accreditation Data System (ADS). (Core)

II. Program Personnel and Resources

II.A. Program Director

II.A.1. There must be a single program director with authority and accountability for the operation of the program. The sponsoring institution's GMEC must approve a change in program director. (Core)

II.A.1.a) The program director must submit this change to the ACGME via the ADS. (Core)

II.A.2. Qualifications of the program director must include:

II.A.2.a) requisite specialty expertise and documented educational and administrative experience acceptable to the Review Committee; (Core)

II.A.2.b) current certification in the subspecialty by the American Board of Dermatology, or subspecialty qualifications that are acceptable to the Review Committee; (Core)

II.A.2.c) current medical licensure and appropriate medical staff appointment; (Core)

II.A.2.d) completion of an ACGME-accredited procedural dermatology or micrographic surgery and dermatologic oncology fellowship, an American College of Mohs Surgery-approved fellowship, or experience as a program director of a dermatologic surgery fellowship program for at least 10 years; (Core)

II.A.2.e) at least five years of patient care experience as a dermatologist and dermatologic surgeon; (Core)

II.A.2.f) at least three years of experience as a teacher in graduate medical education in dermatology and dermatologic surgery; and, (Core)

II.A.2.g) an ongoing clinical practice in micrographic surgery and dermatologic oncology that includes personal performance of key aspects of micrographic surgery and dermatologic oncology as the fellow observes. (Core)
II.A.3. The program director must administer and maintain an educational environment conducive to educating the fellows in each of the ACGME competency areas. (Core)

The program director must:

II.A.3.a) prepare and submit all information required and requested by the ACGME; (Core)

II.A.3.b) be familiar with and oversee compliance with ACGME and Review Committee policies and procedures as outlined in the ACGME Manual of Policies and Procedures; (Detail)

II.A.3.c) obtain review and approval of the sponsoring institution’s GMEC/DIO before submitting information or requests to the ACGME, including: (Core)

II.A.3.c).(1) all applications for ACGME accreditation of new programs; (Detail)

II.A.3.c).(2) changes in fellow complement; (Detail)

II.A.3.c).(3) major changes in program structure or length of training; (Detail)

II.A.3.c).(4) progress reports requested by the Review Committee; (Detail)

II.A.3.c).(5) requests for increases or any change to fellow duty hours; (Detail)

II.A.3.c).(6) voluntary withdrawals of ACGME-accredited programs; (Detail)

II.A.3.c).(7) requests for appeal of an adverse action; and, (Detail)

II.A.3.c).(8) appeal presentations to a Board of Appeal or the ACGME. (Detail)

II.A.3.d) obtain DIO review and co-signature on all program application forms, as well as any correspondence or document submitted to the ACGME that addresses: (Detail)

II.A.3.d).(1) program citations, and/or, (Detail)

II.A.3.d).(2) request for changes in the program that would have significant impact, including financial, on the program or institution. (Detail)
II.A.3.e) commit at least 24 hours per week to the administrative and teaching tasks inherent to achieving the educational goals of the program. (Detail)

II.A.4. The program director must review and confirm the fellows’ Case Logs. (Core)

II.A.4.a) This review should occur semi-annually. (Detail)

II.B. Faculty

II.B.1. There must be a sufficient number of faculty with documented qualifications to instruct and supervise all fellows. (Core)

II.B.1.a) In addition to the program director, there must be at least one faculty member who is actively involved in the clinical practice of cutaneous oncologic surgery. (Core)

II.B.1.b) A second faculty member should be a Mohs surgeon, an otolaryngologist, an ophthalmic plastic and reconstructive surgeon, or a plastic surgeon who is actively involved in the surgical management of cutaneous oncology patients. (Detail)

II.B.1.b).(1) Programs with only one Mohs surgeon must have a written agreement with another Mohs surgeon who is qualified and willing to fill in as the program director in the event that the program’s Mohs surgeon is absent for longer than six consecutive weeks. (Core)

II.B.2. The faculty must devote sufficient time to the educational program to fulfill their supervisory and teaching responsibilities and demonstrate a strong interest in the education of fellows. (Core)

II.B.3. The physician faculty must have current certification in the subspecialty by the American Board of Dermatology, or possess qualifications judged acceptable to the Review Committee. (Core)

II.B.4. The physician faculty must possess current medical licensure and appropriate medical staff appointment. (Core)

II.B.5. Members of the faculty who have responsibility for fellow education in Mohs micrographic surgery must have completed a 12-month PGY-5 dermatologic surgery fellowship or have experience as a program director of a dermatologic surgery fellowship program for at least 10 years; (Core)

II.B.6. Other members of the faculty in related disciplines should include members from specialties with overlapping expertise, including at least two of the following: dermatology; dermatopathology; general surgery; medical oncology; ophthalmology; otolaryngology; ophthalmic plastic and reconstructive surgery (oculoplastic surgeons), plastic surgery and prosthetics, pathology, and radiation therapy. (Detail)
II.B.7. If the program director is absent for longer than six consecutive weeks, a Mohs surgeon who meets the requirements of the program director must assume responsibility for the education of fellows until the program director returns. (Core)

II.C. Other Program Personnel

The institution and the program must jointly ensure the availability of all necessary professional, technical, and clerical personnel for the effective administration of the program. (Core)

II.D. Resources

The institution and the program must jointly ensure the availability of adequate resources for fellow education, as defined in the specialty program requirements. (Core)

II.D.1. Adequate space must be dedicated to the performance of dermatologic surgery procedures, and must include a Mohs micrographic frozen section laboratory and examination areas for surgical patients. (Core)

II.D.1.a) The space should be accredited by the appropriate oversight bodies as required by federal, state, and local laws. (Detail)

II.D.1.b) The frozen section laboratory must be adjacent to the operating suite or rooms in which dermatologic surgery is performed. (Core)

II.D.1.c) Program laboratories must be in compliance with all federal, state, and local regulations regarding a work environment. (Core)

II.D.2. Frozen section slides for Mohs micrographic surgery must be reviewed and approved, as part of an ongoing quality assurance process, by an appropriately qualified external organization or equivalent academic medical center’s Quality Assessment and Control program that has experience reviewing the unique method of histology slide preparation required to perform Mohs surgery. (Core)

II.D.3. Quality Assurance/Quality Control must include formal evaluation and written comments regarding slide quality, to include tissue thickness, completeness of epidermal edges, quality of sections of fat, staining quality, lack of holes in sections, accuracy of staining and mapping of section, and concordance with interpretation by the fellows the slides. (Core)

II.D.4. There should be appropriate space for fellows to read, study, and complete their paperwork. (Detail)

II.D.5. The program must provide a sufficient volume and variety of surgical cases. (Core)
II.D.5.a) At least 1000 dermatologic surgical procedures per fellow must be available. (Core)

II.D.5.a).(1) At least 600 of that minimum total must be Mohs micrographic surgery procedures. (Core)

II.E. Medical Information Access

Fellows must have ready access to specialty-specific and other appropriate reference material in print or electronic format. Electronic medical literature databases with search capabilities should be available. (Detail)

III. Fellow Appointments

III.A. Eligibility Requirements – Fellowship Programs

All required clinical education for entry into ACGME-accredited fellowship programs must be completed in an ACGME-accredited residency program, or in an RCPSC-accredited or CFPC-accredited residency program located in Canada. (Core)

Prior to appointment in the program, fellows must have successfully completed an ACGME-accredited residency program in dermatology or an RCPSC-accredited residency program in dermatology located in Canada. (Core)

III.A.1. Fellowship programs must receive verification of each entering fellow’s level of competency in the required field using ACGME or CanMEDS Milestones assessments from the core residency program. (Core)

III.A.2. Fellow Eligibility Exception

A Review Committee may grant the following exception to the fellowship eligibility requirements:

An ACGME-accredited fellowship program may accept an exceptionally qualified applicant**, who does not satisfy the eligibility requirements listed in Sections III.A. and III.A.1., but who does meet all of the following additional qualifications and conditions: (Core)

III.A.2.a) Assessment by the program director and fellowship selection committee of the applicant’s suitability to enter the program, based on prior training and review of the summative evaluations of training in the core specialty; and (Core)

III.A.2.b) Review and approval of the applicant’s exceptional qualifications by the GMEC or a subcommittee of the GMEC; and (Core)
III.A.2.c) Satisfactory completion of the United States Medical Licensing Examination (USMLE) Steps 1, 2, and, if the applicant is eligible, 3, and; (Core)

III.A.2.d) For an international graduate, verification of Educational Commission for Foreign Medical Graduates (ECFMG) certification; and, (Core)

III.A.2.e) Applicants accepted by this exception must complete fellowship Milestones evaluation (for the purposes of establishment of baseline performance by the Clinical Competency Committee), conducted by the receiving fellowship program within six weeks of matriculation. This evaluation may be waived for an applicant who has completed an ACGME International-accredited residency based on the applicant’s Milestones evaluation conducted at the conclusion of the residency program. (Core)

III.A.2.e).(1) If the trainee does not meet the expected level of Milestones competency following entry into the fellowship program, the trainee must undergo a period of remediation, overseen by the Clinical Competency Committee and monitored by the GMEC or a subcommittee of the GMEC. This period of remediation must not count toward time in fellowship training. (Core)

** An exceptionally qualified applicant has (1) completed a non-ACGME-accredited residency program in the core specialty, and (2) demonstrated clinical excellence, in comparison to peers, throughout training. Additional evidence of exceptional qualifications is required, which may include one of the following: (a) participation in additional clinical or research training in the specialty or subspecialty; (b) demonstrated scholarship in the specialty or subspecialty; (c) demonstrated leadership during or after residency training; (d) completion of an ACGME-International-accredited residency program.

III.A.3. The Review Committee for Dermatology does allow exceptions to the Eligibility Requirements for Fellowship Programs in Section III.A. (Core)

III.B. Number of Fellows

The program’s educational resources must be adequate to support the number of fellows appointed to the program. (Core)

III.B.1. The program director may not appoint more fellows than approved by the Review Committee, unless otherwise stated in the specialty-specific requirements. (Core)
III.B.2. The presence of other learners in the program, including residents from other specialties, subspecialty fellows, PhD students, and nurse practitioners, must not interfere with the appointed fellows’ education. (Core)

IV. Educational Program

IV.A. The curriculum must contain the following educational components:

IV.A.1. Skills and competencies the fellow will be able to demonstrate at the conclusion of the program. The program must distribute these skills and competencies to fellows and faculty at least annually, in either written or electronic form. (Core)

IV.A.1.a) The program must provide an organized, systematic, and progressive educational experience that includes both clinical and didactic exposure for physicians seeking to acquire advanced competence as dermatologic surgeons. (Core)

IV.A.2. ACGME Competencies

The program must integrate the following ACGME competencies into the curriculum: (Core)

IV.A.2.a) Patient Care and Procedural Skills

IV.A.2.a).(1) Fellows must be able to provide patient care that is compassionate, appropriate, and effective for the treatment of health problems and the promotion of health. (Outcome)

IV.A.2.a).(2) Fellows must be able to competently perform all medical, diagnostic, and surgical procedures considered essential for the area of practice. Fellows: (Outcome)

IV.A.2.a).(2).(a) must demonstrate competence in making decisions regarding patient treatment, including instances in which the patient prefers to be referred or would benefit from referral to a different specialty or to a multidisciplinary team; (Outcome)

IV.A.2.a).(2).(b) must demonstrate competence in performing procedures and must: (Outcome)

IV.A.2.a).(2).(b).(i) be competent in skin neoplasm destruction techniques, excision, and Mohs micrographic surgery; (Outcome)

IV.A.2.a).(2).(b).(ii) be competent in cutaneous reconstructive surgery, including random pattern and axial
flap repair, and partial and full thickness skin grafting.

IV.A.2.a).(2).(b).(iii) be competent in recognizing when a staged reconstructive technique is in the best interest of the patient and appropriately refer to other specialists if necessary; and, (Outcome)

IV.A.2.a).(2).(b).(iv) perform at least 400 Mohs micrographic surgeries and 300 reconstructions as the primary surgeon. (Core)

IV.A.2.a).(2).(c) must demonstrate advanced evaluation and management skills for all cutaneous surgical patients regardless of diagnosis, including pre-, peri-, and post-operative evaluation; (Outcome)

IV.A.2.a).(2).(d) must demonstrate competence in the early identification of malignant skin lesions through visual morphologic recognition; (Outcome)

IV.A.2.a).(2).(e) must demonstrate competence in interpretation of frozen sections of a variety of cutaneous cancers; (Outcome)

IV.A.2.a).(2).(f) must demonstrate competence in the management, including multidisciplinary management, of a variety of cutaneous cancers, to include basal cell carcinoma, squamous cell carcinoma, melanoma, adnexal carcinoma, Merkel cell carcinoma, extramammary Paget’s disease, Atypical fibroxanthoma, sebaceous carcinoma, and dermatofibrosarcoma protuberans (DFSP); and, (Outcome)

IV.A.2.a).(2).(g) must demonstrate the ability to manage emergencies that occur during the care of patients, to include cardiac events and other life threatening medical emergencies. (Outcome)

IV.A.2.a).(2).(g).(i) Fellows should have advanced cardiac life support (ACLS) certification. (Outcome)

IV.A.2.b) Medical Knowledge

Fellows must demonstrate knowledge of established and evolving biomedical, clinical, epidemiological and social-behavioral sciences, as well as the application of this knowledge to patient care. Fellows: (Outcome)
IV.A.2.b).(1) must demonstrate knowledge of related disciplines, including surgical anatomy, sterilization of equipment, aseptic technique, anesthesia, closure materials, and instrumentation; (Outcome)

IV.A.2.b).(2) must demonstrate knowledge of the basic science of wound healing, surgical anatomy, local and regional anesthesia, proper surgical technique, and, pre- and post-operative management of patients who undergo Mohs or cutaneous surgery; (Outcome)

IV.A.2.b).(3) must demonstrate knowledge of non-surgical treatments for cutaneous malignancies, non-surgical therapies for the prevention of cutaneous malignancies, and when surgical treatment is not the optimal primary therapy for a patient with a cutaneous malignancy; (Outcome)

IV.A.2.b).(4) must demonstrate knowledge of cutaneous metastatic disease from primary skin cancers and non-cutaneous malignancies, to include appropriate diagnostic evaluation, surgical management, and when referral to other specialists is appropriate; and, (Outcome)

IV.A.2.b).(5) must demonstrate in-depth knowledge of clinical diagnosis, biology, and pathology of skin tumors, as well as laboratory interpretation related to diagnosis and surgical treatment. (Outcome)

IV.A.2.c) Practice-based Learning and Improvement

Fellows are expected to develop skills and habits to be able to meet the following goals:

IV.A.2.c).(1) systematically analyze practice using quality improvement methods, and implement changes with the goal of practice improvement; and, (Outcome)

IV.A.2.c).(2) locate, appraise, and assimilate evidence from scientific studies related to their patients’ health problems. (Outcome)

IV.A.2.d) Interpersonal and Communication Skills

Fellows must demonstrate interpersonal and communication skills that result in the effective exchange of information and collaboration with patients, their families, and health professionals. (Outcome)

IV.A.2.e) Professionalism
Fellows must demonstrate a commitment to carrying out professional responsibilities and an adherence to ethical principles. \textit{(Outcome)}

\textbf{IV.A.2.f)} \hspace{1cm} \textbf{Systems-based Practice}

Fellows must demonstrate an awareness of and responsiveness to the larger context and system of health care, as well as the ability to call effectively on other resources in the system to provide optimal health care. \textit{(Outcome)}

\textbf{IV.A.3.} \hspace{1cm} \textbf{Curriculum Organization and Fellow Experiences}

\textbf{IV.A.3.a)} \hspace{1cm} There must be didactic sessions centered around a structured curriculum, to include a regularly-held journal club. \textit{(Core)}

\textbf{IV.A.3.b)} \hspace{1cm} Didactic sessions should include regularly scheduled and held lectures, tutorials, seminars, multidisciplinary conferences, and conferences that consider complications, outcomes, and utilization review. \textit{(Detail)}

\textbf{IV.A.3.c)} \hspace{1cm} Didactics must include participation by the fellow in a multidisciplinary tumor board for presentation of patients with advanced or aggressive cutaneous malignancies. \textit{(Core)}

\textbf{IV.A.4.} \hspace{1cm} Programs must provide organized education and experience in all current aspects of micrographic surgery and dermatologic oncology. \textit{(Core)}

This must include:

\textbf{IV.A.4.a)} \hspace{1cm} instruction and experience in Mohs micrographic surgery, and reconstruction of resultant surgical defects in a variety of anatomic locations using a variety of methods, to include complex cutaneous closures, local flaps, grafts, and staged reconstruction techniques; \textit{(Core)}

\textbf{IV.A.4.b)} \hspace{1cm} instruction and experience in non-surgical alternative treatments for cutaneous malignancies, such as cryosurgery, curettage and electrosurgery, chemical destructive techniques, and laser and light modalities; and, \textit{(Core)}

\textbf{IV.A.4.c)} \hspace{1cm} instruction in procedures of an aesthetic nature, including cutaneous soft tissue augmentation with injectable filler material, dermabrasion, skin resurfacing and tightening techniques, and laser procedures used to improve aesthetic appearance following cutaneous oncologic surgery.\textit{(Core)}

\textbf{IV.A.4.c).(1)} \hspace{1cm} Instruction in these procedures must provide fellows with the ability to properly assess the value of these techniques, as well as those of new techniques used to
enhance restoration of the skin’s normal appearance and function. (Core)

IV.A.5. The program must provide each fellow with formal education in setting up and operating a frozen section laboratory capable of processing sections for Mohs micrographic surgery. (Core)

IV.A.5.a) The program must provide training and experience in supervising and training laboratory personnel. (Core)

IV.A.6. Fellows must have experience working with health care personnel from dermatology, dermatopathology, and medical oncology. (Core)

IV.A.7. Fellows must have experience in radiation oncology to ensure an ability to effectively work with other specialties essential to the optimal management of cutaneous oncology patients. (Core)

IV.A.8. Fellows must be actively engaged in teaching. (Core)

IV.A.9. Fellow experience should also include interaction with general surgery, ophthalmology, otolaryngology, plastic surgery, and radiation oncology to ensure a broad knowledge of specialties essential to the optimal management of cutaneous malignancies. (Detail)

IV.B. Fellows’ Scholarly Activities

Each fellow must complete an original research project (clinical trial, cohort study, or systematic review/textbook chapter on a topic relevant to dermatologic surgery) that should result in either: (Core)

IV.B.1. submission to a peer-reviewed journal or textbook or, (Core)

IV.B.2. one or more presentations at a regional or national professional society meeting relevant to micrographic surgery and dermatologic oncology. (Core)

V. Evaluation

V.A. Fellow Evaluation

V.A.1. The program director must appoint the Clinical Competency Committee. (Core)

V.A.1.a) At a minimum the Clinical Competency Committee must be composed of three members of the program faculty. (Core)

V.A.1.a).(1) The program director may appoint additional members of the Clinical Competency Committee.

V.A.1.a).(1).(a) These additional members must be physician faculty members from the same program or other programs, or other health professionals
who have extensive contact and experience with the program’s fellows in patient care and other health care settings. (Core)

V.A.1.a).(1).(b) Chief residents who have completed core residency programs in their specialty and are eligible for specialty board certification may be members of the Clinical Competency Committee. (Core)

V.A.1.b) There must be a written description of the responsibilities of the Clinical Competency Committee. (Core)

V.A.1.b).(1) The Clinical Competency Committee should:

V.A.1.b).(1).(a) review all fellow evaluations semi-annually; (Core)

V.A.1.b).(1).(b) prepare and ensure the reporting of Milestones evaluations of each fellow semi-annually to ACGME; and, (Core)

V.A.1.b).(1).(c) advise the program director regarding fellow progress, including promotion, remediation, and dismissal. (Detail)

V.A.2. Formative Evaluation

V.A.2.a) The faculty must evaluate fellow performance in a timely manner. (Core)

V.A.2.b) The program must:

V.A.2.b).(1) provide objective assessments of competence in patient care and procedural skills, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice based on the specialty-specific Milestones; (Core)

V.A.2.b).(2) use multiple evaluators (e.g., faculty, peers, patients, self, and other professional staff); and, (Detail)

V.A.2.b).(3) provide each fellow with documented semiannual evaluation of performance with feedback. (Core)

V.A.2.c) The evaluations of fellow performance must be accessible for review by the fellow, in accordance with institutional policy. (Detail)

V.A.3. Summative Evaluation
V.A.3.a) The specialty-specific Milestones must be used as one of the tools to ensure fellows are able to practice core professional activities without supervision upon completion of the program. (Core)

V.A.3.b) The program director must provide a summative evaluation for each fellow upon completion of the program. (Core)

This evaluation must:

V.A.3.b).(1) become part of the fellow’s permanent record maintained by the institution, and must be accessible for review by the fellow in accordance with institutional policy; (Detail)

V.A.3.b).(2) document the fellow’s performance during their education; and, (Detail)

V.A.3.b).(3) verify that the fellow has demonstrated sufficient competence to enter practice without direct supervision. (Detail)

V.B. Faculty Evaluation

V.B.1. At least annually, the program must evaluate faculty performance as it relates to the educational program. (Core)

V.B.2. These evaluations should include a review of the faculty’s clinical teaching abilities, commitment to the educational program, clinical knowledge, professionalism, and scholarly activities. (Detail)

V.C. Program Evaluation and Improvement

V.C.1. The program director must appoint the Program Evaluation Committee (PEC). (Core)

V.C.1.a) The Program Evaluation Committee:

V.C.1.a).(1) must be composed of at least two program faculty members and should include at least one fellow; (Core)

V.C.1.a).(2) must have a written description of its responsibilities; and, (Core)

V.C.1.a).(3) should participate actively in:

V.C.1.a).(3).(a) planning, developing, implementing, and evaluating educational activities of the program; (Detail)
V.C.1.a).(3).(b) reviewing and making recommendations for revision of competency-based curriculum goals and objectives; (Detail)

V.C.1.a).(3).(c) addressing areas of non-compliance with ACGME standards; and, (Detail)

V.C.1.a).(3).(d) reviewing the program annually using evaluations of faculty, fellows, and others, as specified below. (Detail)

V.C.2. The program, through the PEC, must document formal, systematic evaluation of the curriculum at least annually, and is responsible for rendering a written, annual program evaluation. (Core)

The program must monitor and track each of the following areas:

V.C.2.a) fellow performance; (Core)

V.C.2.b) faculty development; and, (Core)

V.C.2.c) progress on the previous year’s action plan(s). (Core)

V.C.3. The PEC must prepare a written plan of action to document initiatives to improve performance in one or more of the areas listed in section V.C.2., as well as delineate how they will be measured and monitored. (Core)

V.C.3.a) The action plan should be reviewed and approved by the teaching faculty and documented in meeting minutes. (Detail)

VI. The Learning and Working Environment

Fellowship education must occur in the context of a learning and working environment that emphasizes the following principles:

- **Excellence in the safety and quality of care rendered to patients by fellows today**

- **Excellence in the safety and quality of care rendered to patients by today’s fellows in their future practice**

- **Excellence in professionalism through faculty modeling of:**
  - the effacement of self-interest in a humanistic environment that supports the professional development of physicians
  - the joy of curiosity, problem-solving, intellectual rigor, and discovery

- **Commitment to the well-being of the students, residents/fellows, faculty**
members, and all members of the health care team

VI.A. Patient Safety, Quality Improvement, Supervision, and Accountability

VI.A.1. Patient Safety and Quality Improvement

All physicians share responsibility for promoting patient safety and enhancing quality of patient care. Graduate medical education must prepare fellows to provide the highest level of clinical care with continuous focus on the safety, individual needs, and humanity of their patients. It is the right of each patient to be cared for by fellows who are appropriately supervised; possess the requisite knowledge, skills, and abilities; understand the limits of their knowledge and experience; and seek assistance as required to provide optimal patient care.

Fellows must demonstrate the ability to analyze the care they provide, understand their roles within health care teams, and play an active role in system improvement processes. Graduating fellows will apply these skills to critique their future unsupervised practice and effect quality improvement measures.

It is necessary for fellows and faculty members to consistently work in a well-coordinated manner with other health care professionals to achieve organizational patient safety goals.

VI.A.1.a) Patient Safety

VI.A.1.a).(1) Culture of Safety

A culture of safety requires continuous identification of vulnerabilities and a willingness to transparently deal with them. An effective organization has formal mechanisms to assess the knowledge, skills, and attitudes of its personnel toward safety in order to identify areas for improvement.

VI.A.1.a).(1).(a) The program, its faculty, residents, and fellows must actively participate in patient safety systems and contribute to a culture of safety. (Core)

VI.A.1.a).(1).(b) The program must have a structure that promotes safe, interprofessional, team-based care. (Core)

VI.A.1.a).(2) Education on Patient Safety

Programs must provide formal educational activities that promote patient safety-related goals, tools, and techniques. (Core)
VI.A.1.a).(3) Patient Safety Events

*Reporting, investigation, and follow-up of adverse events, near misses, and unsafe conditions are pivotal mechanisms for improving patient safety, and are essential for the success of any patient safety program. Feedback and experiential learning are essential to developing true competence in the ability to identify causes and institute sustainable systems-based changes to ameliorate patient safety vulnerabilities.*

VI.A.1.a).(3).(a) Residents, fellows, faculty members, and other clinical staff members must:

VI.A.1.a).(3).(a).(i) know their responsibilities in reporting patient safety events at the clinical site; *(Core)*

VI.A.1.a).(3).(a).(ii) know how to report patient safety events, including near misses, at the clinical site; and, *(Core)*

VI.A.1.a).(3).(a).(iii) be provided with summary information of their institution’s patient safety reports. *(Core)*

VI.A.1.a).(3).(b) Fellows must participate as team members in real and/or simulated interprofessional clinical patient safety activities, such as root cause analyses or other activities that include analysis, as well as formulation and implementation of actions. *(Core)*

VI.A.1.a).(4) Fellow Education and Experience in Disclosure of Adverse Events

*Patient-centered care requires patients, and when appropriate families, to be apprised of clinical situations that affect them, including adverse events. This is an important skill for faculty physicians to model, and for fellows to develop and apply.*

VI.A.1.a).(4).(a) All fellows must receive training in how to disclose adverse events to patients and families. *(Core)*

VI.A.1.a).(4).(b) Fellows should have the opportunity to participate in the disclosure of patient safety events, real or simulated. *(Detail)*
VI.A.1.b) Quality Improvement

VI.A.1.b).(1) Education in Quality Improvement

A cohesive model of health care includes quality-related goals, tools, and techniques that are necessary in order for health care professionals to achieve quality improvement goals.

VI.A.1.b).(1).(a) Fellows must receive training and experience in quality improvement processes, including an understanding of health care disparities. (Core)

VI.A.1.b).(2) Quality Metrics

Access to data is essential to prioritizing activities for care improvement and evaluating success of improvement efforts.

VI.A.1.b).(2).(a) Fellows and faculty members must receive data on quality metrics and benchmarks related to their patient populations. (Core)

VI.A.1.b).(3) Engagement in Quality Improvement Activities

Experiential learning is essential to developing the ability to identify and institute sustainable systems-based changes to improve patient care.

VI.A.1.b).(3).(a) Fellows must have the opportunity to participate in interprofessional quality improvement activities. (Core)

VI.A.1.b).(3).(a).(i) This should include activities aimed at reducing health care disparities. (Detail)

VI.A.2. Supervision and Accountability

VI.A.2.a) Although the attending physician is ultimately responsible for the care of the patient, every physician shares in the responsibility and accountability for their efforts in the provision of care. Effective programs, in partnership with their Sponsoring Institutions, define, widely communicate, and monitor a structured chain of responsibility and accountability as it relates to the supervision of all patient care.

Supervision in the setting of graduate medical education provides safe and effective care to patients; ensures each fellow’s development of the skills, knowledge, and attitudes...
required to enter the unsupervised practice of medicine; and establishes a foundation for continued professional growth.

VI.A.2.a).(1) Each patient must have an identifiable and appropriately-credentialed and privileged attending physician (or licensed independent practitioner as specified by the applicable Review Committee) who is responsible and accountable for the patient’s care. (Core)

Physician faculty members must supervise fellows. (Core)

VI.A.2.a).(1).(a) This information must be available to fellows, faculty members, other members of the health care team, and patients. (Core)

VI.A.2.a).(1).(b) Fellows and faculty members must inform each patient of their respective roles in that patient’s care when providing direct patient care. (Core)

VI.A.2.b) Supervision may be exercised through a variety of methods. For many aspects of patient care, the supervising physician may be a more advanced fellow. Other portions of care provided by the fellow can be adequately supervised by the immediate availability of the supervising faculty member or fellow physician, either on site or by means of telephonic and/or electronic modalities. Some activities require the physical presence of the supervising faculty member. In some circumstances, supervision may include post-hoc review of fellow-delivered care with feedback.

VI.A.2.b).(1) The program must demonstrate that the appropriate level of supervision in place for all fellows is based on each fellow’s level of training and ability, as well as patient complexity and acuity. Supervision may be exercised through a variety of methods, as appropriate to the situation. (Core)

VI.A.2.c) Levels of Supervision

To promote oversight of fellow supervision while providing for graded authority and responsibility, the program must use the following classification of supervision: (Core)

VI.A.2.c).(1) Direct Supervision – the supervising physician is physically present with the fellow and patient. (Core)

VI.A.2.c).(2) Indirect Supervision:

VI.A.2.c).(2).(a) with Direct Supervision immediately available – the supervising physician is physically within
the hospital or other site of patient care, and is immediately available to provide Direct Supervision. (Core)

VI.A.2.c).(2).(b) with Direct Supervision available – the supervising physician is not physically present within the hospital or other site of patient care, but is immediately available by means of telephonic and/or electronic modalities, and is available to provide Direct Supervision. (Core)

VI.A.2.c).(3) Oversight – the supervising physician is available to provide review of procedures/encounters with feedback provided after care is delivered. (Core)

VI.A.2.d) The privilege of progressive authority and responsibility, conditional independence, and a supervisory role in patient care delegated to each fellow must be assigned by the program director and faculty members. (Core)

VI.A.2.d).(1) The program director must evaluate each fellow’s abilities based on specific criteria, guided by the Milestones. (Core)

VI.A.2.d).(2) Faculty members functioning as supervising physicians must delegate portions of care to fellows based on the needs of the patient and the skills of each fellow. (Core)

VI.A.2.d).(3) Fellows should serve in a supervisory role to residents or junior fellows in recognition of their progress toward independence, based on the needs of each patient and the skills of the individual resident or fellow. (Detail)

VI.A.2.e) Programs must set guidelines for circumstances and events in which fellows must communicate with the supervising faculty member(s). (Core)

VI.A.2.e).(1) Each fellow must know the limits of their scope of authority, and the circumstances under which the fellow is permitted to act with conditional independence. (Outcome)

VI.A.2.f) Faculty supervision assignments must be of sufficient duration to assess the knowledge and skills of each fellow and to delegate to the fellow the appropriate level of patient care authority and responsibility. (Core)

VI.A.2.f).(1) All fellows must have direct supervision available at all times. (Detail)
VI.B. Professionalism

VI.B.1. Programs, in partnership with their Sponsoring Institutions, must educate fellows and faculty members concerning the professional responsibilities of physicians, including their obligation to be appropriately rested and fit to provide the care required by their patients. (Core)

VI.B.2. The learning objectives of the program must:

VI.B.2.a) be accomplished through an appropriate blend of supervised patient care responsibilities, clinical teaching, and didactic educational events; (Core)

VI.B.2.b) be accomplished without excessive reliance on fellows to fulfill non-physician obligations; and, (Core)

VI.B.2.c) ensure manageable patient care responsibilities. (Core)

VI.B.3. The program director, in partnership with the Sponsoring Institution, must provide a culture of professionalism that supports patient safety and personal responsibility. (Core)

VI.B.4. Fellows and faculty members must demonstrate an understanding of their personal role in the:

VI.B.4.a) provision of patient- and family-centered care; (Outcome)

VI.B.4.b) safety and welfare of patients entrusted to their care, including the ability to report unsafe conditions and adverse events; (Outcome)

VI.B.4.c) assurance of their fitness for work, including:

VI.B.4.c).(1) management of their time before, during, and after clinical assignments; and, (Outcome)

VI.B.4.c).(2) recognition of impairment, including from illness, fatigue, and substance use, in themselves, their peers, and other members of the health care team. (Outcome)

VI.B.4.d) commitment to lifelong learning; (Outcome)

VI.B.4.e) monitoring of their patient care performance improvement indicators; and, (Outcome)

VI.B.4.f) accurate reporting of clinical and educational work hours, patient outcomes, and clinical experience data. (Outcome)

VI.B.5. All fellows and faculty members must demonstrate responsiveness
to patient needs that supersedes self-interest. This includes the recognition that under certain circumstances, the best interests of the patient may be served by transitioning that patient’s care to another qualified and rested provider. (Outcome)

VI.B.6. Programs must provide a professional, respectful, and civil environment that is free from mistreatment, abuse, or coercion of students, residents/fellows, faculty, and staff. Programs, in partnership with their Sponsoring Institutions, should have a process for education of fellows and faculty regarding unprofessional behavior and a confidential process for reporting, investigating, and addressing such concerns. (Core)

VI.C. Well-Being

In the current health care environment, fellows and faculty members are at increased risk for burnout and depression. Psychological, emotional, and physical well-being are critical in the development of the competent, caring, and resilient physician. Self-care is an important component of professionalism; it is also a skill that must be learned and nurtured in the context of other aspects of fellowship training. Programs, in partnership with their Sponsoring Institutions, have the same responsibility to address well-being as they do to evaluate other aspects of fellow competence.

VI.C.1. This responsibility must include:

VI.C.1.a) efforts to enhance the meaning that each fellow finds in the experience of being a physician, including protecting time with patients, minimizing non-physician obligations, providing administrative support, promoting progressive autonomy and flexibility, and enhancing professional relationships; (Core)

VI.C.1.b) attention to scheduling, work intensity, and work compression that impacts fellow well-being; (Core)

VI.C.1.c) evaluating workplace safety data and addressing the safety of fellows and faculty members; (Core)

VI.C.1.d) policies and programs that encourage optimal fellow and faculty member well-being; and, (Core)

VI.C.1.d).1 Fellows must be given the opportunity to attend medical, mental health, and dental care appointments, including those scheduled during their working hours. (Core)

VI.C.1.e) attention to fellow and faculty member burnout, depression, and substance abuse. The program, in partnership with its Sponsoring Institution, must educate faculty members and fellows in identification of the symptoms of burnout,
depression, and substance abuse, including means to assist those who experience these conditions. Fellows and faculty members must also be educated to recognize those symptoms in themselves and how to seek appropriate care. The program, in partnership with its Sponsoring Institution, must: (Core)

VI.C.1.e).(1) encourage fellows and faculty members to alert the program director or other designated personnel or programs when they are concerned that another resident, fellow, or faculty member may be displaying signs of burnout, depression, substance abuse, suicidal ideation, or potential for violence; (Core)

VI.C.1.e).(2) provide access to appropriate tools for self-screening; and, (Core)

VI.C.1.e).(3) provide access to confidential, affordable mental health assessment, counseling, and treatment, including access to urgent and emergent care 24 hours a day, seven days a week. (Core)

VI.C.2. There are circumstances in which fellows may be unable to attend work, including but not limited to fatigue, illness, and family emergencies. Each program must have policies and procedures in place that ensure coverage of patient care in the event that a fellow may be unable to perform their patient care responsibilities. These policies must be implemented without fear of negative consequences for the fellow who is unable to provide the clinical work. (Core)

VI.D. Fatigue Mitigation

VI.D.1. Programs must:

VI.D.1.a) educate all faculty members and fellows to recognize the signs of fatigue and sleep deprivation; (Core)

VI.D.1.b) educate all faculty members and fellows in alertness management and fatigue mitigation processes; and, (Core)

VI.D.1.c) encourage fellows to use fatigue mitigation processes to manage the potential negative effects of fatigue on patient care and learning. (Detail)

VI.D.2. Each program must ensure continuity of patient care, consistent with the program’s policies and procedures referenced in VI.C.2, in the event that a fellow may be unable to perform their patient care responsibilities due to excessive fatigue. (Core)

VI.D.3. The program, in partnership with its Sponsoring Institution, must
ensure adequate sleep facilities and safe transportation options for fellows who may be too fatigued to safely return home. (Core)

VI.E. Clinical Responsibilities, Teamwork, and Transitions of Care

VI.E.1. Clinical Responsibilities

The clinical responsibilities for each fellow must be based on PGY level, patient safety, fellow ability, severity and complexity of patient illness/condition, and available support services. (Core)

VI.E.1.a) Each fellow must perform at least 400 Mohs surgery cases and 300 cutaneous reconstructive surgeries as the primary surgeon. (Outcome)

VI.E.1.a).(1) These surgeries should be scheduled throughout the course of the 12-month fellowship. (Detail)

VI.E.2. Teamwork

Fellows must care for patients in an environment that maximizes communication. This must include the opportunity to work as a member of effective interprofessional teams that are appropriate to the delivery of care in the specialty and larger health system. (Core)

VI.E.2.a) Fellows must demonstrate the ability to work in an interprofessional team that includes clinic management, receptionists, nursing staff, histo-technicians, program faculty members, and referring clinical personnel. (Outcome)

VI.E.2.a).(1) Each fellow must be an integral part of the evaluation, management, and coordination of care of his or her surgical patients, and must demonstrate the ability to lead these interprofessional teams. (Outcome)

VI.E.3. Transitions of Care

VI.E.3.a) Programs must design clinical assignments to optimize transitions in patient care, including their safety, frequency, and structure. (Core)

VI.E.3.b) Programs, in partnership with their Sponsoring Institutions, must ensure and monitor effective, structured hand-over processes to facilitate both continuity of care and patient safety. (Core)

VI.E.3.c) Programs must ensure that fellows are competent in communicating with team members in the hand-over process. (Outcome)

VI.E.3.d) Programs and clinical sites must maintain and communicate
schedules of attending physicians and fellows currently responsible for care. \(^{(\text{Core})}\)

VI.E.3.e) Each program must ensure continuity of patient care, consistent with the program’s policies and procedures referenced in VI.C.2, in the event that a fellow may be unable to perform their patient care responsibilities due to excessive fatigue or illness, or family emergency. \(^{(\text{Core})}\)

VI.F. Clinical Experience and Education

*Programs, in partnership with their Sponsoring Institutions, must design an effective program structure that is configured to provide fellows with educational and clinical experience opportunities, as well as reasonable opportunities for rest and personal activities.*

VI.F.1. Maximum Hours of Clinical and Educational Work per Week

Clinical and educational work hours must be limited to no more than 80 hours per week, averaged over a four-week period, inclusive of all in-house clinical and educational activities, clinical work done from home, and all moonlighting. \(^{(\text{Core})}\)

VI.F.2. Mandatory Time Free of Clinical Work and Education

VI.F.2.a) The program must design an effective program structure that is configured to provide fellows with educational opportunities, as well as reasonable opportunities for rest and personal well-being. \(^{(\text{Core})}\)

VI.F.2.b) Fellows should have eight hours off between scheduled clinical work and education periods. \(^{(\text{Detail})}\)

VI.F.2.b).(1) There may be circumstances when fellows choose to stay to care for their patients or return to the hospital with fewer than eight hours free of clinical experience and education. This must occur within the context of the 80-hour and the one-day-off-in-seven requirements. \(^{(\text{Detail})}\)

VI.F.2.c) Fellows must have at least 14 hours free of clinical work and education after 24 hours of in-house call. \(^{(\text{Core})}\)

VI.F.2.d) Fellows must be scheduled for a minimum of one day in seven free of clinical work and required education (when averaged over four weeks). At-home call cannot be assigned on these free days. \(^{(\text{Core})}\)

VI.F.3. Maximum Clinical Work and Education Period Length

VI.F.3.a) Clinical and educational work periods for fellows must not
exceed 24 hours of continuous scheduled clinical assignments. (Core)

VI.F.3.a).(1) Up to four hours of additional time may be used for activities related to patient safety, such as providing effective transitions of care, and/or fellow education. (Core)

VI.F.3.a).(1).(a) Additional patient care responsibilities must not be assigned to a fellow during this time. (Core)

VI.F.4. Clinical and Educational Work Hour Exceptions

VI.F.4.a) In rare circumstances, after handing off all other responsibilities, a fellow, on their own initiative, may elect to remain or return to the clinical site in the following circumstances:

VI.F.4.a).(1) to continue to provide care to a single severely ill or unstable patient; (Detail)

VI.F.4.a).(2) humanistic attention to the needs of a patient or family; or, (Detail)

VI.F.4.a).(3) to attend unique educational events. (Detail)

VI.F.4.b) These additional hours of care or education will be counted toward the 80-hour weekly limit. (Detail)

VI.F.4.c) A Review Committee may grant rotation-specific exceptions for up to 10 percent or a maximum of 88 clinical and educational work hours to individual programs based on a sound educational rationale.

The Review Committee for Dermatology will not consider requests for exceptions to the 80-hour limit to the fellows' work week.

VI.F.4.c).(1) In preparing a request for an exception, the program director must follow the clinical and educational work hour exception policy from the ACGME Manual of Policies and Procedures. (Core)

VI.F.4.c).(2) Prior to submitting the request to the Review Committee, the program director must obtain approval from the Sponsoring Institution's GMEC and DIO. (Core)

VI.F.5. Moonlighting

VI.F.5.a) Moonlighting must not interfere with the ability of the fellow to achieve the goals and objectives of the educational program, and must not interfere with the fellow's fitness for
work nor compromise patient safety. (Core)

VI.F.5.b) Time spent by fellows in internal and external moonlighting (as defined in the ACGME Glossary of Terms) must be counted toward the 80-hour maximum weekly limit. (Core)

VI.F.6. In-House Night Float

Night float must occur within the context of the 80-hour and one-day-off-in-seven requirements. (Core)

VI.F.7. Maximum In-House On-Call Frequency

Fellows must be scheduled for in-house call no more frequently than every third night (when averaged over a four-week period). (Core)

VI.F.8. At-Home Call

VI.F.8.a) Time spent on patient care activities by fellows on at-home call must count toward the 80-hour maximum weekly limit. The frequency of at-home call is not subject to the every-third-night limitation, but must satisfy the requirement for one day in seven free of clinical work and education, when averaged over four weeks. (Core)

VI.F.8.a).(1) At-home call must not be so frequent or taxing as to preclude rest or reasonable personal time for each fellow. (Core)

VI.F.8.b) Fellows are permitted to return to the hospital while on at-home call to provide direct care for new or established patients. These hours of inpatient patient care must be included in the 80-hour maximum weekly limit. (Detail)

***

*Core Requirements*: Statements that define structure, resource, or process elements essential to every graduate medical educational program.

*Detail Requirements*: Statements that describe a specific structure, resource, or process, for achieving compliance with a Core Requirement. Programs and sponsoring institutions in substantial compliance with the Outcome Requirements may utilize alternative or innovative approaches to meet Core Requirements.

*Outcome Requirements*: Statements that specify expected measurable or observable attributes (knowledge, abilities, skills, or attitudes) of residents or fellows at key stages of their graduate medical education.

**Osteopathic Recognition**

For programs seeking Osteopathic Recognition for the entire program, or for a track within the program, the Osteopathic Recognition Requirements are also applicable.

(http://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/Osteopathic_Recognition_Requirements.pdf)
Current status of surgery in dermatology

C. William Hanke, MD, a Ronald L. Moy, MD, b Randall K. Roenigk, MD, z Henry H. Roenigk, Jr, MD, y James M. Spencer, MD, MS, c Emily P. Tierney, MD, d Cynthia L. Bartus, MD, e,c,g Robert M. Bernstein, MD, MBA, h,i Marc D. Brown, MD, l Mariano Busso, MD, PA, b Alastair Carruthers, MD, i Jean Carruthers, MD, m Omar A. Ibrahim, MD, PhD, n,o Arielle N. B. Kauvar, MD, b,q Kathryn M. Kent, MD, r Nils Krueger, PhD, s Marina Landau, MD, t Aimee L. Leonard, MD, u Stephen H. Mandy, MD, u,v,x Thomas E. Rohrer, MD, a,a,b Neil S. Sadick, MD, c,c and Luitgard G. Wiest, MD, PhD,dd Carmel, Indiana; Los Angeles, California; New York and Rochester, New York; Boston, Springfield, and Chestnut Hill, Massachusetts; Allentown and Center Valley, Pennsylvania; Coconut Grove, Miami Beach, and Miami, Florida; Vancouver, British Columbia, Canada; Stamford, Connecticut; Hamburg and Munich, Germany; Holon, Israel; Chicago, Illinois; Rochester, Minnesota; and Providence, Rhode Island

An article titled “Current issues in dermatologic office-based surgery” was published in the JAAD in October 1999 (volume 41, issue 4, pp. 624-634). The article was developed by the Joint American Academy of Dermatology/American Society for Dermatologic Surgery Liaison Committee. A number of subjects were addressed in the article including surgical training program requirements for dermatology residents and selected advances in dermatologic surgery that had been pioneered by dermatologists. The article concluded with sections on credentialing, privileging, and accreditation of office-based surgical facilities. Much has changed since 1999, including more stringent requirements for surgical training during dermatology residency, and the establishment of 57 accredited Procedural Dermatology Fellowship Training Programs. All of these changes have been overseen and approved by the Residency Review Committee for Dermatology and the Accreditation Committee for Graduate Medical Education. The fertile academic environment of academic training programs with interaction between established dermatologic surgeons and fellows, as well as the inquisitive nature of many of our colleagues, has led to the numerous major advances in dermatologic surgery, which are described herein. (J Am Acad Dermatol 2013;69:972-1001.)

Learning objectives: Dermatologists have been responsible for multiple advances and refinements in dermatologic office-based surgery over many decades. Dermatologists receive extensive training in office-based surgical procedures during residency, fellowships, and continuing medical education courses. The last update on this subject appeared in the Journal in 1999. This article will document the multitude of advances that have occurred since 1999.

Key words: fellowship; office-based; quality; surgery; training.
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II. SURGICAL TRAINING IN DERMATOLOGY

Dermatology is an organ-based specialty of the skin, hair, and nails with major subspecialty fields of study in medical disease, pathology, pediatrics, and surgery. Dermatology is similar to other organ-based specialties such as ophthalmology, otolaryngology, and obstetrics-gynecology in which all medical and surgical aspects of the specialty are taught during residency training. Dermatology residents receive extensive training in the structure and function of skin, clinical diagnosis, and pathology, along with
medical and surgical treatment of over 3000 cutaneous diseases and tumors. Dermatologists have been responsible for many advances in dermatologic surgery over many decades.1

A postgraduate year (PGY)-1 (medicine, rotating, surgical) is completed before 3 years of dermatology residency training (PGY 2-4). Some dermatology residents complete elective rotations in general surgery, otolaryngology, plastic surgery, and other surgical disciplines during PGY-1, PGY-2, PGY-3, and PGY-4. The surgical training in dermatology is taught during residency as is required and documented by the Accreditation Council for Graduate Medical Education (ACGME). Some residents choose to receive added fellowship training (PGY 5), which is currently available in pathology and surgery (procedural dermatology) as overseen by the ACGME and pediatrics, which is overseen by the American Board of Dermatology (ABD). The ABD tests and certifies that dermatologists are competent in all aspects of the specialty including surgery. Subspecialty certification through the ABD is available in dermatopathology and pediatric dermatology, but is not currently available in procedural dermatology.

Many of the surgical procedures that are performed by dermatologists today did not exist 25 years ago. This is also the case for most specialties in medicine. The new procedures are learned by all physicians in the same way after residency. This is done through postgraduate medical education, which includes courses, seminars, and live surgery workshops. The postgraduate courses are attended by practicing physicians and also residents in training. These courses are rich learning experiences that are attended by thousands of dermatologists each year.

A. An abbreviated history of dermatologic surgery and early surgical postgraduate courses

Although surgery has long been part of the specialty of dermatology, a new era of dermatologic surgery began at New York University (NYU, New York, NY) in the 1950s. Dermatologists at NYU became leading practitioners of dermabrasion (Kurtin, Orentreich), chemical peel (MacKee), hair transplantation (Orentreich), Mohs Chemosurgery (Robins), and excisional skin surgery (Popkin). Goldman began performing cutaneous laser surgery at the University of Cincinnati in Cincinnati, Ohio in the early 1960s.

Table I. Milestones in surgical training in dermatology

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1970</td>
<td>ASDS is founded by Leonard Lewis, Sorrel Resnick, and 11 other founding member dermatologists. Norman Orentreich is elected as first president.</td>
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<tr>
<td>1970</td>
<td>First 1-year fellowship training program is started by Perry Robins at NYU.</td>
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<tr>
<td>1972</td>
<td>ASDS holds its first course: Basic surgical techniques for dermatologists.</td>
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<tr>
<td>1975</td>
<td>Journal of Dermatologic Surgery is founded by Perry Robins and George Popkin. Dr Robins is first editor-in-chief.</td>
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<tr>
<td>1982</td>
<td>First ASDS Core Curriculum for Dermatologic Surgery is completed by Ed Krull.</td>
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<tr>
<td>1987</td>
<td>ASDS Core Curriculum for Dermatologic Surgery is revised by C. William Hanke.</td>
</tr>
<tr>
<td>1988</td>
<td>Association of Academic Dermatologic Surgeons is founded by Ed Krull.</td>
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<tr>
<td>1990</td>
<td>Residency Review Committee for Dermatology (Ed Krull, Chair) receives approval from ACGME for special training requirements for all dermatology residency training programs to include complex closures, flaps, grafts, laser surgery, and nail surgery. ACGME also approves requirement for designated surgical program director for each dermatology residency program.</td>
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<tr>
<td>1991</td>
<td>ASDS Core Curriculum for Dermatologic Surgery is revised by C. William Hanke and Tom Meek.</td>
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<td>1991</td>
<td>Testimony in favor of board certification in Mohs micrographic surgery and cutaneous oncology is given at COCERT by Ed Krull, C. William Hanke, and Martin Braun.</td>
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<tr>
<td>1998</td>
<td>Residency Review Committee for Dermatology (Randall Roenigk, Chair) receives approval from ACGME for revised surgical training requirements. Revised program requirements state “Residents should become familiar with hair transplantation, dermabrasion, sclerotherapy, laser resurfacing, liposuction, chemical peel, and tissue augmentation. In addition, residents should gain experience with Mohs micrographic surgery...Dermatologic surgery training should include appropriate anesthesia, electrosurgery, cryosurgery, laser surgery, biopsy techniques, and excisional surgery with appropriate closures, including flaps and grafts when indicated.” The newly revised requirements for the surgical program director require “at least 5 years of experience (following residency) in the care of dermatology patients and as a teacher in a dermatology residency.”</td>
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<tr>
<td>2003</td>
<td>ACGME approves 1-year procedural dermatology fellowship training program.</td>
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<tr>
<td>2004</td>
<td>First ACGME-approved 1-year procedural dermatology fellowship training programs begin.</td>
</tr>
<tr>
<td>2012</td>
<td>ACGME approves 57th procedural dermatology fellowship training program.</td>
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ACGME, Accreditation Council for Graduate Medical Education; ASDS, American Society for Dermatologic Surgery; COCERT, Committee on Certification; NYU, New York University.
B. Surgical training program requirements in dermatology

Surgical training in dermatology takes place during the 3 years of dermatology residency in programs accredited by the Residency Review Committee (RRC) for dermatology on behalf of the ACGME. Surgical training in dermatology has expanded over the years to encompass a large variety of cosmetic, reconstructive, and dermatologic surgery procedures. The 3 years of dermatology residency is preceded by an introductory year of residency in internal medicine, pediatrics, or surgery.

Dermatology residents have always been taught surgical operative techniques necessary to perform excisional surgery for the treatment of skin cancers. Suturing techniques, local anesthesia, sterilization of instruments, skin preparation, and scar revision techniques have always been a part of dermatology training. The development of the 1-year surgical fellowship programs by the ACMS, beginning with Perry Robins’ training program at NYU in 1970, had the effect of greatly expanding the number of academic surgical faculty dedicated to teaching residents skin surgery in dermatology residency programs and providing surgical procedures to dermatology patients. The number of full-time dermatologic surgeons at every major medical center had the effect of exposing most dermatology residents to sophisticated procedures such as complicated skin flaps, skin grafts, liposuction, laser procedures, scar revision techniques, and MMS. Ed Krull used survey results from dermatology residency programs to change the core ACGME requirements so that all programs were required to teach complex repairs, transposition flaps, rotation flaps, advancement flaps, and skin grafts. MMS was added in 1998, when Randall Roenigk chaired the RRC.

This surgical foundation established during medical school and dermatology residency and augmented by fellowship programs in procedural dermatology has been sustained and built upon in subsequent years of practice through courses and symposia accredited by the Accreditation Council on Continuing Medical Education and offered by educational institutions and professional societies such as the AAD, ASDS, ACMS, and ASMS. Some dermatologists also complete 1- to 2-year cosmetic surgery fellowship training programs administered by the American Academy of Cosmetic Surgery and other non-ACGME-approved fellowships in cosmetic laser procedures.

Dermatology training program requirements and board certification by the ABD. The core of dermatology and dermatologic surgery knowledge
and skills for all graduates of dermatology residency programs is derived from the standard requirements for dermatology residency training. These requirements are established and monitored by the RRC for Dermatology on behalf of the ACGME. The ABD requires graduation from an accredited ACGME-approved residency and passing the ABD certifying examination. The ABD outlines for graduates the surgical subjects that are contained in the certifying examination. These surgical subjects include suturing techniques, anesthesia, electrosurgery, nail surgery, cryosurgery, excisions, hemostasis, sterilization, MMS, flaps (advancement, rotation, and transposition), grafts, scar revisions, complex closures, lasers, phlebology, tumescent liposuction, hair restoration, use of neurotoxins, and use of fillers. These surgical subjects are developed by surgical dermatologists who are experts in these surgical subjects. An educational in-training examination is given yearly to all dermatology residents in addition to the certifying examination, which leads to the distinction of being board certified in dermatology.

Training as outlined by the RRC/ACGME should be sufficient to ensure knowledge or competence in the performance of cryosurgery, dermatologic surgery, cosmetic surgery, and laser surgery. Dermatologic surgery should be given emphasis and should include appropriate local anesthesia, electrosurgery, cryosurgery, laser surgery, nail surgery, biopsy techniques, excisional surgery, advancement flaps, transposition flaps, rotation flaps, and grafts. Residents should have exposure through observation or assisting with hair restoration, Mohs micrographic surgery, sclerotherapy, laser resurfacing, and use of neurotoxins, chemical peels and tissue augmentation. In addition, residents should be provided education relating to cosmetic procedures such as tumescent liposuction, scar revision and dermabrasion. Didactic training in cosmetic surgery is required by the RRC/ACGME. This surgical training is documented both by the program and the ACGME case log system by the residents. The ACGME case logs are used by all surgical specialties to document resident experience. Based on the program requirements, a lack of experience by residents in key surgical procedures can result in a program citation. The ACGME also uses this system to monitor the surgical experience in a specialty and has plans to make these data public.

The level of training in dermatologic surgery is divided into 3 categories. Dermatology residents should achieve competency in biopsy techniques, destruction of benign and malignant tumors, use of lasers for the treatment of superficial vascular tumors (eg, port wine stains), and excision of benign and malignant tumors with simple, intermediate, and complex repair techniques including flaps and grafts. Significant exposure to other procedures either through direct observation or as an assistant at surgery is required. Examples in this category include MMS and reconstruction of surgical defects, the application of a wide range of lasers and other energy sources, sclerotherapy, botulinum toxin (BoNT) injection, soft-tissue augmentation, and chemical peels.

Program faculty must provide education relating to certain cosmetic techniques without necessarily affording direct exposure. Among these are liposuction, scar revision, and dermabrasion. The program’s experience in cosmetic surgery may vary depending on the nature and experience of the practice; however, didactic training in this area is required.

Dermatologists are specialists with expertise in the diagnosis and treatment of pediatric and adolescent patients with benign and malignant disorders of the skin, mouth, external genitalia, hair, and nails. Dermatologists have extensive training and experience in the diagnosis and treatment of all types of skin cancers. The dermatologists have expertise in the management of cosmetic disorders of the skin such as removal of excess hair, wrinkles, sun-damaged skin, hair loss, scars, and loose skin. Among the techniques used by dermatologists for the correction of cosmetic defects are laser resurfacing, tumescent liposuction, dermabrasion, chemical peels, hair transplantation, phlebology, and tightening procedures including face, brow and neck lifting, and injections of fillers.

C. History of fellowship training in dermatologic surgery

The ACMS was formed in 1967 with a principal mission to advocate for and train physicians in MMS. Soon thereafter, the Fellowship Training Committee (FTC) of ACMS was formed and program requirements developed. In the early years the training requirements were modest, but over time and under the leadership of the chairs of the FTC such as Drs Philip Bailin, Ted Tromovitch, Sam Stegman, Rex Ammonette, John Zitelli, Barry Leshin, and Ron Moy, the requirements evolved into a 1-year structured program that required a minimum of 500 MMS cases to be performed by the program with the fellow, along with a diverse array of other topics in cutaneous oncology and reconstructive surgery. Ron Moy, who chaired the FTC for 8 years, and the FTC members implemented the site visits, national matching program (1995), frozen section quality review, more stringent facility criteria, and the
transition to the future ACGME fellowship training programs that are now in existence.

In the early years there were a very few fellowship training programs, most notably at the University of California-San Francisco, the Cleveland Clinic, and NYU followed later by the University of Wisconsin at Madison where Fred Mohs developed the technique.

In the late 1980s, the ABD sought to create a subspecialty in MMS. In the 1970s the ABD had successfully codified the subspecialty of dermatopathology by developing ACGME-accredited standards for training and a subspecialty certifying examination, which greatly benefits all dermatologists to this day. Ed Krull founded the Association of Academic Dermatologic Surgeons in 1988, to promote, support, and critically assess the quality and scope of surgical teaching of residents and fellows by academic-based dermatologic surgeons. The group provided support for the concept of ACGME accreditation of surgical fellowships in dermatology. In 1991, Drs Ed Krull and Irwin Friedberg, on behalf of ABD, with testimony to American Board of Medical Specialties (ABMS) Committee on Certification by C. William Hanke and Martin Braun, proposed the new subspecialty to ABMS. However, the representatives from general surgery, plastic surgery, and otolaryngology were strongly opposed for a variety of reasons and the proposal was defeated.

In the 1990s, Dr Krull was chair of the RRC for Dermatology of the Accreditation Council for Graduate Medical Education (ACGME), which is charged with the oversight of all dermatology specialty and subspecialty training programs in the United States. Dr Randall Roenigk joined the committee in 1994 and succeeded Dr Krull as chair of the committee. After much discussion, Drs Krull and Roenigk led the effort to seek accreditation of a subspecialty training program in dermatologic surgery. The proposal was developed and first finalized in 1997. Unfortunately at the same time Medicare published IL-372, the intermediary letter clarifying the role of teaching physicians at academic medical centers for billing purposes. This ruling was followed by a series of audits (Physicians at Teaching Hospitals [PaTH] Audits). Program directors and department chairs were concerned about the impact of these new rules on their ability to be reimbursed for patient care provided in teaching programs. As a result, the creation of the new subspecialty was delayed as it was thought that ACGME accreditation of the new program might limit the ability of departments to bill for patient care services. There was also opposition from some dermatologists who thought that accreditation would put those without fellowship training at a disadvantage.

In 2000, the RRC decided to reopen the proposal for accreditation in the subspecialty. Between the years of 2000 through 2003, a series of negotiations occurred between specialties represented by the ACGME to vet concerns expressed by general surgery, plastic surgery, and otolaryngology. Some of the concerns centered on the amount of surgical training in dermatology and the name “dermatologic surgery.” At that time, general surgeons thought that the word “surgery” should be limited to specialists who complete training in general surgery. ACGME policy at that time allowed ownership of certain terms by a specialty and hence required that the use of the term “surgery” be limited to the title of specialties that required a general surgery residency; just as the term “dermatology” could not be used by other specialties. For example, surgical specialties such as otolaryngology, ophthalmology, and obstetrics-gynecology do not use the term “surgery” to describe their specialty or subspecialties. After much discussion, a program in procedural dermatology was approved by the ACGME in 2003 allowing the first programs to become accredited in 2004.

Between the years of 2004 and 2012, 57 programs in procedural dermatology were accredited. An important part of the process during this period included dual accreditation/approval from both the ACGME and ACMS. Some members of ACMS were still concerned about giving up the approval process for these programs. Under the leadership of Roenigk, Moy, the ACMS Fellowship Training Committee, the ACMS Board, and ACMS President Whitaker, it was recognized that ACGME accreditation of the fellowships would be a better process in the long run and consistent with that used by almost all specialties and subspecialties in organized medicine. There was a transition from the ACMS site visit accreditation to the ACGME accreditation process that includes ongoing program review, site visits, and review by the RRC and the use of the ACGME case log system to document the fellows surgical experience. The incorporation of cosmetic surgery into the training was a change for some ACMS programs. Fellowship training programs in private practice settings were required to adopt the same policies and procedures that were required of large university residency programs. ACMS completely discontinued the process of approving US programs by 2013 but continued to approve a small number of international programs. The ACMS continues to provide other resources including sponsorship of the annual match, conducting a slide review program needed
for accreditation, receiving grievances from fellows who are trained in private practice programs, and maintaining a forum for discussion between program directors.

After several years of preparation the ABD submitted its application for subspecialty certification in procedural dermatology to the ABMS in 2009. What happened in 2009 was quite different compared with the process in the late 1980s. General surgery, plastic surgery, otolaryngology, and other specialties now recognized that dermatologists had developed a surgical subspecialty in MMS, cutaneous reconstruction, and related procedures that was unique and valuable. They had very few concerns about giving a certification examination in this subspecialty sponsored by ABMS. Concerns about certification came mainly from the specialty of dermatology. One issue centered on the name “procedural dermatology” because it was considered to be too generic and did not properly reflect the practice of those who had been trained. All dermatologists are trained in skin surgery during their residency and most perform surgical procedures daily. In addition, there was concern about whether or not subspecialty certification would have an impact on a dermatologist’s ability to bill insurance companies for surgical services. The ABD put a pause on the process after its first review by Committee on Certification to examine these concerns in more detail. As of this writing, the future of subspecialty certification in procedural dermatology is uncertain.

Subspecialty programs in procedural dermatology remain accredited by the ACGME. Many programs have undergone several reviews and continue to improve through this process. The program requirements have also undergone review and will continue to be improved with input from organized medicine.

Based on a review of claims data from the Center for Medicare and Medicaid Services it is clear that dermatologists perform more surgery on the skin than any other specialty. This is in great part because of our aging population and the epidemic of skin cancer. MMS and the other dermatologic surgical procedures for the treatment of skin cancer continue to be important tools to manage an increasingly significant health care problem in this country. Access to dermatologic surgical care for the treatment of skin cancer and other cosmetic procedures unique to our specialty must be taught in residency and fellowship programs, and be a part of continuing medical education for physicians engaged in lifelong learning. Regardless of whether a dermatologist has taken an added year of fellowship training, it is the expectation of the ACGME, ABMS, and ABD that all dermatologists be competent in the surgical treatment of skin disease.

D. The literature and books of dermatologic surgery

Journals. The founding of the Journal of Dermatologic Surgery by Robins and Popkin in 1975 was an important event in the evolution of dermatologic surgery. The journal has published a steady stream of instructional and research articles covering dermatologic oncology, reconstructive surgery, laser and cosmetic surgery, and cosmetic dermatology. The journal was purchased from Elsevier Science Publishers by the ASDS in 1995. The journal name has evolved from the Journal of Dermatologic Surgery (1975) to the Journal of Dermatologic Surgery and Oncology (1977) to Dermatologic Surgery (1995). Special topic issues such as lasers and fillers are frequently published alongside regular monthly issues.

Other major dermatology journals such as the Journal of the American Academy of Dermatology and the Archives of Dermatology regularly publish articles on many aspects of dermatologic surgery. Other dermatology journals such as the Journal of Drugs in Dermatology also publish surgical articles and special surgical issues.

Books. A multitude of books on dermatologic surgery and oncology have been authored or edited by dermatologists over many decades. The number of new books has steadily increased from 28 (1990-1995) to more than 70 (2007-2012) (Fig 1).

Many of these journals and books are formally reviewed by dermatology residents and procedural dermatology fellows, along with academic faculty and physicians in private practice.

E. History of patient safety and the AAD

The safety of the patient is the most important thing, and the AAD has been active in the
area of patient safety for a number of years. Dermatologists have pioneered minimally invasive outpatient dermatologic surgery procedures that are performed safely and effectively using topical, local, or tumescent local anesthesia (TLA). The outcomes are superior and complications are infrequent and minor. MMS for skin cancer and liposuction using TLA are 2 well-documented examples whereby patients are spared more invasive procedures under general anesthesia.

The AAD was one of the first national specialty organizations to develop a patient safety initiative. The AAD held a Patient Safety Summit on August 7, 2007, in New York, NY. More than 100 AAD leaders and many leaders in other areas of medicine attended. Many patient safety subject areas were covered by experts in the field including: “Establishing a strategy for patient safety in a medical specialty: lessons from the anesthesia experience” (Jeffrey B. Cooper, PhD, Executive Vice-President, Anesthesia Patient Safety Foundation); “Scope of practice in medicine” (James N. Thompson, MD, President/CEO, Federation of State Licensing Boards); “Scope of practice panel” (William H. Beeson, MD, Vice-President, Indiana Medical Licensing Board); “Scope of practice expansion by nonphysicians” (Stephen H. Mandy, MD); “Lasers and scope of practice” (Roy G. Geronomus, MD); “Day spa nightmares” (Deborah Sarnoff, MD); “Supervision of PAs and NPs” (Roger I. Ceilley, MD); “Mandatory adverse event reporting” (Brett M. Coldiron, MD); “Office accreditation panel” (Duane C. Whittaker, MD, Roy C. Grekin, MD, W. Patrick Davey, MD, Pat Ferrigno, MS); “Dermatology malpractice: a 20-year analysis of malpractice claims against dermatologists” (Sandra I. Read, MD); “Patient safety organizations” (William H. Beeson, MD); “Patient safety research” (Doral Rosauer, MBA, Katie B. Baeverstad, MD); and “The case for a dermatology credentialing verification organization” (C. William Hanke, MD, Pat Ferrigno, MS, William H. Beeson, MD).

After the Patient Safety Summit, an AAD Ad Hoc Task Force on Patient Safety was formed with James S. Taylor, MD, as Chair. The charge of the ad hoc task force was to: (1) define the current state of patient safety in dermatology; (2) evaluate existing academy activities, identify gaps and priorities, and recommend changes in the existing portfolio; and (3) develop a comprehensive strategy for developing a culture of patient safety and quality in dermatology within the AAD. Three task forces of the committee were established: (1) performance measurement; (2) patient safety curriculum; and (3) data collecting and reporting.

The AAD has been an advocate for mandatory adverse event reporting in every state. It is only through verifiable data collection on adverse events that problems can be identified and quantified. Solutions can then be crafted to prevent future adverse events. Coldiron et al reported multiple times on the Florida database for mandatory reporting of adverse events for offices that has been in place since 2000. The most recent report also included adverse event reporting for Alabama. Reporting of surgical complications that occurred in the offices were reported by physicians to a central agency in both states. Cosmetic procedures were responsible for roughly half of all adverse events reported in Florida and Alabama. Plastic surgeons reported the greatest number of complications. The majority of the fatalities and complications occurred in patients who received general anesthesia. There were no fatalities reported by dermatologists, and the number of complications was extremely small.

F. Conclusion

The fertile academic environment of academic training programs with interaction between established dermatologic surgeons and fellows, along with the inquisitive and innovative nature of many of our colleagues, has led to numerous advances in dermatologic surgery, which are described subsequently.

III. ADVANCES IN DERMATOLOGIC SURGERY

In October 1999, an article titled “Current issues in dermatologic office-based surgery” was published in this journal. The article chronicled the myriad of cutaneous surgical techniques that have been developed and pioneered by dermatologists. Many more advances have occurred since 1999. In March 2012, the Board of Directors of the AAD commissioned the AAD Ad Hoc Task Force on Office-based Surgery to update the previous article. This article is intended as an update, and the reader is referred to the previous article for historical details. The authors and co-authors of the various sections of the new article are all dermatologists who have
been involved in the developments and refinements that have occurred since 1999.

Dermatologists and dermatologic surgeons have continued to demonstrate leadership in office-based surgery and cutaneous oncology. Training in dermatologic surgery is required for all dermatology residents. Some residents undergo additional surgical training through 1-year ACGME-approved fellowship-training programs in procedural dermatology. Of these programs, 57 are currently accredited by ACGME.

Dermatologists are the only specialists in medicine who receive comprehensive training in the clinical diagnosis, basic science, pathophysiology, dermatopathology, and medical and surgical treatment of over 3000 cutaneous diseases and tumors. This foundation is the key to the advancements that have occurred in dermatologic surgery and the other areas of dermatology as well.

A. MMS and reconstruction

MMS has advanced significantly since Fred Mohs first described the surgical technique with zinc chloride paste more than 60 years ago. Tromovich and Stegman reported on the success of MMS using the fresh tissue technique. Over the past 3 decades, MMS has expanded and flourished and has given us new insights into the management of complex and challenging skin cancers. Although the terms “gold standard” and “standard of care” should be used wisely and sparingly, it is likely the case that MMS has established itself as such for the treatment of nonmelanoma skin cancers. Reviews by Rowe et al established a low recurrence rate of 1% for primary basal cell carcinomas and 5.6% for recurrent basal cell carcinomas treated with MMS. For squamous cell carcinoma, the success rate for primary tumors treated with MMS is approximately 95%.15

MMS is highly successful because of precise horizontal sectioning and meticulous microscopic inspection of tumor margins. The most unique aspect of the Mohs procedure is the fact that the physician serves as both the surgeon and pathologist, a role dermatology embraced because of our unique training in both skin surgery and dermatopathology. MMS has grown in popularity and demand because of the exploding incidence of skin cancer (approximately 3.5 million new cases per year of nonmelanoma skin cancer) and increased numbers of highly skilled trained Mohs surgeons performing the procedure. In addition, MMS has been established as an extremely safe, well-tolerated, and highly accepted surgical procedure with a very low incidence of nonlife-threatening complications. Patients who might otherwise be at risk undergoing general anesthesia can safely complete MMS under local anesthesia.

MMS has the potential risk to be an overused procedure, which is why recent appropriate use criteria for MMS have been published. MMS is best used for high-risk basal cell carcinomas including recurrent tumors, those in high-risk anatomic locations, aggressive histologic subtypes, incompletely excised tumors, larger size tumors, and for patients who are immunosuppressed. Likewise, invasive squamous cell carcinomas of the head and neck are indications for MMS. Melanoma in situ (50,000 new cases per year) especially the lentigo maligna subtype, can be challenging because of the location on the face, ill-defined margins, and subclinical extension. MMS (especially with the use of immunostains) has been shown to be highly effective for lentigo maligna with a very low recurrence rate. MMS has been described for the treatment of several rare cutaneous tumors. Although studies can be hampered by smaller numbers and retrospective reviews, there clearly is a robust literature to support MMS as a superior treatment versus standard wide excisions for these unusual cutaneous neoplasms. Rare tumors that are amenable to treatment with MMS include dermatofibrosarcoma protubersans, microcytic adenoid carcinoma, atypical fibroxanthoma, superficial leiomyosarcomas, sebaceous carcinomas, and extra-mammary Paget disease. Merkel cell carcinomas, especially those on the head and neck, have been treated with MMS but new standards also recommend the performance of sentinel lymph node biopsies, typically performed by surgical oncologists.

In summary, MMS has been documented to be safe and effective. Its use has increased 400% and currently 1 of every 4 skin cancers is treated with MMS. It is a procedure of ongoing innovation and improvement. Its distinct advantages include: (1) the highest documented cure rate; (2) tissue conservation as a result of smaller margins; (3) safety and tolerability in an outpatient setting; and (4) immediate reconstruction with confidence that clear margins have been ascertained. Challenges include a longer procedure for the patient because of waiting time for the frozen sections and the need for excellent quality control of the laboratory. The preparation of excellent quality frozen sections is a highly skilled procedure and a Mohs surgeon is only as good as the technician and laboratory. MMS has been reported to be a more expensive procedure but studies have documented that it is very cost-effective, especially
compared with excision in an ambulatory surgery center.\textsuperscript{25,26}

Along with the increased use of MMS has come the remarkable advancements and refinements in facial reconstruction. From the earliest days of allowing Mohs defects to heal by second intention, dermatologic surgeons have led the way in creative and novel reconstructions with advanced flaps and grafts. Zitelli\textsuperscript{27} revolutionized the use of a bilobed flap for nasal reconstruction by redefining its arc of rotation.

Likewise, Zitelli\textsuperscript{28} modified the melial labial transposition flap to make it a cosmetically acceptable 1-stage procedure. Dzubow\textsuperscript{29} refined and popularized the dorsal nasal rotation flap for nasal defects. Skouge\textsuperscript{30} described the use of the island pedicle flap for cutaneous lip reconstruction and others defined its use for the forehead, cheek, and nose. Papadopoulous and Triner\textsuperscript{31} described a myocutaneous island pedicle flap for nasal tip reconstruction. More complex staged interpolation flaps, including paramedian forehead flaps and cheek-to-nose flaps were popularized by Mellette,\textsuperscript{32} Brodland,\textsuperscript{33} and Fader et al.\textsuperscript{34} Cook\textsuperscript{35} explained modifications of the Spear turnover flap and other creative approaches to alar reconstructions. Advanced skin grafting techniques with cartilage support have been described by Otley\textsuperscript{36} and Adams and Ratner.\textsuperscript{37} Finally, dermatologists have always been on the leading front to define when primary closures or even second-intention healing is not only simpler but likely to result in better cosmesis.\textsuperscript{38}

B. Botulinum toxin

Although originally developed for therapeutic use, BoNT received international attention when Jean Carruthers\textsuperscript{39} and her dermatologist spouse, Alastair Carruthers, published their landmark trial in 1992, demonstrating that small amounts of BoNT injected into the forehead could improve the appearance of glabellar rhytides for up to 3 months. A decade later, Carruthers et al\textsuperscript{40} published the results of a multicenter, double-blind, placebo-controlled randomized trial that led to the Food and Drug Administration (FDA) approval of BoNT for the treatment of glabellar rhytides. In addition to further research by Carruthers and Carruthers,\textsuperscript{41,42} many dermatologists—including Becker-Wegerich et al\textsuperscript{43} and Lowe and Yamauchi\textsuperscript{44}—contributed to the early research that furthered the understanding of the toxin and its use for the treatment of a variety of hyperkinetic facial lines in the upper and lower aspect of the face, neck, and chest with a high degree of patient satisfaction.

Over the next 10 years, the use of BoNT expanded to include facial sculpting and the restoration of symmetry: Flynn et al\textsuperscript{45} widened eyes, whereas Huiligol et al\textsuperscript{46} and Carruthers and Carruthers\textsuperscript{47} induced a chemical brow lift. Moreover, it became apparent that BoNT was particularly effective when used in combination with soft-tissue augmentation, laser resurfacing, light-based therapies, and surgery, as reported by dermatologists West and Alster,\textsuperscript{48} Fagien and Brandt,\textsuperscript{49} Carruthers et al,\textsuperscript{50-52} and Khoury et al.\textsuperscript{53}

In 1994, researchers first demonstrated that BoNT produced localized anhidrosis in the faces of patients treated for hemifacial spasm.\textsuperscript{54} Since then, a number of dermatologists have demonstrated the therapeutic efficacy of BoNT in patients with palmar and axillary hyperhidrosis, including Glogau,\textsuperscript{55} Shelley et al,\textsuperscript{56} Heckmann et al,\textsuperscript{57} Lowe et al,\textsuperscript{58} Glaser et al,\textsuperscript{59} and Solish et al.\textsuperscript{60}

Twenty years of cosmetic use has yielded a wealth of information regarding the efficacy and safety of long-term treatment. Dermatologist Arnold Klein\textsuperscript{61} meticulously detailed side effects and more serious—although rare—complications, whereas Rzany et al,\textsuperscript{62} Carruthers et al,\textsuperscript{63,64} and Cohen et al\textsuperscript{65} analyzed large pools of data to demonstrate minimal adverse effects and establish the long-term safety of BoNT for cosmetic indications.

C. Hyaluronic acid fillers

In the past 15 years, there has been an explosion of interest, use, and availability of hyaluronic acid (HA) filling agents. HAs have become the leading filler agents worldwide, surpassing collagen products, which had previously dominated the filler market. The most widely used HA fillers are produced from bacterial (Streptococcus) fermentation, with this class of dermal fillers designated as nonanimal stabilized HA (NASHA), distinguishing them from earlier animal-sourced products. Currently, there are dozens of NASHA formulations available worldwide. Variations in product performance, tolerance, and durability have been associated with differences in cross-linking, molecular weight, concentration, particle size, and addition of anesthetic agents.

Initial studies establishing the biologic compatibility and stability of HA as a filler material were pioneered by dermatologists Piacquadio et al\textsuperscript{66,67} in both a guinea pig model and in a multicenter clinical study. Dermatologists Narins et al\textsuperscript{68} led a pivotal randomized double-blind multicenter split-face study in 138 patients that first demonstrated superior efficacy and comparable safety of NASHA (Restylane) compared with
collagen (Zyplast) over 6 months. Subsequent studies led by dermatologists explored differences in efficacy and tolerability among the various HA fillers emerging in clinical use. In a randomized, double-blind comparison of 150 patients, Carruthers et al. demonstrated superior durability and comparable safety of the NASHA (Restylane Perlane) at 6 months compared with Hylaform, a cross-linked HA sourced from rooster combs. In a prospective, randomized, comparative, multicenter study of 248 patients, Dover et al. compared a large-particle NASHA-based filler with a small-particle NASHA filler and found similar efficacy, durability, and safety profiles. Narins et al. further explored the long-term efficacy and effects of different NASHA (Restylane) retreatment schedules, demonstrating persistence of correction beyond the expected 6 to 12 months when retreatment was performed before dissolution of the initial treatment product. Dermatologists were the first to describe in vivo deposition of new collagen after dermal injections of both HA filler and calcium hydroxylapatite (CaHA) via histologic and biochemical analysis. It is postulated that this stimulatory effect may be induced by mechanical stretching of the dermis thereby leading to activation of dermal fibroblasts.

Dermatologists were among the first to establish safety data on HA fillers. Friedman et al. reported the first retrospective review of adverse reactions associated with early NASHA injection, which included data from over 144,000 patients worldwide. The authors found that localized hypersensitivity reactions were the major adverse event associated with injection, and that these declined dramatically after more purified source material became available.

Dermatologists made significant contributions to the early evolving literature on HA side effects and their appropriate management. One benefit of HA fillers is the unique ability to correct and reverse complications through the injection of hyaluronidase to enzymatically degrade the HA material. Glogau and Kane demonstrated a direct correlation between injector techniques such as rapid injection and higher volumes with the rate of local adverse events in a prospective, blinded, controlled study of 283 patients undergoing NASHA injection. Taylor et al. and Grimes et al. have established safety and efficacy of HA filler injections in over 300 patients with skin of color in 2 prospective randomized clinical trials. Dermatologists have been leaders in establishing guidelines and consensus recommendations for appropriate use of HA dermal fillers to optimize patient safety and satisfaction.

HA fillers are FDA approved for correction of “moderate to severe facial wrinkles and folds such as the nasolabial folds” (NLF). However, they have been widely and successfully used for off-label volume enhancement of the vermilion lip, perioral area, suprabrow region, earlobes, back of hands, prejowl sulcus, and tear troughs. Dermatologists Alam et al., Goldman et al., and Carruthers et al. have also explored the safety and synergistic effects of combining HAs with other treatment modalities such as radiofrequency, intense pulsed light, and BoNT. Dermatologists have helped to establish more recent advances in formulation and technique including combining HA fillers with lidocaine to optimize tolerability and injection through a blunt-tipped cannula to minimize pain, bruising, and edema.

As the demand for noninvasive cosmetic procedures continues to grow, the science of injectable soft-tissue fillers, including HAs, will continue to evolve. Dermatologists have been, and will continue to be, at the forefront of evolving HA filler practice, safety, and material technology.

**D. Poly-L-lactic acid filler**

Injectable poly-L-lactic acid (PLLA) is a filler device used to stimulate collagen production to restore lost facial volume. It differs from other facial fillers such as HA in that PLLA does not directly fill in lines or depressions, but instead induces a host response resulting in a gradual correction of the volume-depleted area. As volume is restored, however, the NLF, marionette lines, and other undesirable lines are corrected.

Injectable PLLA has been used worldwide for more than a decade to treat soft-tissue atrophy related to aging, photoaging, and HIV-related lipoatrophy. Safe use of PLLA requires working knowledge of facial anatomy including location of major nerves, vessels, and fat pads. An understanding of the changes to the face that occur with aging/photoaging and HIV-related lipoatrophy is imperative. Full comprehension and awareness of the different properties of the skin and soft tissue in the various cosmetic units of the face is necessary for the safe injection of PLLA.

This knowledge is not unique to dermatologists, but dermatologists have received extensive training on these topics through residency training, fellowship training, and continuing education.

Dermatologists have played an essential role in establishing the safety and efficacy of injectable PLLA. European dermatologists and skin specialists developed the safe injection techniques for this
unique device before the introduction of PLLA in the United States. Early work by Vleggaar\textsuperscript{96} and Lowe\textsuperscript{97} helped establish the injection techniques and demonstrated efficacy of PLLA for sculpting and rejuvenating the aging face. One of the noted frequent side effects of injectable PLLA was the delayed formation of subcutaneous nodules. Through the collective experiences of dermatologists, reconstitution protocols and injection techniques have evolved leading to a notable reduction in the formation of subcutaneous nodules.\textsuperscript{98-102}

Injectable PLLA has been approved in the United States since 2004. The product was initially approved for treating HIV lipoatrophy associated with highly active antiretroviral therapies. Again, dermatologists played a pivotal part in understanding the role of PLLA in the management of this stigmatizing side effect of HIV treatment.\textsuperscript{103} Hanke, Redbord, and Levy\textsuperscript{99} published an extensive case series on the safety and efficacy of injectable PLLA for treating HIV lipoatrophy. Dermatologists have continued to provide their expertise in treating HIV facial lipoatrophy.

In 2009 PLLA was approved by the FDA for aesthetic use.\textsuperscript{104} The experience of dermatologists was imperative in gaining FDA approval of the device. Work by dermatologists including Fitzgerald and Vleggaar,\textsuperscript{105} Palm et al,\textsuperscript{102} Hanke and Redbord,\textsuperscript{99} Narins et al,\textsuperscript{101} and Burgess and Quiroga\textsuperscript{103} helped establish the efficacy of PLLA for cosmetic use and has continued to demonstrate the safety of this facial volume restoration device.

Injectable PLLA is a safe and effective filler to restore the lost facial volume that contributes to the appearance of the aged face. The skills and knowledge that are needed to perform PLLA injections in the office are taught to dermatology residents during their core training. Frequent publications in the dermatology literature on the use of PLLA further contribute to the knowledge base and keep dermatologists at the forefront of using this unique facial filler. Without the work of dermatologists, this product would not have its established safety profile or be widely available for treating facial soft-tissue atrophy.

E. Calcium hydroxylapatite filler

CaHA is one of the natural components found in human bone. Synthetic CaHA is manufactured as Radiesse by Merz Aesthetics (San Mateo, CA). It consists of microspheres of CaHA, 25 to 45 μm in diameter, in a soluble carboxymethylcellulose gel carrier. Although it is now a popular compound for aesthetic use, synthetic CaHA was originally developed for the treatment of stress urinary incontinence and oropharyngeal repair.\textsuperscript{106}

In 2002, Dr Mariano Busso was the first dermatologist in the United States to explore the use of CaHA for aesthetic enhancement. He developed a novel 3-dimensional vectoring filler injection technique, in which the face is conceptualized in different mobility zones. Vectoring can address surplus skin reduction and structural enhancement.\textsuperscript{107} Busso developed a series of injection techniques for optimum and safe use of CaHA for malar,\textsuperscript{108} zygomatic, temporal, and supraciliary regions;\textsuperscript{109} the lower aspect of the face;\textsuperscript{110} and nonfacial areas such as hands.\textsuperscript{111}

CaHA has several properties that make it an important tool in the facial recontouring armamentarium.\textsuperscript{112,113} These include lack of allergenicity, longer tissue residence, and high elasticity (G'). Limiting factors include its radiopacity and tendencies to produce nodules when injected in lips and to show filler visibility after superficial injections. Instead, it should be injected at the junction of the dermis and the subcutaneous level or, when volumization is required, supraproptioestally.

The pivotal trial compared CaHA with human-based collagen for correction of NLF in 117 patients.\textsuperscript{112} In the randomized, bilateral, and prospective study, subjects were treated with CaHA in one fold and with collagen in the other; they were followed up for as long as 6 months. Of subjects, 79% had superior improvement on the CaHA side through 6 months ($P < .000$) using the Global Aesthetic Improvement Scale ($P < .0001$). Significantly less volume of CaHA was needed for optimal correction, compared with collagen ($P < .0001$). Adverse events were generally comparable between the 2 groups, though increases in bruising and edema were noted in the CaHA-treated fold.

Subsequent results of this same trial were reported extending more than 3 years.\textsuperscript{113} Of the original 117 subjects, 99 subjects were available for all 3 years. Using the Global Aesthetic Improvement Scale, researchers found that, at 30 months, 40% of the CaHA-treated folds were rated as “improved” or better. No long-term or delayed-onset adverse events were reported, including “no reports of nodules, granulomata, or infections.”

Patients reported immediate post-CAHA injection discomfort. To address the issue of pain control, Busso and Applebaum\textsuperscript{114,115} developed a method of mixing lidocaine with CaHA immediately before injection. A Luer lock-to-Luer lock connector between a syringe containing lidocaine and a syringe containing CaHA allows the lidocaine to
mix with the CaHA without altering the duration of the correction. In 2009, the FDA approved the technique for mixing lidocaine with CaHA.

In the controlled, randomized, patient-blinded, split-face clinical trial, 50 subjects received CaHA without lidocaine in one NLF and CaHA premixed with 2% lidocaine in the other NLF. Subjects reported statistically significantly less pain in the NLF treated with CaHA premixed with lidocaine immediately posttreatment ($P < .001$) and 48 subjects (96%) expressed a preference for CaHA premixed with lidocaine.

In nonfacial areas, the Busso hand injection technique of CaHA was the basis of the first clinical trial to measure the efficacy of a dermal filler for hand augmentation. A multicenter, blinded, randomized clinical trial addressed the use of CaHA in hand rejuvenation. In this study, 101 subjects were randomized to receive CaHA (76 patients) or to receive no treatment. Using the validated Busso Hand Volume Severity Scale, researchers found that the treatment group was statistically significantly improved compared with the control ($P = .0001$). No adverse effect on hand function was noted in the study.

The Busso method of CaHA mixed with lidocaine has since been expanded to adjust rheological properties of CaHA and other fillers as well. Today, use of a Luer lock-to-Luer lock connector to tailor filler characteristics has become a familiar technique in the field of tissue augmentation.

**F. Laser treatment of vascular lesions**

The treatment of congenital and acquired vascular lesions is one of the most commonly requested and performed cutaneous laser and light-based office procedures. The pulsed dye laser was the first laser that was developed based on the theory of selective photothermolysis, a conceptual framework proposed by dermatologists Anderson and Parrish in the 1980s. Their theory revolutionized the treatment of vascular lesions, and continues to serve as the basis for most cutaneous laser and energy-based treatments today.

Clinical studies of the original pulsed dye laser and its subsequent refinements by dermatologists Garden et al., Ashinoff and Geronemus and others demonstrated its efficacy and high safety profile for treating pediatric and adult port wine stains, infantile hemangiomas, and other vascular lesions. Before the development of pulsed laser therapy, there was no adequate treatment method for port wine stain birthmarks that characteristically hypertrophy with time, leading to cosmetic disfigurement, psychological impairment, and other medical complications. Numerous studies have demonstrated that the best results are achieved when treatment is initiated early in infancy or childhood, and that even with multiple, repetitive treatment sessions in a pediatric population, the risk of scarring or long-term pigment alteration is rare.

Recent studies by dermatologists Izikson et al. and Tierney and Hanke demonstrated the benefit of the more deeply penetrating alexandrite laser for the treatment of hypertrophic and recalcitrant port wine stains. Dermatologists are currently investigating novel techniques to improve port wine stain treatment, including the combination of laser and antiangiogenic or immunomodulatory drugs.

Infantile hemangiomas are common, benign vascular lesions of infancy that are often present on the head and neck. During their growth phase, hemangiomas can obstruct vital organs; they often heal with residual fibrofatty tissue and they negatively impact the psychosocial development of the affected children. Dermatologists Garden et al., Morelli et al., and Geronemus and Kauvar showed that pulsed dye laser can slow the proliferation of hemangiomas during their growth phase, speed their involution, and stimulate epithelialization of ulcerated lesions. Fractional resurfacing lasers are now being used to treat the residuum of involuted hemangiomas.

Dermatologists developed and improved the techniques to treat telangiectases, rosacea, poikiloderma, spider angiomas, cherry angiomas, pyogenic granulomas, and venous lakes. Bernstein and Kligman showed that laser treatment of rosacea-associated telangiectasia and erythema also improves the symptomology associated with the flushing and blushing and reduces the number of inflammatory lesions. Studies by dermatologists revealed that the pulsed dye laser, used with repetitive high-energy pulses, effectively treats recalcitrant warts, including plantar and periangual lesions, without the morbidity and scarring observed with other destructive methods. Pioneering work by Alster and Williams using the pulsed dye laser at low fluences transformed the treatment of erythematous and hypertrophic scars, and McDaniel et al. demonstrated its efficacy in treating stretch marks.

In the 1990s, the 532-nm pulsed KTP, 755-nm long-pulsed alexandrite, and 1064-nm pulsed neodymium (Nd):yttrium-aluminum-garnet (YAG) lasers were explored for vascular lesion treatment. Goldman et al. pioneered the use of intense pulsed light, noncoherent light delivered by a flashlamp with millisecond domain pulses, for the treatment...
of vascular and pigmented lesions. Studies by dermatologists Dierickx et al.\textsuperscript{141} showed that longer pulse durations were ideally suited for the treatment of telangiectasia and enabled purpura-free treatment of most acquired vascular lesions and greater patient acceptance of these procedures. The introduction of skin cooling techniques using cryogen, cold air, or contact cooling devices improved treatment outcomes for congenital and acquired vascular lesions by protecting the epidermis and allowing the safe use of higher energy laser pulses.\textsuperscript{142,143}

Kauvar and Lou,\textsuperscript{144} Kauvar and Khrom,\textsuperscript{145} Omura et al.,\textsuperscript{146} and Parlette et al.,\textsuperscript{147} optimized parameters for the treatment of spider and reticular leg veins by using the more deeply penetrating, near-infrared alexandrite and Nd:YAG lasers. Goldman and Weiss were instrumental in developing endovenous closure, a technique that has largely replaced venous stripping for greater saphenous vein incompetence, whereby a bare laser fiber or radiofrequency-emitting catheter is introduced directly into the vein.\textsuperscript{148}

**G. Treatment of tattoos and pigmented lesions**

Three years after Dr Theodore Maiman\textsuperscript{149} created the first laser using a synthetic ruby crystal, dermatologist Dr Leon Goldman\textsuperscript{150} became the first physician to use therapeutic laser energy on the skin. Goldman observed highly selective injury of pigmented structures after treatment with the laser, prompting further investigation into its potential applications. In the years that followed these initial observations, Goldman et al.\textsuperscript{150} conducted experiments demonstrating the ability of the ruby laser to selectively destroy pigmented lesions, tattoo, and blood vessels. In 1983, dermatologists Anderson and Parrish\textsuperscript{150} described their groundbreaking theory of selective photothermolysis, shedding light on the physics at work in earlier observations of Goldman. Their groundbreaking theory that set the stage for the modern laser era states that through the use of the appropriate wavelength of light and pulse duration, one may precisely target and destroy a given chromophore.

Since the field’s inception, dermatologists have been at the forefront of laser skin surgery. Armed with the knowledge of selective photothermolysis, in the late 1980s and 1990s pioneering dermatologists such as, Geronemus, Kilmer, Wheeland, Goldberg, and Anderson\textsuperscript{151,152} continued to explore the clinical use of lasers for the treatment of both endogenous and exogenous pigment in the skin. The theory of selective photothermolysis predicted that the small size of melanosomes and tattoo particles would benefit from the use of very short pulse durations, in the submillisecond range. Clinically, this has been accomplished through the use of Q-switched lasers. Today the Q-switched ruby, Q-switched Nd:YAG, and Q-switched alexandrite lasers remain the workhorses for the treatment of pigmented lesions. However, over the past decade there have been many exciting discoveries, innovations, and new additions to the armamentarium.

Although Q-switched lasers emit laser light with pulse durations in the nanosecond range, data now suggest tattoo pigment particles may be more precisely targeted and completely destroyed by even shorter pulse durations, in the picosecond range. In 1998, dermatologists Ross et al.\textsuperscript{153} treated 16 black tattoos in a split lesion study with a Q-switched Nd:YAG laser and a picosecond Nd:YAG laser. While holding all other parameters constant, picosecond laser pulses were more efficient at clearing tattoo pigment than nanosecond domain pulses. One year later, dermatologists Herd et al.\textsuperscript{154} demonstrated superior tattoo clearance in a guinea pig model with a picosecond titanium:sapphire (795-nm) laser versus the Q-switched alexandrite (755-nm) laser. In a more recent study, Izikson et al.\textsuperscript{155} showed superiority of a picosecond laser when treating tattoo in a pig model when compared with a nanosecond laser of similar wavelength.

Another study by Saedi et al.\textsuperscript{156} also showed superiority of the picosecond alexandrite laser in tattoo removal. Benign pigmented lesions and colored tattoos also respond favorably to treatment with picosecond laser pulses. Dover et al.\textsuperscript{157} achieved 100% clearance of pigmented lesions by 2 treatments with a picosecond alexandrite laser. Brauer\textsuperscript{158} found this same laser to be effective in clearing difficult-to-treat blue and green tattoos.

Depending on color, age, and mechanism of placement, tattoo removal may require 6 to 10 treatments or more. Typically treatment sessions are spaced at 4- to 6-week intervals, necessitating that the patient return for multiple visits over a treatment period that may span years. However, recent work by dermatologists Kossida et al.\textsuperscript{159} suggest that this observed time between treatment sessions may be unnecessary. In their study 18 tattoos were divided in half and randomized. One half was treated with a single pass from a Q-switched alexandrite laser while the other half was treated with 4 passes with the same laser separated by 20 minutes. At 3 months the 4-pass treatment showed significantly greater clearing than the conventional single-pass treatment, often with complete tattoo clearing after the single treatment. This new
technique may significantly reduce the number of treatment visits to clear tattoos.

In 2004, another breakthrough in laser skin surgery introduced a different approach to the elimination of unwanted skin pigment. Fractional photothermolysis, first described by Manstein et al.\textsuperscript{160} delivers laser light to only a fraction of the treated surface area by splitting it into many microbeams. Vertical microscopic columns of tissue damage are created leaving intervening tissue intact and allowing more rapid healing. Using a novel fractionated 1540-nm nonablative laser, dermatologists Laubach et al.\textsuperscript{161} observed the microepidermal necrotic debris generated by the laser to be eliminated transepidermally. As the microepidermal necrotic debris was eliminated it carried excess and unwanted pigment with it, acting as a vehicle for controlled melanin release. Later it was confirmed that dermal necrotic debris created may be eliminated in the same manner.\textsuperscript{162}

Fractional photothermolysis has proved to be effective for many disorders of hyperpigmentation. Dermatologists Koubal et al.\textsuperscript{163} successfully treated nevus of Ota in Asian skin with a fractionated 1440-nm Nd:YAG laser without resultant postinflammatory hyperpigmentation. Dermatologists Weiss and Geronemus\textsuperscript{164} showed improved tattoo clearing when conventional Q-switched pigment lasers were combined with fractionated devices.

One of the benefits of nonablative fractional photothermolysis as a means of pigment elimination is the low rate of posttreatment pigmentedary complications, especially in darker skin. This attribute may be particularly useful in a condition such as melasma, which typically occurs in Fitzpatrick skin types III to V. Rokhsar and Fitzpatrick\textsuperscript{165} showed a high rate of response in melasma treated with 1550-nm erbium (Er)-doped fiber laser. Rokhsar and Giocon\textsuperscript{166} and Katz et al.\textsuperscript{167} both demonstrated the 1550-nm Er-doped fiber laser to be effective in the treatment of post-inflammatory hyperpigmentation as well. The fractionated 1927-nm laser was also shown to be very effective in the treatment of melasma by Polder and Bruce.\textsuperscript{168} Recently, the use of very low fluence Q-switched Nd:YAG devices to treat melasma has been shown to be very effective in studies by Polnikorn,\textsuperscript{169} Jeong et al.,\textsuperscript{170} and Kauvar.\textsuperscript{171}

Dyschromia, universally a component of photodamaged skin, responds to nonablative fractional photothermolysis as well. Dermatologists Wanner et al.\textsuperscript{172} observed improvement in the dyspigmentation of photodamaged skin after treatment with 1550-nm Er-doped fiber laser. Other non-Q-switched devices such as intense pulsed light and pulsed dye lasers operating in the millisecond domain have also been shown be effective in the treatment of epidermal pigmented lesions.\textsuperscript{173-175}

**H. Nonablative fractional laser resurfacing**

Dermatologists Manstein et al.\textsuperscript{160} pioneered the science of fractional resurfacing, a novel concept in which a device emits light in a pixilated fashion, producing a field of microthermal zones and small columns of thermal injury to the skin. Fractional emission of light to the skin promotes rapid collagen remodeling and re-epithelization and clinically manifests in a more advantageous side-effect profile and greater improvement in skin texture and tightening as a result of the increased depth of dermal injury.

Manstein et al.\textsuperscript{160} first postulated that fractional resurfacing may have a role in the treatment of skin laxity and textural anomalies as a result of their work with a prototype device that demonstrated tissue shrinkage in tattoos. In 2006, Hantash et al.\textsuperscript{162} further expanded upon the work of Manstein et al.\textsuperscript{160} and validated with histologic studies the mechanism of tissue injury and repair after fractional resurfacing. They used immunohistochemistry with human antielastin antibodies to identify that the product of thermal damage, degenerated dermal material, is shuttled up through the epidermis and ultimately, exfoliated through the stratum corneum within 7 days after injury.\textsuperscript{162} This hallmark discovery identified that fractional resurfacing is the first nonablative laser technology to result in removal of damaged dermal material through a perforated dermoepidermal junction.\textsuperscript{160} In 2006, Laubach et al.\textsuperscript{161} provided the clinical correlate to this study describing how fractional resurfacing results in improvement in dyschromia through creation of microscopic necrotic columns of epidermal debris containing melanocytes destroyed by thermal columns of injury. With this novel mechanism of injury and repair of dermal and epidermal zones of injury, a number of dermatologic investigators have used fractional resurfacing as a unique therapeutic option for the treatment of a diverse number of conditions of epidermal and dermal biology, including photoaging of the face, neck, and hands,\textsuperscript{161,176-178} melasma,\textsuperscript{176} and acne scarring.\textsuperscript{179}

**Ablative fractional resurfacing.** Although many studies have demonstrated significant benefits of nonablative fractional resurfacing, with minimal adverse effects,\textsuperscript{160,162,176-179} the resulting improvement in skin texture and pigmentedary variation fell significantly behind those of traditional ablative carbon dioxide (CO\textsubscript{2}) and Er:YAG laser resurfacing.
and medium to deep chemical peels. As a result of the need for greater results with fractional photothermolysis with similar minimal side-effect profiles, Hantash et al.\textsuperscript{180,181} published the first results with an ablative fractional CO\textsubscript{2} device in 2007. The excitement of this discovery stemmed from initial reports of the efficacy of ablative fractional photothermolysis in skin tightening, with similar results to those of traditional ablative CO\textsubscript{2} and Er:YAG resurfacing, with advantages of only 5 to 7 days of downtime and less risk of permanent scarring and dyspigmentation. Ablative fractional resurfacing has recently demonstrated significant promise in moderate to severe acne scarring in terms of clinical improvement and topographic mapping of decreases in individual scar volume.\textsuperscript{182} In addition, ablative fractional resurfacing has shown great promise in reducing skin surface and texture abnormalities, including moderate to severe rhytides and skin laxity of the face, including the neck, chest, and hands.\textsuperscript{183-185}

Hantash et al.\textsuperscript{181} introduced the first ablative fractional CO\textsubscript{2} device in 2007, with a similar column of thermal coagulation as with the nonablative fractional device of Manstein et al.\textsuperscript{160} with the differentiation of technology of a confluent column of tissue ablative injury from the dermis through the stratum corneum. Using immunohistochemistry, Hantash et al.\textsuperscript{180} demonstrated persistent collagen remodeling that occurred for at least 3 months after injury with an ablative fractional resurfacing device. Subsequently, dermatologists Goldberg et al.\textsuperscript{186} demonstrated clinical improvement in photoaging and histologic and ultrastructural change in collagen deposition on both light and electron microscopy.

Resurfacing of the face with ablative fractional resurfacing marks a significant advantage over traditional ablative resurfacing, where significant risks of prolonged erythema, scarring, and dyspigmentation complicate treatment. Stebbins and Hanke\textsuperscript{183} treated a series of patients with photoaging of the hands and noted significant improvement in wrinkles, pigment, and texture, with no adverse effects. Resurfacing of the neck is complicated by unpredictable and prolonged wound healing owing to the ultrastructure of the skin with a decreased number and density of pilosebaceous units, which is thought to delay re-epithelialization and increase scarring risk. Tierney and Hanke\textsuperscript{184} treated a series of patients with moderate to severe photoaging and laxity of neck skin, and found significant improvement in skin texture, skin laxity, and overall cosmetic outcome with ablative fractional resurfacing.

Sukal et al.\textsuperscript{187} first evaluated treatment of eyelid skin laxity with nonablative fractional resurfacing where investigators noted that patients experienced improvement in eyelid skin tightening and had a significant improvement in eyelid aperture as a result of skin tightening achieved with fractionated resurfacing. Tierney et al.\textsuperscript{185} performed a single blinded study with an ablative fractional CO\textsubscript{2} device and observed significant improvement in lower eyelid laxity with 2 to 3 sessions.

### I. Laser (nonvascular) and energy-based devices

Dermatologist Leon Goldman et al.\textsuperscript{188} was the first adopter of laser technology in medicine applying the work of American physicists such as Charles Townes and Theodore Maiman to treat a variety of skin conditions. In 1983, Anderson and Parrish\textsuperscript{120} revolutionized the specialty of laser surgery by proposing the theory of selective photothermolysis. The Department of Dermatology at Harvard Medical School encompasses the Wellman Center for Photomedicine, headed by Anderson, and is responsible for the majority of advances in modern laser medicine and energy-based devices. Notably, roughly half of the technology developed at the Wellman Center of Photomedicine has applications beyond the skin, and has led to major advances in other specialties including ophthalmology, gastroenterology, and cardiology, thus highlighting the leading role dermatologists have played in advancing medicine in general.

The development of pulsed lasers based on the theory of selective photothermolysis has led to safe and effective treatment for vascular lesions, including many pediatric vascular malformations, pigmented lesions, tattoos, the permanent removal of hair, and photoaging/resurfacing.\textsuperscript{189} Lasers have also been found to be useful for medical dermatologic conditions, such as psoriasis.\textsuperscript{190} Current investigations by the dermatologists Hongcharu et al.\textsuperscript{191} are developing novel future applications of selective photothermolysis, including the treatment of fat and acne with lasers. The use of photodynamic therapy to treat acne, actinic keratoses, and non-melanoma skin cancer has also been pioneered by many dermatologists. Fractional photothermolysis developed by dermatologists Anderson et al.\textsuperscript{192} has revolutionized the treatment of scarring. Interestingly, fractional laser treatments hold the potential to impact medicine beyond dermatology, as it allows for the systemic delivery of large molecules across the skin barrier.\textsuperscript{193} Numerous contributions to laser surgery have also come from the Beckman Laser Institute at University of California-Irvine, where dermatologists, other physicians, and basic scientists collaborate to advance laser medicine.
Innovation by dermatologists has resulted in the development of other devices within the electromagnetic spectrum or through controlled cooling. Dermatologists Manstein et al.\textsuperscript{160,194} developed a novel method of noninvasive localized fat removal through the controlled cooling of skin. The use of focused ultrasound for skin tightening was also developed by Laubach et al.\textsuperscript{195} and clinical trials performed by dermatologists such as Alam et al.\textsuperscript{196} The fractional treatment model has also been extended to radiofrequency to result in skin tightening and elastin production. Clinical studies have been led by dermatologists Hruza et al.\textsuperscript{197} and Alexiades-Armenakas et al.\textsuperscript{198} A microwave-based device to treat axillary hyperhidrosis was also guided in the earliest clinical testing by several dermatologists.\textsuperscript{199}

J. Liposuction using TLA

Several US dermatologists, including Saul Asken\textsuperscript{200,201} and Sam Stegman and Ted Tromovitch,\textsuperscript{202} began performing liposuction using local anesthesia in the mid-1980s. Asken\textsuperscript{200,201} was the first dermatologist to author 2 elegantly illustrated books on the subject. Liposuction safety took a major step forward when Jeffrey Klein\textsuperscript{203} described the tumescent technique in 1987. The work of Klein has been truly revolutionary in that liposuction could be performed safely and effectively on awake patients thereby avoiding the risks of general anesthesia. Bleeding was minimized with the technique of Klein and the cosmetic results were excellent. Multiple studies by dermatologists have demonstrated the safety and effectiveness of the tumescent technique.\textsuperscript{204-206} The tumescent technique was also adapted by nondermatologists who performed liposuction using general anesthesia. However, the safety profile for liposuction changes when general anesthesia is added. Guidelines for the safe use of TLA have been published on multiple occasions by the AAD and the ASDS.\textsuperscript{207,208} When these guidelines are followed, the safety of patients undergoing liposuction using TLA is maximized, and significant postoperative complications are minimized.\textsuperscript{209,210} To date, there have been no documented fatalities from liposuction using strictly TLA on awake patients when safety guidelines are followed.

\textit{Tumescent Technique} was the title of Klein’s\textsuperscript{211} hallmark book on microcannular liposuction published in 2000. A more descriptive term, “tumescent local anesthesia,” was first used in the title of a German textbook on liposuction in 1999.\textsuperscript{212} The book \textit{Tumescent Local Anesthesia} was published in English in 2001.\textsuperscript{213} Klein’s book is currently out of print, but other books have been published on the subject.\textsuperscript{214,215}

K. Microdermabrasion

Since ancient times it has been appreciated that removing the superficial layers of the skin ultimately results in improved appearance of the skin. During the 20th century dermatologists led the way in resurfacing techniques such as chemical peels and wire-brush dermabrasion, then into the 21st century with ablative and fractionated laser resurfacing. Among the gentler resurfacing techniques is microdermabrasion. The first mention of this technique in the medical literature is found in the dermatology journal \textit{Dermatologic Surgery} when Tsai et al.\textsuperscript{216} discussed the use of this device for acne scars. Since that time microdermabrasion has found widespread acceptance in cosmetic practice.

Microdermabrasion originally consisted of a hand piece connected to a suction line that drew the skin gently into the hand piece itself. Then, a second line blew aluminum oxide crystals onto the skin to produce a gentle abrasion. Histologic studies carried out by dermatologists suggest the technique removes only the stratum corneum,\textsuperscript{217,218} but there may be a contribution of the suction itself to the success of the technique.\textsuperscript{218} Detailed molecular studies, carried out by dermatologists at the University of Michigan,\textsuperscript{219} have convincingly demonstrated biochemical changes associated with dermal remodeling with this procedure. These changes include increased gene expression of c-Jun component of activator protein 1, interleukin 1-beta, tumor necrosis factor-alfa, and matrix metalloproteinases (MMP) associated with dermal remodeling (MMP-1, MMP-3, MMP-9). Further studies from the same group also found molecular changes associated with the wound-healing process including induction of cytokeratin 16 and activation of the activator protein-1 transcription factor in the epidermis.\textsuperscript{220} Again, induction of MMP-mediated degradation of the extracellular matrix in the dermis was observed, and significant dermal remodeling as evidenced by induction of type I and type III procollagen, and collagen production enhancers heat shock protein 47 and prolyl 4-hydroxylase was seen.

Since the original aluminum oxide crystal devices were introduced, a number of modifications have appeared on the market. These modifications were induced by a desire to avoid the use of aluminum, which has been suggested to be associated with the development of Alzheimer disease,\textsuperscript{221} but not convincingly so. One modification simply substituted sodium chloride for aluminum oxide crystals. More recently, small metal plates coated with diamond dust have been incorporated into the hand piece to replace any crystals at all. The skin is drawn into the
hand piece, and then rubbed with the diamond fraise plate to produce a superficial abrasion.

Beyond cosmetic use, dermatologists have used these devices to increase penetration of topical medications. For example, dermatologists Katz et al. demonstrated microdermabrasion used before application of topical d-aminolevulinic acid for photodynamic therapy dramatically improved clinical response to the photodynamic therapy procedure, presumably by enhanced penetration of the aminolevulinic acid. It has now become common practice to combine microdermabrasion with topical medications to enhance penetration of the topical itself. Dermatologists have combined microdermabrasion with medications as diverse as 5-fluorouracil in a report that suggested the combination was more effective in treating vitiligo compared with using 5-fluorouracil alone. Microdermabrasion is now firmly established as a gentle cosmetic procedure and a device to enhance topical medication and product delivery.

L. Dermabrasion

Over the past century, dermatologists originated, developed, and mastered the techniques of resurfacing the skin by the use of dermabrasion. “Cold steel” dermabrasion is a means of removing the epidermis by means of a rotating diamond fraise or wire brush to create a papillary or mid-dermal wound. Subsequent healing results in the formation of new collagen and a renewed epidermis generated from cells deep within the follicles, without a scar. The reorganized collagen and fresh epidermis provide superb cosmetic improvement in actinically damaged or scarred skin. This was first described in 1905 by Kronmayer, a dermatologist in Germany. He adapted the use of power tools and skin refrigeration to the technique. Abner Kurtin, a New York dermatologist, developed the wire brush and its adaptation to a power dental tool to treat scars and wrinkles. Burks treatise modernized the wire-brush technique and expanded the scope of the procedure in the late 1950s. These advances energized Orentrich, Ayres, and others to refine the procedure further in the 1970s and 1980s. Nelson et al. contrasted the effects of wire-brush and diamond fraise methods, and then used immunohistology to show the development of transforming growth factor β, procollagen, and type I and III collagen after dermabrasion in photoaged skin. Mandy and others improved the preoperative and postoperative management of dermabrasion by the preoperative use of topical retinoids, and the postoperative use occlusive dressings as described by Maibach and Rovee. Rubenstein et al. created controversy by reporting that treatment of acne with isotretinoin in proximity to dermabrasion adversely affected healing, possibly resulting in hypertrophic scarring. Other studies by Moy et al. failed to confirm an affect on dermal healing. Coleman et al. expanded the indications for dermabrasion demonstrating its benefit in the management of precancerous skin to prevent the development to carcinoma.

Thorough descriptions of dermabrasive techniques have been written by Burks, Yarborough, Alt, and Mandy and Monheit. Many practitioners of the art have different preferences as to the use of wire brush versus diamond fraise for abrasion, but the most important element is prior hands-on training in a preceptor environment. An area in which dermabrasion has recently changed is in pain management during the procedure. In prior years, chlorofluorocarbon refrigerant aerosol spray was used to anesthetize and solidify the skin.

By freezing the skin, it became simultaneously numb and rigid, facilitating the sanding while preventing pain. Controversy about the possible scarring caused by freezing was described by Hanke but became mute after chlorofluorocarbons were banned from production in the United States in 1996 because of their theoretical atmospheric impact.

Consequentially, analgesia today involves regional nerve blocks described by Countryman and Hanke and supplementation with modified TLA also described by Hanke. These techniques can provide adequate full-face anesthesia for dermabrasion and laser procedures as well.

As lasers have become the most frequently used method of resurfacing, some believe that dermabrasion will soon be absent from the dermatologic tool box. Yet the cost of the equipment is far less than lasers, is technologically stable, and consumes little space. The procedure has broad application in the treatment of actinic damage, tattoos, and traumatic, burn, surgical, and acne scars. Fitzpatrick et al. has shown that the ultrastructural changes seen after laser, trichloroacetic acid (TCA) peeling, and dermabrasion are all comparable. Giese et al. showed that at 6 months dermabraded skin was stronger and more supple than skin after phenol peel. Dermabrasion remains an effective, economical, and some might argue superior, resurfacing modality addressing many indications. Perhaps the single impediment to its remaining a vital part of the dermatology armamentarium is that as the artisans in this procedure retire, there will be few left to provide the hands-on training necessary to be proficient in its application.
M. Chemical peels
During 1980s Stegman\textsuperscript{243} paved the way for a scientific investigation of chemical peels by analyzing the histologic sections of human skin after TCA and phenol peels. He further compared the effect of occluded versus unoccluded procedures.

Unfortunately dermatologists, with a few exceptions, gave up almost completely in recent years the privilege of performing deep chemical peels, leaving this field to other medical specialties.\textsuperscript{244}

From the end of the 20th century dermatologists concentrated their effort in the optimization of the medium-depth peels. Various combinations have been used to increase the efficacy of TCA peel without affecting its safety. Brody and Hailey\textsuperscript{245} implemented the combination of TCA with CO\textsubscript{2} freeze. Monheit\textsuperscript{246} publicized the combination of TCA and Jessner solution, whereas Coleman and Futrell\textsuperscript{247} suggested skin pretreatment with glycolic acid to create a more even penetration of TCA. CROSS technique (chemical reconstruction of skin surface improvement and pigmentary variation, to more moderate approaches to address deeper and widespread scarring, such as scar subcision, dermabrasion, punch grafts, ablative CO\textsubscript{2}, and Er:YAG laser resurfacing and most recently, fractional photothermolysis.

The current armamentarium of treatment approaches for acne scarring ranges from superficial approaches, such as glycolic acid, chemical peels, topical tretinoin, and topical hydroquinone for skin surface improvement and pigmentary variation, to more moderate approaches to address deeper and widespread scarring, such as scar subcision, dermabrasion, punch grafts, ablative CO\textsubscript{2}, and Er:YAG laser resurfacing.

In the last decade, fractional resurfacing for acne scarring has been performed by dermatologists for acne scarring for the last 2 decades. Dermatologists Alster and West\textsuperscript{258} reported on a series of 50 patients with moderate to severe acne scars with improvement of 81.4\% in all patients. However, the adverse effects experienced were significant, where 36\% of patients had transient hyperpigmentation, and all patients had a significant degree of posttreatment erythema that persisted at 3-month follow-up.

In the last decade, fractional resurfacing for acne scars has been developed by dermatologists Manstein et al.\textsuperscript{160} The significance of fractional resurfacing for acne scarring is associated with a significantly lesser degree of risk of posttreatment induction of pigmentation and scarring. The pixilated nature of fractional resurfacing, in which the laser stimulates the adjacent stem cells in adjacent intact columns of tissue, promotes collagen remodeling and neocollagenesis and results in the clinical improvement in the atrophic component of acne scarring. Dermatologist Roy Geronemus\textsuperscript{176}...
was the first to report on fractional photothermolysis for acne scarring, where 17 subjects with ice-pick, boxcar, and rolling scars received a series of 5 treatments. No instances of posttreatment hyperpigmentation, hypopigmentation, or scarring were observed.

A recent consensus statement about the use of the nonablative fractionated laser by Sherling et al divided acne scars into 2 categories: distensible or nondistensible scars. Distensible scars improve more readily with fillers and laser resurfacing than nondistensible scars. Physicians may consider doing punch excisions of nondistensible acne scars, especially narrow, deep acne scars (ice-pick scars) before nonablative laser resurfacing. The panel contended that nonablative fractional lasers improved the appearance of acne scars by as much as 50%; however, treatment requires an extensive series of 4 to 5 treatments, each spaced 1 month apart. Uniquely, nonablative fractional resurfacing has been shown to improve acne scars in patients with darker skin phototypes (IV-VI) with minimal risks of postinflammatory hyperpigmentation.259

Although the initial reports of nonablative fractional laser technology for acne scarring were promising, recent work has shown that this technology provides limited efficacy in the treatment for deeper scars, such as those of the ice-pick morphology, with a rapid drop-off in depth from the surface. Most recently, the advent of ablative fractional resurfacing as a safe and effective treatment for acne scarring represents a significant advance. It promotes greater efficacy in atrophic scars through the delivery of high fluences to reticular dermal tissue and results in efficacy in a decreased number of treatments compared with nonablative fractional resurfacing.

Ortiz et al presented the first results of a fractionated CO\textsubscript{2} device for the treatment of acne scarring. A total of 15 subjects underwent up to 3 treatments. Patients with a diversity of skin types (I-V) were treated with no complications such as short- or long-term hyperpigmentation reported. Of patients, 87% sustained significant improvement in the appearance of acne scarring at 3-month follow-up visits.

In 2008, dermatologists Chapas et al published the results of the largest study of an ablative fractional resurfacing device to date, which resulted in significant improvement in patients with moderate to severe acne scarring. In vivo studies by Hantash et al with this device have shown tissue ablation and thermal effects as deep as 1 mm into this skin. This likely accounts for the effect on moderate to severe acne scarring observed. Side effects with the ablative fractional device were mild to moderate, including posttreatment erythema, edema, and petechiae, all of which resolved within 7 days after treatment. Most importantly, unlike traditional ablative CO\textsubscript{2} resurfacing, no incidence of delayed dyspigmentation was noted during the treatment interval or during the 3 months of follow-up posttreatment.

The high degree of efficacy in the absence of significant adverse side effects makes fractional resurfacing a novel and safe addition to the treatment armamentarium for acne scarring.

O. Hair transplantation

The dermatology residency is unique in that it trains its physicians in the biology of hair follicles, encourages research in both the basic science and clinical aspects of hair, and teaches its residents to perform hair transplantations. Hair transplantation was pioneered by the dermatologist Norman Orentreich. Dermatologists continue to make major contributions to this very specialized branch of medicine.

Dermatologist Bobby Limmer had the novel idea of using a microscope to aid in the dissection of grafts to avoid follicular transection. His method was described in his 1994 article, “Elliptical donor stereoscopically assisted micrografting as an approach to further refinement in hair transplantation.”

The following year, dermatologists Bernstein et al laid down the conceptual framework for follicular unit transplantation in their 1995 article, “Follicular transplantation.” In 1997, they detailed its clinical application in the paired articles, “Follicular transplantation: patient evaluation and surgical planning” and “The aesthetics of follicular transplantation.”

The 2 advances, the application of the stereomicroscope to follicular dissection and the use of follicular units as the basic element of hair transplantation, arose from a background in dermatology. They moved the field of hair restoration surgery from plugs and mini-micrografting, where this basic anatomical feature of the hair follicle was ignored, to follicular unit transplantation, where the follicular unit became sacrosanct. These 2 ideas, when put to clinical use, allowed the once elusive goal of a completely natural-looking hair transplant to finally be achieved.

Stereomicroscopic dissection is a powerful tool for avoiding follicular unit damage when isolating the units from a donor strip; however, it is unable to prevent transection when the strip is first removed from the scalp. For more than 25 years the donor strip had been excised from the surrounding tissue using a scalpel. It took dermatologist Robert
Haber\textsuperscript{266} to design a spreading device that could remove the strip using blunt manipulation. This innovation helps surgeons reduce follicular transection in the important first step of a follicular unit transplantation procedure.

A number of hair-implanting devices have been devised over the years, but none have been as popular as the Choi hair transplanter. This ingenious hand-held device, created by the dermatologist Yung Choi and his colleague Jung Kim\textsuperscript{267} in 1992, simultaneously creates a recipient site and inserts a hair-bearing graft that had been loaded into its chamber. It was equally as useful for the micrografts of 20 years ago as it is for the follicular unit hair transplantations performed today.

Limmer\textsuperscript{268} suspected that the time grafts were held outside the body was an important variable in graft survival. In a landmark study, he showed a high, but diminishing, survival for micrografts held in chilled saline for the first 8 hours. Dermatologist Jerry Cooley\textsuperscript{269} took it a step further, exploring whether the characteristics of the holding solution itself can be modified to enhance the survival of follicular unit grafts. With his work on both ischemia-reperfusion injury and storage injury, Cooley\textsuperscript{269} has shown that the use of antioxidants to lower free radical activity can significantly increase graft survival time. This is an important modification of the hair transplantation procedure because, over the years, the number of grafts transplanted per session and the length of time grafts are held outside the body continue to grow.

Dermatologist Dow Stough\textsuperscript{270}, appreciating the inexorable progression of androgenetic alopecia, was one of the first physicians to stress a conservative, long-term approach to hair transplantation. This included: creating an irregular pattern of single-hair grafts at the frontal hairline; using a mature, adult pattern for its position; and focusing on restoring hair to the frontal scalp. Most importantly, he encouraged doctors to delay hair transplantation in younger patients until their hair-loss patterns could be better assessed and their expectations set appropriately.

Stough, with dermatologist O’tar Norwood, founded the International Society for Hair Restoration Surgery, an organization with over 800 physician members that has become the foremost international association of hair restoration surgeons. Norwood also launched the bimonthly journal \textit{Hair Transplant Forum International} that now serves as the educational hub through which hair restoration surgeons around the globe communicate new ideas and present preliminary scientific data in an informal, but timely, way. Stough, with fellow dermatologist Haber,\textsuperscript{271,272} has published 2 concise, but excellent, texts on hair replacement.

Dermatologist Walter Unger et al\textsuperscript{273} edited \textit{Hair Transplantation}, the first comprehensive multiphysician reference textbook dedicated to hair transplantation surgery. Now in its fifth iteration, this encyclopedic series of textbooks has become the standard reference text in the field. Unger et al\textsuperscript{275} has served as an important cautionary influence on the impetuosity of many newer members of our profession. He astutely warned that ideas, which initially seem to hold promise, warrant further scientific investigation before being adopted.

The office clinician is unable to precisely measure the natural progression of hair loss and its response to treatment. Densitometry can assess the percent of hair affected by miniaturization, but is unable to quantify the wide range of hair diameters seen in androgenetic alopecia. Dermatologist Bernard Cohen\textsuperscript{274} cleverly solved this problem with an instrument called the cross-section trichometer. This instrument measures hair mass: the cross-sectional area of a bundle of hair present in a premeasured area of scalp. It detects small changes in both hair density and diameter, and is an objective way to measure the effectiveness of various therapies provided by the hair restoration physician.

A method of removing follicular unit grafts directly from the scalp, without the need for a linear incision, had been worked out by an Australian physician in the 1990s. He was, however, secretive with his techniques, and few other doctors attempted to duplicate this new procedure. With the publication of the article, “Follicular unit extraction,” by Rassman et al\textsuperscript{275} in 2002, the follicular unit extraction procedure gained popular appeal and was rapidly adopted by doctors worldwide. The authors cautioned on the limitations of this harvesting technique and the risk of follicular damage. Dermatologists Berman, Zering, and Bernstein—along with their colleagues in other specialties—continue to work on the problem of harvesting in follicular unit extraction, with the application of robotic technology showing particular promise.\textsuperscript{276}

Although donor dominance has been the guiding principle for hair transplantation surgeons over the past half century, this did not deter dermatologist Hwang et al\textsuperscript{277} from challenging the very concept. Hwang et al\textsuperscript{277} showed that when hair was transplanted from one part of the body to another, the recipient site can influence such factors as hair growth and survival, hair shaft diameter, and length. His work has profound implications for transplanting hair into a balding
scars from other parts of the body—such as the trunk, legs, and beard—potentially expanding a person’s supply of donor hair.

Going forward, the field of hair transplantation will be shaped by advances in biotechnology that will, in time, enable the cloning of human hair and possibly make a person’s donor supply unlimited. Although it is not clear who will be the first to achieve this elusive goal, important research is currently underway by a number of dermatologist investigators.278-281

This article has surveyed some of the important contributions dermatologists have made to the field of hair restoration surgery over the past 2 decades. Because of space constraints, the contributions of a number of other notable dermatologists have not been mentioned including James Arnold, Marc Avrum, Pierre Bouhanna, Francisco Jimenez, Matt Leavitt, William Parsley, Paul Rose, and Arthur Tykocinski. That this writing is a snippet of this elusive goal, important research is currently underway by a number of dermatologist investigators.278-281

P. Sclerotherapy and varicose vein therapy

Vascular lesions including varicose veins or telangiectases are common and affect up to 50% of the adult population. Several studies show that these lesions, even if they are typically not painful, can have a great impact on quality of life.282 Although leg lesions with symptoms such as aching, discomfort, or muscle cramps primarily affect the health-related quality of life, facial lesions such as rosacea or telangiectasia can lead to psychological discomfort.283 This can lead to embarrassment, anxiety, decreased self-esteem, and avoidance of social situations in those affected. Seen from this perspective it becomes apparent that the treatment of vascular lesions has a high medical relevance and is far from just being cosmetically important.

An early development was the use of injectable sclerosants to block or shrink vessels. After first attempts with several agents beginning at the end of the 19th century, the foundation of modern sclerotherapy began in 1916, when the dermatologist Paul Linser284 reported successful treatments using perchloride of mercury with an intravascular technique. Over the years the procedure was improved steadily and became fully accepted by the medical community. Even today, innovations are still evolving, making the procedure safer and more effective for patients and physicians.

An example of the steady evolution of sclerotherapy is the recently FDA-approved sclerosant polidocanol, a mixture of ethers, macrogols, and fatty alcohols, which produces endothelial damage by multiple mechanisms. It shows equal clinical efficacy to sodium tetradeyl sulfate, but with less severe complications.285 A pivotal study actually showed a higher treatment success rate and statistical superiority in patient satisfaction of polidocanol over sodium tetradeyl sulfate and isotonic saline. The incidence of side effects was generally lower for patients treated with polidocanol than for patients treated with sodium tetradeyl sulfate.286 Experimental studies show that polidocanol has a lower probability for tissue necrosis than any other sclerosant.287 Furthermore, because of its anesthetic effect, it does not cause pain.288

Another innovation that enhanced the spectrum of minimally invasive treatment options for varicose veins was the use of endovenous radiofrequency ablation, first described by Weiss and Goldman289 in 1999. Radiofrequency energy is delivered through a special catheter with deployable electrodes at the tip; the electrodes contact the vein walls and deliver energy directly into the tissues, where the radiofrequency is converted into heat and causes irreversible localized tissue damage. The endovenous radiofrequency ablation procedure can be performed entirely under local tumescent anesthesia, with patients resuming normal activities 1 to 2 days postoperatively.

In 2001, only a short time after the introduction of endovenous radiofrequency ablation, another endovenous procedure was introduced by Navarro et al.290 The procedure is based on laser energy delivered endovascularly via a fiberoptic laser fiber. The laser energy leads to the formation of steam bubbles at the tip of the laser fibers, which causes thermal damage to the venous endothelium and results in thrombotic occlusion of the vessel lumen. Endovenous laser treatment is a safe and well-tolerated alternative in the management of uncomplicated varicose veins and has subsequently to its introduction undergone a rapid increase in popularity and use with a concomitant decrease in traditional operative saphenectomy.291

The goal of several studies in recent years was to identify the influence of using a foamed sclerosant. A study published by Ouvry et al292 in 2008 showed that with 3% polidocanol foam complete elimination of reflux was obtained in 85% of patients after 3 weeks, whereas 3% liquid polidocanol was effective in only 35%. There was no difference in the incidence of ecchymosis, inflammatory reactions,
Goldman identified room air as being perfectly ideal gas for the foaming process. Peterson and many indications, the latest research focuses on the treatment of the greater saphenous vein. After safe compared with 3% liquid polidocanol for polidocanol foam to be more efficient and equally same efficacy and safety profile as CO2, but the half-life is 3 times longer and less sclerosant is needed.

Another goal in the recent years has been to identify the relevance of compression after sclerotherapy, a technique that has been used since the 1960s but is still controversial. Although Weiss et al. and Kern et al. found that wearing compression stockings for 3 weeks enhances the efficacy of sclerotherapy of leg telangiectasias, a study by Hamel-Desnos et al. found no difference comparing efficacy, side effects, satisfaction scores, symptoms, and quality of life after foam sclerotherapy of the saphenous veins.

The management of both cosmetic telangiectasias and medical indications has been advanced by dermatologists and encompasses a multiple modality approach using sclerosants, radiofrequency, light sources, and minimally invasive techniques. This multimodality approach has changed the scope of management of both cosmetic and medical venous disorders.

IV. REFERENCES


68. Carruthers A, Carey W, De Lorenzi C, Remington K, Schachter D, Sapra S. Randomized, double-blind comparison of the
efficacy of two hyaluronic acid derivatives, Restylane, Perlane and Hylaform, in the treatment of nasolabal folds. Dermatol
69. Dover JS, Rubin MG, Bhatia AC. Review of the efficacy, durability, and safety data of two nonanimal stabilized
70. Narins RS, Dayan SH, Brandt FS, Baldwin EK. Persistence and improvement of nasolabal fold correction with
nonanimal-stabilized hyaluronic acid 100,000 gel particles/mL filler on two retreatment schedules: results up to 18 months
71. Narins RS, Brandt FS, Dayan SH, Hornfeldt CS. Persistence of nasolabal fold correction with a hyaluronic acid dermal filler
caused by cross-linked hyaluronic acid dermal filler injections in photodamaged human skin. Arch Dermatol 2007;143:
155-63.
73. Marmur ES, Phelps R, Goldberg DJ. Clinical, histologic and electron microscopic findings after injection of a calcium
74. Friedman PM, Mafong EA, Kauvar AN, Geronemus RG. Safety data of injectable nonanimal stabilized hyaluronic
77. Schanz S, Schippert W, Ulmer A, Rassner G, Fierlbeck G. Arterial embolization caused by injection of hyaluronic acid
78. Glomau RG, Kane MA. Effect of injection techniques on the rate of local adverse events in patients implanted with
79. Taylor SC, Burgess CM, Callender VD. Safety of nonanimal stabilized hyaluronic acid dermal fillers in patients with skin
81. Matarasso SL, Carruthers JD, Jewell ML. Consensus recommendations for soft-tissue augmentation with nonanimal
82. Dover JS, Brown MG, Bhatia AC. Review of the efficacy, durability, and safety data of two nonanimal stabilized
injectable poly-L-lactic acid versus human-based collagen


Mohs micrographic surgery is a precise surgical method developed to excise different skin cancers with complete microscopic margin control, resulting in the highest cure rate with maximal tissue conservation.

This technique was first described more than 80 years ago and has become the treatment of choice for non-melanoma skin cancers (NMSCs) with high risk for local recurrence or possible significant functional or cosmetic impairment.

The aim of our study was to test the hypothesis that the total number of publications regarding Mohs micrographic surgery has increased over time in a linear fashion.

Methods

The authors searched PubMed (http://www.ncbi.nlm.nih.gov/entrez) to evaluate all articles published from January 1, 1994, to December 31, 2013, using the search terms “Mohs surgery” and “Mohs micrographic surgery” and filters for case reports, clinical trials, comparative studies, guidelines, meta-analysis, multicenter studies, reviews, and editorials.

Studies were then divided into 3 groups: (1) basal cell carcinoma (BCC)/squamous cell carcinoma (SCC), (2) melanoma, and (3) other topics which included preoperative and postoperative care, other skin tumors, complications, reconstruction techniques, histological techniques, and cure rates.

To verify that the categorization and tagging offered automatically by PubMed was accurate, the authors reviewed all abstracts published in this timeline.

Minitab software (version 16.0; State College, PA) was used for statistical analyses. The authors used regression analysis to determine the effect of an advancing year of publication on the number of publications of each type and group. A p-value of <0.05 was considered significant.

Results

The authors’ search yielded 2,297 publications, 1,390 of which were included in their analysis after limiting to their predefined filters.

Table 1 depicts the number of publications per year in each category and group.

There was a statistically significant linear increase over time in the total number of publications on Mohs micrographic surgery published in the last 20 years in the medical literature both overall (R² = 57.4%, p < 0.00001) and in all of our studied groups.
# TABLE 1. Number of Publications Per Year in Each Category and Group

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B/S, basal cell carcinoma/squamous cell carcinoma; CR, case reports; E, editorials; G, practice guidelines; MEL, melanoma; MA, meta-analysis; OS, observational studies; OTH, others; R, reviews; T, total.
melanoma (R2 = 34.38%, p < 0.007), BCC/SCC (R2 = 31.74%, p < 0.001), and others (R2 = 45.72%, p < 0.001) (Figure 1).

Further analysis by the type of study revealed a significant increase in the number of case reports published in the BCC/SCC group (R2 = 22.43%, p < 0.05) and more significantly in the others group (R2 = 51.01%, p < 0.00001) (Figure 2). There was also a substantial increase in the number of observational studies and reviews in this group: R2 = 32.69%, p < 0.008 and R2 = 38.94%, p < 0.003, respectively. Even though there was a linear increase in the number of publications in the remaining of the categories studied, there was no statistical significance.

Due to the large increase in the number of case report publications in the “other” group, the authors further analyzed publications filtered by case report and found that 81% of all case reports belonged to the “other” group, in which 60% were related to preoperative and postoperative care, complications, reconstruction and histological techniques, and cure rates, whereas the remaining 40% were related to skin tumors other than melanoma, BCC, and SCC and new indications for the use of Mohs surgery (Table 2).

**Discussion**

This study shows that the overall number of publications on Mohs surgery in the medical literature has increased steadily over the past 20 years. However, this increase in the number of publications is largely attributed to studies of lower scientific value, namely case reports, observational studies, and reviews.

When comparing the present results to that of other subjects in dermatology, the authors found that there was a similar linear increase in publications in general dermatology (R2 = 85%, p < 0.000001), pemphigus (R2 = 75.9%, p < 0.00002), dermatologic surgery (R2 = 73.2%, p < 0.002), and Mohs surgery (R2 = 86.4%, p < 0.000002) between 1994 and 2007. Apart from a broader publication space in dermatology, the overall increase in publications associated with Mohs is closely related to the exponential increase in the percentage of skin cancers managed with Mohs surgery in the United States, which increased from 3% in 1995 to 17% in 2010, plus a larger number of Mohs surgeons worldwide each year.

The increase in the number of publications was largely attributed to studies of lower scientific value. Although, case reports and observational studies significantly influence medicine because they are often the first line of evidence in efficacy or failure of treatments, there is still a need to further corroborate or disprove their results by large prospective comparative trials. For example, according to the National Comprehensive Cancer Network guidelines, one can consider Mohs surgery or...
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ANGIO, angiosarcoma; AT, adnexal tumors; DF, dermatofibroma; DFSP, dermatofibrosarcoma protuberans; EP, extramammary Paget disease; FX, fibroxanthomas; GCT, granular cell tumor; GLOMUS, glomus tumor; LE, lymphoepithelioma; LM, leiomyosarcoma; MERKEL, Merkel cell carcinoma; METS, cutaneous metastasis of systemic carcinoma; NT, neurothekeoma.
Dermoscopic Features of Cutaneous Lymphoepithelioma-Like Carcinoma

Lymphoepithelioma-like carcinomas (LELC) is a rare malignant tumor with microscopic features similar to undifferentiated nasopharyngeal carcinoma at extra-nasopharyngeal sites. Lymphoepithelioma-like carcinomas of the skin was first described by Swanson and colleagues in 1988. However, to the best of our
Understanding Mohs Micrographic Surgery: A Review and Practical Guide for the Nondermatologist

Stanislav N. Tolkachjov, MD; David G. Brodland, MD; Brett M. Coldiron, MD; Michael J. Fazio, MD; George J. Hruza, MD; Randall K. Roenigk, MD; Howard W. Rogers, MD; John A. Zitelli, MD; Daniel S. Winchester, MD; and Christopher B. Harmon, MD

Abstract

The incidence and diagnosis of cutaneous malignancies are steadily rising. In addition, with the aging population and increasing use of organ transplant and immunosuppressive medications, subsets of patients are now more susceptible to skin cancer. Mohs micrographic surgery (MMS) has become the standard of care for the treatment of high-risk nonmelanoma skin cancers and is increasingly used to treat melanoma. Mohs micrographic surgery has the highest cure rates, spares the maximal amount of normal tissue, and is cost-effective for the treatment of cutaneous malignancies. As in other medical fields, appropriate use criteria were developed for MMS and have become an evolving guideline for determining which patients and tumors are appropriate for referral to MMS. Patients with cutaneous malignancies often require multidisciplinary care. With the changing landscape of medicine and the rapidly increasing incidence of skin cancer, primary care providers and specialists who do not commonly manage cutaneous malignancies will need to have an understanding of MMS and its role in patient care. This review better familiarizes the medical community with the practice of MMS, its utilization and capabilities, differences from wide excision and vertical section pathology, and cost-effectiveness, and it guides practitioners in the process of appropriately evaluating and determining when patients with skin cancer might be appropriate candidates for MMS.

Mohs micrographic surgery has become the gold standard of treatment of cutaneous malignancy, with a focus on tumor eradication and tissue sparing. The aim of this report is to better explain the utility and advantages of MMS and guide medical professionals on the appropriate management of patients with skin cancer.

Among the authors, more than 312,000 MMS procedures have been performed at more than 10 different institutions, including private practices, hospital settings, academic departments, and tertiary referral centers. Nonmelanoma skin cancer (NMSC) is the most common malignancy in the United States and European countries, with substantial associated morbidity and cost, as well as relatively low but significant mortality. The NMSCs are increasing in incidence and diagnosis.
Approximately 80% of all NMSCs are BCC, whereas cutaneous SCC (cSCC) represents approximately 20%, and the remaining rare NMSCs represent 1%.2,9,10 Mohs micrographic surgery is the standard of care for select BCCs and SCCs.11-13

The incidence of melanoma (MM) is steadily rising.14 Recent data and projections show that in the US white population, annual new cases of MM are projected to rise from approximately 70,000 in 2007-2011 to 116,000 in 2026-2031, with 79% of the increase attributable to rising age-specific rates and 21% to population growth and aging.15 Similar projections have been made about the United Kingdom, Sweden, Norway, Australia, and New Zealand.15 Melanoma is also the most common cancer in the adolescent and young adult population.16 The incidence of MM of all thicknesses is rising; however, although the prognosis of MM worsened with increasing stages, most deaths resulted from MMs that were diagnosed at the T1 stage (thin MM).17 In addition, the long-term risk of subsequent invasive MM increases in patients with melanoma in situ (MIS).18,19 It is prudent to diagnose and treat MM at an early stage and continue to monitor these patients for subsequent skin malignancies.18,20 Mohs micrographic surgery has been used with success to treat MIS as well as invasive MM.21-23

MMS TECHNIQUE, ADVANTAGES, AND DIFFERENCES FROM TRADITIONAL WIDE LOCAL EXCISION

A complete description of MMS is out of the scope of this article, and some technique variability is seen among surgeons. Basically, the technique involves surgically removing the minimal amount of tissue to eradicate cancerous tissue with precise mapping of the entire surgical margin while preserving normal skin.

The surgical site is clearly marked and infiltrated with local anesthetic. Typically, tumor debulking is done to remove clinically evident tumor with either a blade (sharp debulking) or a curette. A saucerized layer of tissue is excised, with tissue nicks or suture placement for orientation and creation of a corresponding tissue map. The tissue is precisely labeled with ink at nicked edges and transposed to a cryostat chuck with the cut surface flattened.24 The entire horizontal section of tissue is frozen, cut, and stained, allowing for lateral and deep margin visualization and precise orientation (Figure 1A).25 Using microscopic examination, the surgeon visualizes the absence or presence of tumor.26 Once tumor is fully removed, either the site is allowed to heal by second intention (granulation) or an appropriate reconstruction is performed.25,27 If tumor is still present, a second or subsequent layer is taken only from the represented tumor site on the map corresponding to both the tissue and the patient’s defect. This is repeated until tumor is no longer present.28-30

The major difference between MMS and wide local excision (WLE) is the fresh frozen technique with horizontal sections, allowing complete margin visualization.26 In contrast to the complete margin control of MMS, classic histopathology uses a “breadloafing” technique in which tissue is sectioned in a vertical orientation at several intervals (Figure 1B). The amount of tissue visualized depends on the number of sections read. Typically, less than 1% to 2% of the specimen margin is evaluated. Sampling error will occur if the intervals of the sections miss extensions of tumor, which may penetrate between the sampled sections (Figure 1B). Mohs micrographic surgery does not rely on the intervals of sampled margins, instead allowing for microscopic control of 100% of the margin,
translating to both superior cure rates and sparing of normal tissue. Tissue sparing with precise mapping allows for potentially more reconstructive options and less disfigurement, especially in cosmetically sensitive areas such as the nose, eyelids, ears, lips, digits, and genitalia.

Histopathologic examination is key to the high cure rates achieved with MMS. Most tumors are very effectively examined with hematoxylin and eosin staining. Certain tumors, such as extramammary Paget disease, can better be examined using periodic acid–Schiff staining or cytokeratin 7 immunostaining. Dermatofibrosarcoma protuberosa can be further delineated with CD34 immunostaining. Intraepidermal MM cells can be highlighted effectively with Mart-1 or Melan-A immunoperoxidase staining and spindle cell MM with S100. Immunostains can now be done rapidly and efficiently in the MMS laboratory on frozen sections, allowing the surgery to be completed within a few hours rather than days.

THE SYNERGY OF MICROGRAPHIC SURGERY AND RECONSTRUCTION

Micrographic surgery is synergistic with cutaneous reconstruction in several ways. First and foremost, no reconstruction is performed until the margins are confirmed to be histologically tumor free. This is beneficial to both the reconstructive surgeon and the patient because at the time of reconstruction the statuses of the margins are not in doubt. This obviates any need for reoperating at a later date based on subsequent pathology findings. The certainty of clear margins is increased by virtue of the 100% peripheral margin evaluation and the microscopically guided excision afforded by micrographic surgery.
Another synergy associated with micrographic surgery is the reconstruction of the smallest possible wound. Excision using microscopic surgery begins at the narrowest clinically tumor-free margin. Because clinically occult tumor extension exists in approximately 30% to 35% of the tumors, additional excision is necessary for those patients. However, that means that up to 70% of patients achieve histologically tumor-free margins with the narrowest of excision, thereby conserving uninvolved surrounding tissue. Standard excision is based on margin identification using visual inspection only. From that margin, a predetermined, agreed-on by convention, and sometimes clinically verified “safe” margin of normal-appearing skin is removed. These margins range from 4 to 10 mm in NMSC and from 5 to 20 mm of normal-appearing skin in MM. Other less common cutaneous malignancy’s margins range from 5 mm to 2 cm depending on the tumor and location.

The depth of excision is also more customized to the actual extent of the tumor using micrographic surgery. With same-day, intraoperative histologic margin evaluation, the fact that more than 95% of cutaneous malignancies are limited to the epidermis and dermis enables the micrographic surgeon to safely preserve underlying soft tissue, including not only subcutaneous fat but also muscles, nerves, and other important structures (Figure 2). Preservation of these tissues simplifies flaps and grafts and improves long-term aesthetic and functional results.

There are times (<1% of cases) when cutaneous malignancies invade beyond the integument into deeper structures such as muscles, tendons, and bone. In these cases, or in cases in which highly complex reconstructions are needed and would be better performed using a multidisciplinary approach, the micrographic surgeon embraces interdisciplinary cooperation. Often, deep structure involvement cannot be anticipated preoperatively. In these cases, the micrographic surgeon can extirpate the entire tumor except that which extends beyond the integument. Residual tumor can be precisely mapped using the micrographic surgical technique and can facilitate subsequent accurate and complete removal of residual malignancy. When a multidisciplinary approach can be anticipated preoperatively, the micrographic surgeon may be instrumental in using intraoperative MMS, allowing for margin control of large tumors, leaving the residual tumor to be excised under general anesthesia.

Again, residual tumor can be precisely located using the mapping techniques, which may be useful for subsequent removal. This may allow for simultaneous reconstruction instead of having to withhold reconstruction to observe for recurrence or for confirmation of clearance by permanent sections, which may prevent potential patient morbidity and psychosocial detriment.

**FIGURE 2.** A, Post-Mohs micrographic surgery (MMS) defect demonstrating preservation of cranial nerve 7 after perineural extension of squamous cell carcinoma. B, Reconstruction immediately after MMS with a bilobed transposition flap over a subcutaneous flap from the jowl covering the nerve. C, Three-year follow-up with no recurrence, and aesthetic outcome.
TUMORS TREATED BY MMS AND THEIR CURE RATES

Nonmelanoma Skin Malignancies
Basal cell carcinoma is the most common malignancy in the United States, and although it rarely metastasizes, untreated BCC may continue to grow, with local destruction. Mohs micrographic surgery has been used successfully to treat primary and recurrent BCCs. The tumor-free recurrence rates for primary and recurrent BCCs treated with WLE and MMS are outlined in Table 1. Mohs micrographic surgery has been shown to have superior cure rates in primary and recurrent BCCs. It is also an efficient and cost-effective procedure as the treatment of choice for high-risk BCCs and for those in cosmetically sensitive locations.

Cutaneous SCC makes up a smaller proportion of NMSCs. However, it is estimated that in the United States, 186,157 to 419,543 white individuals were given a diagnosis of cSCC, 5604 to 12,572 developed nodal metastasis, and 3932 to 8791 died of cSCC in 2012. This mortality burden is on par with renal and oropharyngeal carcinomas and MM. Treatment of cSCC with MMS has shown superior cure rates to WLE, and local recurrences occur less frequently when cSCC is treated by MMS. In addition, high-risk cSCCs have been better defined by Mohs surgeons working in multidisciplinary settings, which has led to the emergence of sentinel lymph node biopsy and adjuvant radiation considerations in treating this subset of cSCC.

The concept of margin control with MMS extends beyond common tumors. Almost all types of cutaneous malignancies have been treated by MMS over the decades, all with superior results to WLE (Table 1). Although these tumors vary in anatomical structure of origin, they all share 1 crucial aspect: they are contiguous tumors, often with subclinical extension underneath the skin surface, rendering the surgeon’s subjective measurement of the tumor margins less efficacious than a micrographic surgeon’s ability to assess the margin microscopically.

MMS in the Treatment of Melanoma
Mohs micrographic surgery is a useful technique for cutaneous MM, and its value is highly evidence based. Current surgical margin guidelines for the excision of MM result in recurrences due to inadequate excision, resulting in true local recurrence rates of 9% to 15% on the head and neck and 3% on the trunk and proximal extremities. These recurrences may adversely affect prognosis and survival because it has been shown that true local recurrences of MIS appear as invasive MM in 23% of cases. Similarly, true local recurrences of inadequately excised invasive MM appear as more deeply invasive MM in 33% of patients. Therefore, the goal of surgical excision is complete removal with histologically negative margins.

The usual methods of pathology processing of excised MM tissue allow examination of only less than 1% to 2% of the margin. More careful processing is rarely performed but may include methods of en face sectioning to examine a higher percentage of the margin. Mohs micrographic surgery is a method of examining 100% of the margin and allows for mapping the precise location of a positive margin so that reexcision is complete. Mart-1 or other immunoperoxidase stains increase the accuracy of margin examination.

### TABLE 1. Cure Rates (5 Years) for Selected Cutaneous Malignancies

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<td>Squamous cell carcinoma&lt;sup&gt;38-90&lt;/sup&gt;</td>
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<sup>a</sup>Same study to correct for bias or operator differences.
<sup>b</sup>Of these 3% of tumors without cure, 33% will reappear with deeper thickness than the original primary tumor.
result of detailed margin examination is published local recurrence rates of 0.2% for head and neck MMs and 0.5% for the trunk and proximal extremities, and metastatic rates and MM-specific survival rates as good as wide excision.71

Mohs micrographic surgery can be particularly valuable for most head and neck MMs, hand and feet MMs, genital MMs, and any MM with poorly defined clinical margins, including amelanotic, desmoplastic, and recurrent MMs.

Recurrences from MMS may be tumor related, including aggressive pathology, multifocal tumor, recurrent tumor, and high-risk anatomical location; patient related, such as immunosuppression; surgeon related, such as incorrect margin resected; or laboratory related. Two retrospective studies looked at possible reasons for tumor recurrence and found that possible errors could account for 77% to 78% of tumor recurrences, including tumor on the final margin, missing epidermis or dermis, dense inflammation possibly hiding tumor, and incorrect additional margin resected (mapping error).72-74 A case-control study found that after multivariate analysis, only tumor on final margin, missing epidermis or dermis, and aggressive tumor type were significantly more frequent in recurrent cases than in controls.75 These findings suggest that continued quality improvement activities can further improve the already excellent MMS cure rates.76

APPROPRIATE USE OF MMS

The utilization of MMS has markedly increased during the past 2 decades, and its use has grown disproportionately compared with all other treatment modalities. Some argue that this is an expected finding given the almost epidemic-like increase in skin cancer and the marked increased number of trained Mohs surgeons in the same time frame. Yet, the concern of overutilization or misuse of MMS brought on greater scrutiny by the Centers for Medicare and Medicaid Services and other insurance carriers and eventually lead to consideration of heavy restrictions, including potentially complete elimination of coverage for MMS. To avert these regulatory actions, and to help define the clinical scenarios that are best treated by MMS, the American Academy of Dermatology (AAD) formed an ad hoc task force to develop appropriate use criteria (AUC) for MMS.77 The AUC process was based on a well-established method developed by the Rand Corp/UCLA and has been successfully applied in the fields of cardiology and radiology. The Mohs AUC are the first AUC developed in dermatology. This was a collaborative effort between the AAD, the American College of Mohs Surgery, the American Society for Dermatologic Surgery, and the American Society for Mohs Surgery. Nearly 80 dermatologists were involved representing all different types of practice and geographic locations. To eliminate potential conflicts of interest or perceived conflicts, most rating panel experts were not Mohs surgeons. More than 400 peer-reviewed articles were presented to the panel, and 161 were identified and analyzed to support the evidence-based tables supporting the MMS AUC.77 This collaboration of dermatologists developed AUC for 270 clinical scenarios of skin cancer based on cancer and patient characteristics.78 The 17-member ratings panel ranked each clinical situation into appropriate, inappropriate, or uncertain categories from evidence-based medicine, clinical expertise, and expert judgment.79 After consensus was achieved in all 270 scenarios, 200 (74.1%) were deemed appropriate, 24 (8.9%) as inappropriate, and 46 (17.0%) as uncertain.78 These results were jointly published in the Journal of the American Academy of Dermatology and Dermatologic Surgery in October of 2012. The AAD subsequently developed a telephone application of the MMS AUC for greater availability in the practice setting.

There are a few caveats to the AUC on MMS. First, they are designed to be a guideline of care and not to define the standard of care. The final decision in patient care should reside in the physician’s expert judgment. Second, these are not comparative AUC, and, thus, no conclusions can be drawn about the efficacy of MMS compared with that of other treatment modalities. Third, cost was considered only as an additional factor (implicit), not as a primary factor (explicit). Therefore, no conclusions can be drawn regarding the cost-effectiveness of MMS compared with that of other modalities. Finally, these guidelines are considered to be a living revisable
document, such that as our experience and knowledge changes so will the Mohs AUC.

**COST ANALYSIS OF MMS**
The US skin cancer epidemic is associated with substantial costs to the health care system. Skin cancer (including MM) is the fifth most costly malignancy to treat in the United States.79,80 A recent report estimates that the average annual cost of treating skin cancer in the United States increased 125% to $8.1 billion in 2007-2011 from $3.6 billion in 2002-2006.7 Moreover, the direct reimbursements from Medicare to physicians for treatment procedures for cutaneous malignancies increased by 137% from 1996 to 2008.8 As health care systems struggle to reduce overall expenditure and promote cost-effective treatment, understanding the costs of skin cancer treatments, including MMS, will be critical.

In evaluating health care system expenditures for skin cancer treatment, numerous cost contributors must be considered, including reimbursement for the treatment procedure itself, pathologic evaluation, repair/reconstruction of the resulting defect, anesthesia, facility charges, materials/supply charges, pharmaceuticals, and any additional treatment procedures to re-treat a skin cancer after inadequate initial treatment or positive margins. Moreover, when reviewing studies that evaluate the relative costs of medical treatments, the distinction between cost comparison and cost-effectiveness is critical.82 Cost comparison can be defined as the evaluation of the cost of one procedure vs a different procedure(s) and the variables that may affect that cost.82 In contrast, cost-effectiveness analysis compares the relative costs and outcomes of 2 or more medical interventions.82

Comparative cost analysis of NMSC treatment options in the US health care system has been evaluated in 4 recent publications.83-86 These studies report the payments by insurers to treat NMSC using a range of modalities, including MMS, traditional surgical excision, local destructive surgery, radiation therapy, and topical immunomodulatory cream (imiquimod) treatment. The effect of histologic margin control in excisional modalities (permanent vs frozen section pathology) and the site of service (office based, ambulatory surgical center, or hospital-based operating room) on the ultimate cost of the procedure are also calculated.82 The results of cost comparison studies are summarized in Table 2.83-86

These studies show that MMS is cost comparable to office-based surgical excision and clearly less expensive than facility-based excision or radiation therapy. Mohs micrographic surgery is more expensive than local destruction or imiquimod therapy. However, the latter treatments have substantial drawbacks. Imiquimod is approved by the Food and Drug Administration for superficial BCC of the trunk and extremities only, and the National Comprehensive Cancer Network guidelines limit the use of local destructions in

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**TABLE 2. Estimated Costs of Varied Nonmelanoma Skin Cancer Treatment Modalities and Sites of Service Based on Published Cost Comparison Studies**

<table>
<thead>
<tr>
<th>Treatment and site</th>
<th>Estimated costs ($)</th>
<th>2012</th>
<th>2004</th>
<th>2009</th>
<th>2012</th>
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<td>937-956</td>
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*ASC = ambulatory surgery center; ED&C = electrodessication and curettage destruction; Exc. = traditional surgical excision; Froz. = frozen section margin control; Imiquimod = topical 5% imiquimod therapy (6 weeks); MMS = Mohs micrographic surgery; Office = office-based surgical setting; OR = hospital-based operating room setting; Perm. = formalin permanent section margin control; Radiation = radiation therapy treatment based on 12 to 17 fractions.

*ASC = ambulatory surgery center; ED&C = electrodessication and curettage destruction; Exc. = traditional surgical excision; Froz. = frozen section margin control; Imiquimod = topical 5% imiquimod therapy (6 weeks); MMS = Mohs micrographic surgery; Office = office-based surgical setting; OR = hospital-based operating room setting; Perm. = formalin permanent section margin control; Radiation = radiation therapy treatment based on 12 to 17 fractions.

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cutaneous malignancies that are large, aggressive, or in high-risk locations.

The cost-effectiveness of MMS compared with traditional surgical excision has also been evaluated. Seidler et al87 used a “time trade off” model based on the surgical defect size and likelihood of tumor recurrence. In this study, MMS had an average cost of $957 with a projected quality-adjusted life expectancy of 15.67 quality-adjusted life-years.82 Traditional surgical excision with a combination of permanent and frozen section margin control costs $1248 and has a projected quality-adjusted life expectancy of 15.61 quality-adjusted life-years.82

A more conventional cost-effectiveness evaluation of cost per cancer cure has also been calculated using costs from US studies and historical outcome rates, resulting in US-specific cost-effectiveness ratios.82 With a difference of $177 in average cost between MMS and office-based excision with permanent sections for NMSC of the face, and taking into account the previously published higher recurrence rates of excisions for NMSC, the cost to prevent a recurrence is $1967. This $1967 is almost twice the cost of a Mohs case.82

Thus, given its better effectiveness and lower price tag, MMS is clearly cost-effective compared with any treatment rendered in an inpatient or outpatient facility setting. Moreover, in evaluations with office-based surgical excision with permanent sections,82 MMS is more effective, with higher cure rates and smaller defects, and also costs less in some studies, but on average, MMS is no more than 15% more expensive.

There is a misperception in the medical community that MMS is a very expensive procedure. It has drawn substantial attention from insurers and regulators as a possibly overused and misvalued procedure, and MMS’s cost-effectiveness has been questioned.80 Mohs micrographic surgery is the only procedure that includes all surgery,

Prereferral steps
- Indicate the skin lesion to be biopsied with a marking pen.
- Obtain photos with at least 2 anatomical landmarks (especially before biopsy).
- Consider having the patient take a photo of the lesion with his or her own phone.
- Clinical information to obtain: prebiopsy measurement, description of lesion (erythematous crusted nodule, indurated plaque, etc)
- Perform skin biopsy as appropriate or refer for biopsy by dermatology provider.

FIGURE 3. Referral steps in the management of cutaneous malignancy for nonmelanoma skin cancer (NMSC). AFX = atypical fibroxanthoma; BCC = basal cell carcinoma; DFSP = dermatofibrosarcoma protuberans; EMPD = extramammary Paget disease; MAC = microcystic adnexal carcinoma; MCC = Merkel cell carcinoma; MIS = melanoma in situ; MMS = Mohs micrographic surgery; SC = sebaceous carcinoma; SCC = squamous cell carcinoma.
pathology, anesthesia, and supply expenses in the payment for the primary code(s). With MMS, a single payment is made to a single provider. When a patient is treated for skin cancer by facility-based excision, insurer payments are spread out over charges for the operating room, surgeon, anesthesiologist, pathologist, all supplies, and laboratory. The result is that when analyzing facility-based excision, it is easy to solely report payment for the surgical excision and ignore all the mandatory attendant costs. This makes surgical excision seem to be much lower in cost than MMS and more difficult for insurers to track.

As patients become more savvy consumers of health care, many are seeking the best value and quality for their health care dollar. It seems that MMS 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.89 As health care costs rise, and insurers and payers attempt to contain costs, there will be increased calls for transparency in charges. Any office-based procedure, but in particular MMS, will become obvious as the most affordable option.

**REFERRING PATIENTS FOR MMS**

Referring patients to the micrographic surgeon necessitates some critical steps (Figure 3). These steps will assist the surgeon and his or her team in correctly identifying the tumor type and tumor site. Commonly, after a skin biopsy is performed, new skin will grow over the biopsy site. If enough time has passed, this biopsy site may not be readily noticeable, especially if the patient has had previous biopsies, cryotherapy, or multiple concurrent biopsy sites. It is essential to ensure that the site is marked with a tissue-marking pen before taking a photograph that shows at least 2 anatomical landmarks to put the site in context.

**CONCLUSION**

In our experience, MMS is a safe, effective, and cost-efficient treatment modality for cutaneous malignancies. It allows for the highest cure rates while preserving the maximum amount of normal tissue, allowing for immediate reconstruction. As the incidence and diagnosis of skin cancer increases, the demand for cutaneous surgery will continue to evolve.

Communication between nondermatology providers and general dermatologists and Mohs surgeons will aid in appropriate and efficient care for patients with skin cancer.

**ACKNOWLEDGMENTS**

We acknowledge the hard work and attention to detail of Leigh Campbell in creating the illustrations for Figure 1.

**Abbreviations and Acronyms:** AAD = American Academy of Dermatology; AFX = atypical fibroxanthoma; ASC = ambulatory surgery center; AUC = appropriate use criteria; BCC = basal cell carcinoma; cSCC = cutaneous squamous cell carcinoma; DFSP = dermatofibrosarcoma protuberans; ED&C = electrodessication and curettage destruction; EMPD = extramammary Paget disease; MAC = microcystic adenoid hidradenoma; MCC = Merkel cell carcinoma; MIS = melanoma in situ; MM = melanoma; MMS = Mohs micrographic surgery; NMSC = nonmelanoma skin cancer; SC = sebaceous carcinoma; SCC = squamous cell carcinoma; WLE = wide local excision

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Showing 1 to 75 of 75 entries
April 28, 2017

Stanley J. Miller, MD
President, American Board of Dermatology
2 Wells Avenue
Newton, Massachusetts 02459

Dear Dr. Miller,

As the President of the American College of Mohs Surgery and the Chair of the Executive Committee of the Board of Directors I represent over 1,400 fellowship-trained Mohs surgeons. Mohs Surgery and Dermatologic Oncology has evolved over the past decades into a mature subspecialty of Dermatology with widespread ACGME accredited fellowships and a well-established, defined curriculum representative of a progressively expanding body of knowledge.

On behalf of the American College of Mohs Surgery, I respectfully request that the American Board of Dermatology explore the development and establishment of certification in Mohs Surgery and Dermatologic Oncology to recognize individuals with advanced training and practice in this area. This action would be consistent with the certification offered by the American Board of Dermatology for Dermatopathology and Pediatric Dermatology.

I would be pleased to discuss the matter in greater detail, if desired.

Sincerely,

Thomas Stasko, MD

Cc: Thomas D. Horn, MD, MBA
BACKGROUND There is a skin cancer epidemic in the United States.

OBJECTIVE To examine skin cancer treatment modality, location, and cost and physician specialty in the Medicare population from 1996 to 2008.

METHODS Centers for Medicare and Medicaid Services databases were used to examine skin cancer treatment procedures performed for Medicare beneficiaries.

RESULTS From 1996 to 2008, the total number of skin cancer treatment procedures (malignant excision, destruction, and Mohs micrographic surgery [MMS]) increased from 1,480,645 to 2,152,615 (53% increase). The numbers of skin cancers treated by excision and destruction increased modestly (20% and 39%, respectively), but the number of MMS procedures increased more rapidly (248% increase). Dermatologists treated an increasing percentage (75–82%) of skin cancers during these years, followed by plastic and general surgery. In 2008, more than 90% of all skin cancers were treated in the office, with the remainder being treated in facility-based settings. Allowable charges paid to physicians by Medicare Part B for skin cancer treatments increased 137% from 1996 to 2008, from $266,960,673 to $633,448,103.

CONCLUSIONS The number of skin cancer treatment procedures increased substantially from 1996 to 2008, as did overall costs to Medicare. Dermatologists treated the vast majority of skin cancers in the Medicare population, using a mix of treatment modalities, almost exclusively in the office setting.

The authors have indicated no significant interest with commercial supporters.

There is an ongoing epidemic of skin cancer in the United States. Studies have documented increases in skin cancer rates for melanoma and non-melanoma skin cancer (NMSC).1–7 The number of NMSC in the United States had been estimated at 3.5 million in 2006, with 2.2 million affected individuals.8 Moreover, skin cancer cases in the Medicare population increased 4% per year from 1992 to 2006, with continued increases to 2008.8,9

Dermatologists are first responders to the skin cancer epidemic, from diagnosis through treatment.10 Dermatologists perform more skin surgery procedures than any other specialty.11 Understanding skin cancer incidence and how skin cancer is treated is important not just in planning prevention strategies and educating dermatology residents, but also in deciding how to allocate increasingly limited medical resources.

Given the recent political discussions about rising healthcare costs, the overall costs of treating skin cancer have gained importance. Medicare claims data from 1992 to 1995 show that the cost of treatment per case of NMSC was 5%–10% of that of many other cancers,12 but the large number of cases made NMSC the fifth most costly cancer to treat overall in the Medicare population.12 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 1999,5,12,13 These costs increased 41% between 1992 and 1995.

Many variables factor into the overall cost of skin cancer treatment.14,15 Choice of treatment method, pathologic evaluation, and treatment facility has a large effect on the cost of treating a particular skin cancer. Destruction of skin cancers is less expensive on average than traditional surgical excision or Mohs micrographic surgery (MMS), but treatment location is the most important determinant of cost, with facility-based surgery costing two to eight times as much as office-based procedures.14,16,17 Regulatory changes can also affect the cost of skin cancer care. In 2007, new Current Procedural Terminology (CPT) codes were introduced for MMS, which decreased the Resource-Based Relative Value Scale values for MMS. In 2008, MMS codes lost their multiple surgery reduction (MSR) exemption, resulting in decreased reimbursement for surgery for multiple cancers on a single date of service and for reconstruction performed on the same day. Loss of the MSR exemption reduced the cost of a typical MMS case by an average of 14.5%, making it comparable with the cost of office-based traditional surgical excision with permanent section margins.14

The purpose of this study was to quantify trends in skin cancer treatment in the Medicare population from 1996 to 2008, evaluating treatment modality, treating specialty, location, and costs.

**Methods**

Our analyses were based on the Medicare physician/supplier procedure summary master file database (Total Claims Data Set) for 1996–2008,18 which was used to provide total numbers of approved fee-for-service Medicare claims categorized according to CPT number.19 The data from each Medicare claim are linked to the medical specialty of the treating physician, the clinical setting of the treatment, and the total charges and approved payment (allowed charges) for the surgical procedure.

The number of skin cancers in the fee-for-service Medicare population was estimated in this study as the number of total skin cancer treatment procedures (malignant destruction, malignant excision, and MMS) approved for payment that year from the Total Claims Data Set. Thus, the total number of skin cancers for a given year was estimated by adding the numbers of approved claims for skin cancer procedure code series (11600–11606, 11620–11626, and 11640–11646 for malignant excision, 17260–17266, 17270–17276, and 17280–17286 for malignant destruction, 17304 for MMS for 1996–2006 and 17311 and 17313 for 2007–2008). The total number of a given modality for skin cancer treatment performed in any year was the total for the given CPT series. The total approved charges were calculated by adding the approved payments associated with the skin cancer procedure series as above, although for MMS, the payments for additional Mohs stages and sections associated with codes 17305–17310 for 1996–2006 and 17312, 17314, and 17315 for 2007–2008 were also added. The average cost of skin cancer treatment was defined as the total approved charges for skin cancer treatment procedures divided by the total number of procedures for a given year.

The number of Medicare beneficiaries whose health care data are collected in the Total Claims Dataset is defined as the number of total Part B fee-for-service enrollees minus the number of Part C (Medicare Advantage) enrollees. The number of Part B and Part C enrollees for 2000–2008 was obtained from the Medicare Trustee’s 2010 report.20 The number of Part B enrollees for 1996–1999 was obtained from the Medicare Trustee’s 2004 report.21 Total allowed charges corrected for population changes from 1996 (corrected allowed charges) were calculated by dividing the total allowed charges for a given year (described above) by the Medicare enrollees served for that year and then by multiplying by the enrollees from 1996 (31,604,000).
The linkage of data of treating information to individual Medicare claims in the Total Claims Data Set allowed separation of the total procedure numbers according to the medical specialty of the treating physician and clinical setting. It also permitted analysis of how specialties differentially utilize treatment locations and modalities.

**Results**

Between 1996 and 2008, the number of skin cancer treatment procedures increased 53%, from 1,410,645 to 2,125,615 (Figure 1); the number of excisions increased 20%, from 637,361 to 765,575; the number of destructions increased 37%, from 623,857 to 866,456; and the number of MMS procedures increased 248%, from 149,427 to 520,584. The percentage of total skin cancers treated using each modality changed from 45.2% excision, 44.2% destruction, and 10.6% MMS in 1996 to 35.6%, 40.3%, and 24.1%, respectively, in 2008.

Skin cancer treatment procedures were separated according to physician specialty and treatment setting. Dermatologists treated 75% of the skin cancers in 1996, increasing to 82% by 2008 (Figure 2). Other leading specialties included plastic surgery, general surgery, family practice, otolaryngology, internal medicine, and general practice. The totals from all other designated specialties are combined.

The percentage of cases treated in the office setting increased from 89.4% in 1996 to 91.6% in 2008 (Figure 3). The percentage of cases in the outpatient operating room (OR) setting decreased from 8.6% to 6.3%, whereas ambulatory surgery center (ASC) cases increased.
from 0.8% to 1.6%. Treatments in the inpatient OR and other settings were less than 1% of the total.

When examining treatment patterns according to specialty, we find that each specialty uses treatment facilities and techniques differently. In 2008, dermatologists treated 96.4% of their cases in the office setting (Figure 4). In contrast, general surgery used facility-based treatment (outpatient OR, inpatient OR, and ASC) in 46.4% of their cases, otolaryngology 38.4%, and plastic surgeons 45.4%. Dermatologists treated skin cancer using excision in 26.0% of cases, destruction in 45.1%, and MMS in 28.8% (Figure 5), whereas general surgery performed excisions in 93.2% of cases, otolaryngology in 82.1%, and plastic surgery in 91.3%.

The total allowed charges for skin cancer procedures increased from $266,960,673 in 1996 to $633,448,103 in 2008 (Figure 6). Correcting the allowed charges for changes in the number of Medicare enrollees showed similar increases. Each year, the overall allowed charges increased except in 1997, 1998, and 2008, when there were 4%, 2%, and 2% decreases, respectively, from the previous years. The average cost per skin cancer case treated increased from $189 in 1996 to $294 in 2008. The total reimbursement for excisions and destructions showed small increases from 1996 to 2008 (15% and 30%, respectively), similar to the increases in total numbers of procedures, whereas the percentages of the total skin cancer treatment reimbursement from excisions and destructions fell from 40%
to 19% and 32% to 17%, respectively. MMS allowed charges increased from $77,064,673 in 1996 to $402,308,469 in 2008, starting at 28% of the total and increasing to 64%. There was a 12% decrease in reimbursement per MMS first stage code from 2007 to 2008.

Conclusions

This study is the most up-to-date analysis of trends in skin cancer procedures in the Medicare population, evaluating numbers of procedures, treatment modality, physician specialty, and treatment setting. It also defines direct Medicare expenditures on skin cancer treatment procedures.

The strengths of this study are that the model uses a Medicare database that incorporates all U.S. Medicare fee-for-service claims and allows accurate analysis of procedure and cost trends over 13 years, although the database used does not link procedure codes to diagnoses. Therefore, this methodology is unable to capture some peripheral costs associated with skin cancer treatment procedures such as diagnostic and consultative physician visits, repairs, pathology, supplies, and facility charges. This underestimation may be significant because the associated costs can make up the majority of overall costs of some skin cancer treatments, especially for facility-based excisions. The costs of alternative skin cancer treatments such as topical therapy with chemotherapeutic agents or immunomodulatory agents are known and are not less than the cost of surgery when used as prescribed, but the frequency of such treatments could also not be evaluated. In addition, the major costs of surgical alternatives are shifted from Medicare Part B to Medicare Part D, or the patient, because most

Figure 5. Specialty and procedure choice for skin cancer treatment, 2008. The number of approved skin cancer treatments that different medical specialists performed in 2008 (dermatology, plastic surgery, general surgery, otolaryngology, and all others combined) are shown according to treatment procedure employed (excision, destruction, and Mohs micrographic surgery).

prescription. Other limitations of this model as an estimate of skin cancer numbers have been discussed previously.8

Our data point to several conclusions about skin cancer treatment. Although numerous medical and surgical specialties bill Medicare for skin cancer treatments, dermatologists are the primary treating physicians of skin cancer, treating 82% of skin cancers in 2008, up from 75% in 1996. Dermatologists are likely to continue in this capacity as they absorb most of the increase in skin cancer numbers.

In treating skin cancers, dermatologists employ a mix of treatment modalities, including excision, destruction, and MMS, as well as topical agents, depending on the clinical situation and tumor type. In contrast, the two other leading specialties, plastic and general surgery, perform excision or MMS in 95% of cases. Our data also indicate that treating specialists use treating facilities differently. Dermatologists treat more than 96% of skin cancers in the office setting, whereas plastic and general surgeons used facilities for 46% of skin cancer cases. Therefore, in the current environment of maximizing cost-efficient healthcare delivery, it is important to realize that dermatologists almost exclusively use the least-expensive treatment location (office) and treat 45% of skin cancers using the least-expensive option (destruction).

The nature of skin cancer treatment has changed substantially over the last 2 decades. The use of destructive modalities such as electrodesiccation and curettage and traditional surgical excision increased by 370,000 cases from 1996 to 2008 but decreased as a percentage of total skin cancer cases. Use of MMS also increased by approximately 370,000 cases from 1996 to 2008 and has increased as a percentage of total skin cancer treatments. In 2008, one in four skin cancers were treated using MMS in the Medicare population (up from one in ten 13 years earlier), but numerous factors beyond the increase in number of skin cancers have driven the increase in MMS. The National Comprehensive Cancer Network guidelines for the treatment of NMSC, developed in 2000, limit the use of destructions on larger and high-risk skin cancers, sending these tumors on for MMS or excision.22 Referring dermatologists, physicians extenders, and primary care physicians more widely accept MMS. Public information on MMS from internet sources and media sources, such as the live MMS telecast on Good Morning America, has widely publicized the benefits of MMS and increased consumer demand.23 Medico-legal concerns also drive demand for and use of MMS. With less public tolerance for skin cancer recurrence, multiple treatment sessions, and scarring, MMS has become the de facto standard of care for even small primary head and neck skin cancers. We feel that, overall, the shift to MMS treatment of skin cancers is a natural evolution toward more-precise treatments with higher cure rates and fewer side effects, which characterizes modern medicine.

The total cost of skin cancer treatment increased rapidly in the Medicare population from 1996 to 2008. As shown in this study, the increase in total costs is not due to an increase in the number of beneficiaries. Moreover, increased reimbursement for surgical services has only a small effect, with the Medicare conversion factor for relative value units increasing just 3.8% from 1998 to 2008.24 The increased costs in our model are due about equally to the increase in the number of skin cancers and to the higher average cost of skin cancer treatment. However, the increased cost per skin cancer may be somewhat illusory because of the shift of treatments to dermatologists and away from surgical specialties. There has been a decrease in the percentage of cases performed by general and plastic surgeons, who treat a high percentage of cases in facilities (the majority of whose costs are not captured using our model and data sets) and use a disproportionately high percentage of expensive repairs such as flaps and grafts (unpublished data). The overall costs of those facility-based treatments have been calculated at up to 10 times the cost of office-based treatments.14 Moreover, with the loss of the multiple surgery reduction, MMS has become
almost cost comparable to office-based excision.\textsuperscript{14}

With the development of appropriate use criteria for MMS, the cost difference may shrink even more as only larger, more-difficult tumors are treated using MMS.

The skin cancer epidemic is a substantial concern for the U.S. healthcare system. The number of NMSC (3.5 million cases) is 2.5 times the number of all other cancers combined (1.4 million).\textsuperscript{25} Despite these stunning numbers, skin cancer is still relatively inexpensive to treat. Skin cancer treatments account for less than 0.5\% of Medicare cancer expenditures and 0.16\% of the total 2008 Medicare budget.\textsuperscript{26,27} On a per-case basis, skin cancer treatment procedures average $294. In contrast, the costs per affected patient with colon, lung, and breast cancer were $27,959, $20,524, and $10,744, respectively.\textsuperscript{28}

There have been many recent initiatives by CMS and the federal government to control rising healthcare expenditures. Decreased reimbursement for skin cancer prevention measures and treatments have been evaluated as ways to cut costs. In 2007, the MMS codes were redefined and valued lower, and in 2008, MMS lost its exemption from multiple surgery reduction, decreasing the reimbursement for MMS and repair by 9\% to 25\%.\textsuperscript{14} Recently, CMS has targeted codes for MMS, the treatment of precancerous skin lesions, complex reconstructions, and skin cancer destruction for review by the relative value update committee. These reviews almost always lead to reduced reimbursement to physicians, which may lead to longer waits for treatment, and de facto rationing of care. We feel that the current Medicare fixed pool pay system for physicians is deeply flawed. This fixed pool has no mechanism to account for increasing incidence of disease, which means that payments to physicians treating unrelated conditions may be decreased as a greater fraction of resources must be directed to treatment of skin cancers. Epidemics need to be recognized and additional monies added to the payment pool.

Despite extensive efforts by dermatologists and dermatologic societies in educating the public and promoting prevention, the number of skin cancers in the U.S. population continues to rise. Dermatologists are the primary care physicians of skin cancer and have responded by treating the skin cancers in a balanced and cost-effective manner. Skin cancer treatment is expensive not because each treatment is costly but because of the sheer numbers treated. In the current atmosphere of healthcare cost cutting, skin cancer treatment is in the cross hairs.

References


18. www.cms.hhs.gov/NonIdentifiableDataFiles/06_PricerValueProviderDataMasterFile.asp


23. www.abcnews.go.com › GMA › America’s Health › GMA OnCall


Address correspondence and reprint requests to: Howard W. Rogers, MD, PhD, Advanced Dermatology, 111 Salem Turnpike, Suite 7, Norwich, CT 06360, or e-mail: rogershoward@sbcglobal.net
2017 Domestic Membership Data

Member Types 2007-2017

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Incidence Estimate of Nonmelanoma Skin Cancer (Keratinocyte Carcinomas) in the US Population, 2012

Howard W. Rogers, MD, PhD; Martin A. Weinstock, MD, PhD; Steven R. Feldman, MD, PhD; Brett M. Coldiron, MD

IMPORTANCE Understanding skin cancer incidence is critical for planning prevention and treatment strategies and allocating medical resources. However, owing to lack of national reporting and previously nonspecific diagnosis classification, accurate measurement of the US incidence of nonmelanoma skin cancer (NMSC) has been difficult.

OBJECTIVE To estimate the incidence of NMSC (keratinocyte carcinomas) in the US population in 2012 and the incidence of basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) in the 2012 Medicare fee-for-service population.

DESIGN, SETTING, AND PARTICIPANTS This study analyzes US government administrative data including the Centers for Medicare & Medicaid Services Physicians Claims databases to calculate totals of skin cancer procedures performed for Medicare beneficiaries from 2006 through 2012 and related parameters. The population-based National Ambulatory Medical Care Survey database was used to estimate NMSC-related office visits for 2012. We combined these analyses to estimate totals of new skin cancer diagnoses and affected individuals in the overall US population.

MAIN OUTCOMES AND MEASURES Incidence of NMSC in the US population in 2012 and BCC and SCC in the 2012 Medicare fee-for-service population.

RESULTS The total number of procedures for skin cancer in the Medicare fee-for-service population increased by 13% from 2,048,517 in 2006 to 2,321,058 in 2012. The age-adjusted skin cancer procedure rate per 100,000 beneficiaries increased from 6075 in 2006 to 7320 in 2012. The number of procedures in Medicare beneficiaries specific for NMSC increased by 14% from 1,918,340 in 2006 to 2,191,100 in 2012. The number of persons with at least 1 procedure for NMSC increased by 14% (from 1,177,618 to 1,336,800) from 2006 through 2012. In the 2012 Medicare fee-for-service population, the age-adjusted procedure rate for BCC and SCC were 3280 and 3278 per 100,000 beneficiaries, respectively. The ratio of BCC to SCC treated in Medicare beneficiaries was 1.0. We estimate the total number of NMSCs in the US population in 2012 at 5,434,193 and the total number of persons in the United States treated for NMSC at 3,315,554.

CONCLUSIONS AND RELEVANCE This study is a thorough nationwide estimate of the incidence of NMSC and provides evidence of continued increases in numbers of skin cancer diagnoses and affected patients in the United States. This study also demonstrates equal incidence rates for BCC and SCC in the Medicare population.
N onmelanoma skin cancer (NMSC) is the most common malignancy in the United States, with substantial associated morbidity and cost, as well as relatively small but significant mortality. Surveys using US national claims and survey databases have demonstrated significant increases in numbers of NMSCs and affected individuals (summarized in Table 1). The most recent peer-reviewed national incidence estimate from 2006 estimated 3,507,069 NMSC cases in that year, greatly exceeding the number of all other cases of human malignancies combined. That study also estimated the total number of persons in the United States treated for NMSC in 2006 at 2,152,500. That estimate was a substantial increase from the previous US national estimate of 900,000 to 1.2 million NMSC cases from 1994. Recently, a published report by Guy et al of skin cancer prevalence using data from the Medical Expenditure Panel Survey estimated an increase from 3.1 to 4.3 million US adults in the treated for NMSC annually from 2002 to 2011. Stern’s study from 2010 was based on mathematical incidence modeling of NMSC and estimated that approximately 13 million white non-Hispanics living in the United States at the beginning of 2007 had had at least 1 NMSC. Moreover, about 1 in 5 white non-Hispanic 70-year-olds had at least 1 NMSC, and most of those affected had multiple NMSCs. Another recent US report evaluated basal cell carcinoma (BCC) incidence trends from a US female cohort, the Nurses’ Health Study (1986-2006), and a US male cohort, the Health Professionals’ Follow-up Study (1988-2006). Age-adjusted BCC incidence rates increased from 519 cases to 1019 cases per 100,000 person years for women and increased from 606 cases to 1488 cases per 100,000 person-years for men during the follow-up period. Finally, evaluation of the National Ambulatory Medical Care Survey database revealed a 70% increase in NMSC-related office visits (from 910 to 1660 per 100,000 person-years) from 1995 to 2007. Despite these increases in incidence estimates, NMSC is not typically reported to cancer registries, and interval changes in incidence are not systematically measured.

Understanding skin cancer incidence is critical for planning prevention and treatment strategies and allocating medical resources. There are very significant costs associated with the treatment of skin cancer. Skin cancer is the fifth most costly malignancy to treat in the United States. A recent report estimates the average annual cost of treating NMSC in the United States at $4.8 billion from 2007 to 2011, which increased 74% since the 2002-2006 estimate. With evidence of continuing increases in the incidence and public health burden of NMSC, the purpose of this study is to provide the most up-to-date estimate of incidence of NMSC in the US population and BCC and squamous cell carcinoma (SCC) in the Medicare fee-for-service population.

### Methods

#### Data Sources

Our analyses were based primarily on 2 distinct Medicare databases and on national survey data. The Physician/Supplier Procedure Summary Master File (Total Claims Data Set) was analyzed for the years 2006 through 2012. For our primary approach to the estimation of incident NMSC, the Total Claims Data Set was used to provide total numbers of approved fee-for-service Medicare claims categorized by Current Procedural Terminology (CPT) procedure code number. However, the Total Claims Data Set does not contain information relating to patient age or diagnosis associated with each procedure code. The Medicare Limited Data Set Standard Analytic File 5% Sample Physician Supplier Data (5% Sample Data Set) is the nationally sampled Medicare database that contains information on claims filed for approved procedures with their associated International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes, patient age stratification, and counts of unique persons receiving the services. Hence, the 5% Sample Data Set allowed estimation of the proportion of procedures for skin cancer that were for NMSC, the proportion of procedures that were conducted on enrollees 65 years or older, and the mean number of procedures per affected beneficiary.

The National Ambulatory Medical Care Survey (NAMCS) is a cross-sectional survey system of ambulatory-based physicians wherein participating physicians complete a questionnaire for patient visits during a random 1-week period of the year. These visit observations are then used to provide a national estimate of physician visits and limited characteristics of these visits for that year. The NAMCS allowed estimation of the proportion of visits for NMSC for US patients 65 years or older. The NAMCS data from the years 2011 and 2012 were not available; NAMCS estimates for NMSC physician visits were evaluated from the years 2008 through 2010 to ensure there was no substantial change over time. The results were averaged and applied to create a 2012 estimate. The NAMCS database could not be used to differentiate visits for BCC and SCC because the more specific diagnosis codes were not available in the examined years.

This study does not report data from studies involving human participants; therefore, formal review and approval, or formal review and waiver, by an appropriate institutional review board or ethics committee is not applicable.

#### BCC and SCC Rates in the Medicare Population and Total NMSCs in the US Population

The number of skin cancers in the fee-for-service Medicare population was estimated in this study as the total of all...
proved skin cancer treatment procedures (malignant destructions, malignant excisions, and Mohs micrographic surgeries) for that year from the Total Claims Data Set. Thus, the crude number of skin cancers for a given year was estimated by adding the numbers of approved claims for skin cancer procedure code series (11600-11606, 11620-11626, and 11640-11646 for malignant excisions; 17260-17266, 17270-17276, and 17280-17286 for malignant destructions; 17304 for Mohs surgeries in 2006 and 17311 and 17313 for Mohs surgeries in subsequent years). The total specific to NMSC was determined by multiplying the estimated crude number of skin cancers by the proportion of skin cancer procedure code claims associated with the ICD-9-CM diagnoses for invasive NMSC (173.0-173.9 for the time from January 2006 through October 2011 and 173.00-173.90, 173.01-173.91, 173.02-173.92, and 173.09-173.99 for November 2011 through 2012) and in situ carcinoma (232.0-232.9) from the 5% Sample Data Set.

Our definition for NMSC is based on the ICD-9-CM code series 173 (invasive nonmelanoma cutaneous malignancy) and 232 (in situ nonmelanoma cutaneous malignancy). Prior to November 2011, the 173 code series had 1 decimal place to define the body site of the malignancy. Limitations and assumptions of using this code set have been previously discussed.2 In November 2011, the 173 code series was modified to 2 decimal places. The first decimal place conveys the same body site information as previously, and the second decimal place defines the subsets of NMSC: 173.X1 indicates BCC; 173.X2 indicates SCC; 173.X0 indicates unspecified cutaneous malignancy; and 173.X9 indicates other specified cutaneous malignancy. In evaluating the numbers of each NMSC subtype in this study, we defined SCC as the total of invasive and in situ SCCs. Unspecified and other specified malignancies are all classified as “unspecified.” The number of procedures per affected individual and the number of unique persons who underwent at least 1 procedure were also derived from the 5% Sample Data Set. Because of the inclusion of unspecified cutaneous malignancies in our totals, we have chosen the broader term NMSC for the body of our report, instead of keratinocyte carcinoma, which refers to BCCs and SCCs only.

In our current study, the percentage of NMSCs treated in the Medicare population attributed to those beneficiaries 65 years or older was established directly from the 5% Sample Data Set. In our group’s previous study,2 the percentage of NMSCs treated in the Medicare fee-for-service population attributed to beneficiaries 65 years or older was derived by multiplying the rate of NMSC procedures per person by the number of beneficiaries in the 2 age categories (<65 and ≥65 years).2 Our current calculation results in a more accurate estimate by using data directly from the Medicare 5% Sample Data Set.

The proportion of the entire US population (age ≥65 years) covered under Medicare was derived from the Centers for Medicare & Medicaid Services 2013 Trustee’s report12 and US census data,13 allowing estimation of the number of NMSCs in the entire population 65 years or older. The proportion of total office visits for NMSC ICD-9-CM codes (173.x and 232.x) for patients 65 years or older in 2008 through 2010 was obtained from the NAMCS. The number of NMSCs in the US population 65 years or older was divided by the proportion of office visits for NMSC in that same patient group to estimate the total number of skin procedures for NMSC in the United States. The total number of persons in the United States diagnosed with NMSC in a given year was calculated from the skin cancer procedure totals and the number of NMSCs per affected Medicare patient. More detailed representation of the calculations described herein is provided in the eAppendix in the Supplement.

### Age Adjustment of NMSC Rates

The Total Claims Data Set does not contain age-stratified data. Therefore, although the crude skin cancer procedure rates were derived using this database, age-specific rates could not be determined. The 5% Sample Data Set allowed calculation of diagnosis-specific, age-specific, and age-adjusted procedure rates. The age-adjusted NMSC Medicare Part B fee-for-service procedure rate was calculated, standardized to the year 2006, as in our group’s previous study.2 Age-adjusted rates were determined by a direct standardization method. Age intervals were used (<65, 65-69, 70-74, 75-79, 80-84, and ≥85 years).

### Results

The total number of fee-for-service Medicare skin cancer procedures increased by 13% over the 7 years of the study (2006-2012) from 2,048,517 to 2,321,058 (Table 2). The age-adjusted rate of skin cancer procedures increased from 6075 per 100,000 beneficiaries in 2006 to 7320 in 2012 (Table 2). Even though the population is aging, age adjustment in Medicare did not have a large effect on the rate of skin cancer procedures because of the trend of increased numbers of enrollees who are younger than 65 years. Using the diagnosis-specific 5% Sample Data Set, we found that the overall number of NMSC-specific procedures in-

### Table 2. Number of Procedures for All Skin Cancers in the Medicare Fee-for-Service Population

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Skin Cancer Procedures, No.</th>
<th>Age-Adjusted Procedures per 100,000 Beneficiaries, No.</th>
<th>Procedures to Treat NMSC, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>2,048,517</td>
<td>6075</td>
<td>93.7</td>
</tr>
<tr>
<td>2007</td>
<td>2,098,300</td>
<td>6499</td>
<td>93.3</td>
</tr>
<tr>
<td>2008</td>
<td>2,152,615</td>
<td>6815</td>
<td>94.2</td>
</tr>
<tr>
<td>2009</td>
<td>2,188,038</td>
<td>7000</td>
<td>94.5</td>
</tr>
<tr>
<td>2010</td>
<td>2,230,927</td>
<td>7076</td>
<td>94.5</td>
</tr>
<tr>
<td>2011</td>
<td>2,266,008</td>
<td>7163</td>
<td>94.5</td>
</tr>
<tr>
<td>2012</td>
<td>2,321,058</td>
<td>7320</td>
<td>94.4</td>
</tr>
</tbody>
</table>

Abbreviation: NMSC, nonmelanoma skin cancer.
creased by 14% from 2006 to 2012 from 1,918,340 to 2,191,100 (Table 3). The number of persons undergoing at least 1 procedure for NMSC increased by 14% from 2006 to 2012 (1,177,618 to 1,336,800), while the average number of procedures per beneficiary remained stable during the study period (Table 3).

Our calculations of the incidence of NMSC and the number of affected individuals in the US population in 2006 and 2012 are detailed in the eAppendix in the Supplement. In Table 4, the key figures of the calculations are listed, including the total procedures for NMSC in fee-for-service Medicare patients 65 years or older, the percentage of the US population 65 years or older enrolled in fee-for-service Medicare, the number of procedures for NMSC in the United States in persons 65 years or older, and the NAMCS estimates of the proportion office visits for NMSC diagnoses in the US population ascribed to patients 65 years or older.

We estimate the total number of NMSCs treated in the United States in 2012 at 5,434,193. From the 5% Sample Data Set, we found the number of skin cancers treated per affected patient in 2012 to be 1.64. If this number is extended to the US population, the number of persons in the United States who were treated for NMSC in 2012 can be estimated at 3,315,554. The number of persons who were treated for at least 1 skin cancer in the United States in 2006 can be estimated at 2,463,567.

Using the diagnosis-specific 5% Sample Data Set, we calculated the number of NMSC treatment procedures specific for BCC, SCC, and unspecified carcinoma. In the Medicare fee-for-service population in 2012, there were 1,029,660 BCCs, 1,027,700 SCCs, and 133,740 unspecified cancers (Table 3). The numbers of persons with at least 1 of the 3 NMSC subtypes treated in 2012 were 726,840 for BCC, 708,540 for SCC, and 98,380 for unspecified cancers. Evaluation of age-specific procedure rates for NMSC revealed increasing rates of both BCC and SCC as beneficiaries age, with a levelling off for SCC and a decrease for BCC in the oldest individuals (Figure). The age-adjusted procedure rates per 100,000 beneficiaries specific to NMSC, BCC, and SCC in 2012 were 6983, 3280, and 3278, respectively. The ratio of treated BCC to SCC was 1.0. Across all Medicare fee-for-service CPT codes, the ratio of BCC to SCC-specific diagnosis codes for 2012 is 1.0. If our estimate incidence excludes in situ SCC, the ratio of BCC to invasive SCC in the Medicare fee-for-service population is 1.23.

Table 3. NMSC-Specific Statistics for the Medicare Fee-for-Service Population

<table>
<thead>
<tr>
<th>Year</th>
<th>Total NMSC Procedures, No.</th>
<th>Affected Persons, No.</th>
<th>NMSC Procedures per Affected Person, No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>1,918,340</td>
<td>1,177,618</td>
<td>1.63</td>
</tr>
<tr>
<td>2007</td>
<td>1,957,060</td>
<td>1,190,600</td>
<td>1.64</td>
</tr>
<tr>
<td>2008</td>
<td>2,028,540</td>
<td>1,224,840</td>
<td>1.66</td>
</tr>
<tr>
<td>2009</td>
<td>2,067,600</td>
<td>1,253,900</td>
<td>1.65</td>
</tr>
<tr>
<td>2010</td>
<td>2,109,200</td>
<td>1,283,120</td>
<td>1.64</td>
</tr>
<tr>
<td>2011</td>
<td>2,141,360</td>
<td>1,302,980</td>
<td>1.64</td>
</tr>
<tr>
<td>2012</td>
<td>2,191,100</td>
<td>1,336,800</td>
<td>1.64</td>
</tr>
<tr>
<td>2012 BCC</td>
<td>1,029,660</td>
<td>726,840</td>
<td>1.42</td>
</tr>
<tr>
<td>2012 SCC</td>
<td>1,027,700</td>
<td>708,540</td>
<td>1.45</td>
</tr>
</tbody>
</table>

Table 4. Calculation of the Number of NMSCs and US Persons of Any Age With NMSCs in 2006 and 2012

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>2006</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedures for NMSC performed in Medicare FFS beneficiaries, No.*</td>
<td>1,919,460</td>
<td>2,191,079</td>
</tr>
<tr>
<td>Proportion of these procedures performed in persons aged ≥65 y</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td>Procedures for NMSC performed in Medicare FFS beneficiaries for persons aged ≥65 y, No.*</td>
<td>1,836,347</td>
<td>2,092,670</td>
</tr>
<tr>
<td>Proportion of all persons aged ≥65 y in the US population enrolled in Medicare FFS</td>
<td>0.74</td>
<td>0.63</td>
</tr>
<tr>
<td>Procedures for NMSC performed in total US population aged ≥65 y</td>
<td>2,488,612</td>
<td>3,314,858</td>
</tr>
<tr>
<td>Proportion of the visits with a procedure for NMSC for persons aged ≥65 y</td>
<td>0.62</td>
<td>0.61</td>
</tr>
<tr>
<td>Incident NMSC in the US population, No.</td>
<td>4,013,890</td>
<td>5,434,193</td>
</tr>
<tr>
<td>Persons in the US population with NMSC, No.</td>
<td>2,463,567</td>
<td>3,315,554</td>
</tr>
</tbody>
</table>

Abbreviations: FFS, fee-for-service; NMSC, nonmelanoma skin cancer.

* Source: Medicare Databases.

† Source: 2012 US Census.

§ Source: National Ambulatory Medical Care Survey.

Discussion

Nonmelanoma skin cancer is the most common malignancy in the United States, but it is generally not reported to registries and is treated mainly in the office-based setting. Therefore, the exact incidence of NMSC and its subtypes is not accurately known. The present study provides an updated US
incidence estimate for NMSC in 2012 as well as a more accurate 2006 estimate. The data presented in this study indicate that the incidence rates of skin cancer continue to rise dramatically, with a 100% increase from 1992 to 2012 in the Medicare fee-for-service population and a 35% increase in NMSC in the US population over the 6-year period 2006 through 2012. This study also indicates that an approximately equal number of BCCs and SCCs were treated in the Medicare fee-for-service population in 2012.

Despite the huge number of NMSCs in the US population, estimation of the proportion of BCCs and SCCs in the NMSC cases has been difficult. We were surprised to find that the ratio of BCC to SCC of 1.0 in the Medicare population. Historically, the ratio of BCC to SCC in general has been estimated at 4 to 1.14 However, recent reports indicate a shift in the numbers of SCC in relation to BCC. Data from Australia have shown a significant change in relative proportions of NMSC with time as the BCC to SCC ratio has decreased from 4 to 1 in 1985 to 2.5 to 1 in 1995.15 A survey of US Mohs fellowship directors indicates an increasing ratio of SCC to BCC treated by Mohs surgery from 1985 through 2006.16 In South Florida, a study of NMSC treated in both Medicare and privately insured patients in 1996 indicated that SCCs were 2.5 times more prevalent than BCCs.17 There is also evidence that although BCCs are much more common than SCCs in the younger population, there is a disproportionately rising incidence of SCC in older age groups.18,19 Thus, an increasing incidence of SCC relative to BCC in our aging Medicare population with heavy, chronic UV exposure may be an underappreciated emerging trend.

In this study, we have updated our group’s previously published 2006 US estimate of NMSC2 upward from 3 507 069 to 4 013 890, and the number of affected individuals is also revised upward from 2 152 500 to 2 463 567. This update is based on 1 improvement in the calculation methodology for the proportion of the procedures for NMSC in Medicare B fee-for-service procedures were performed in beneficiaries 65 years or older. The previous technique multiplied the rate of NMSC procedures per affected person by the number of persons enrolled in Medicare B fee for service. However, for the present study, we used the 5% Sample Data Set to provide a more direct measure of this statistic.

The chief strengths of our current NMSC estimate are that it is up to date and based on the largest, most representative databases available. Revised ICD-9-CM coding in 2012 provides for the most specific definition of treated cutaneous malignancy to date, allowing for estimation of BCC and SCC rates in the Medicare fee-for-service population. Another strength of our NMSC subtype analysis is that the ratio of BCC to SCC of 1.0 holds across all CPT codes reported in Medicare fee for service, across pathology code 88305 (which is reported by pathologists in the diagnosis of skin biopsies and skin excisions), and across all skin cancer treatment codes.

The recent ICD-9-CM update for NMSC coding provides valuable diagnostic information on BCC and SCC, but there is some lack of specificity of the fifth digit of the code series for NMSC. The I73.X0 and I73.X9 codes designate “unspecified” and “other specified” NMSCs, respectively. These codes apply to 6% of treated NMSCs, but the composition of the skin cancers represented by these codes is unclear. Given the large numbers of cancers involved, we suspect that they are mainly BCCs and SCCs coded to a lower level of specificity. However, they also include other uncommon cutaneous malignancies. Diagnostic drift between actinic keratosis and SCC in situ may also contribute to increases in SCC incidence.20 Once data from the 2012 NAMCS becomes available, an additional independent national estimate of SCC and BCC numbers may be possible. Large private insurer databases may also be useful to assess the generalizability of our conclusions.

The assumptions and relative limitations of our estimation model for US incidence of NMSC have been discussed previously and should hold true in this study as well.2 Of note, in this and our group’s previous NMSC incidence estimate,2 we have assumed that the rate of NMSCs per affected individual is the same in the US population as a whole as for the Medicare fee-for-service population.

To our knowledge, no US study has evaluated the average number of skin cancers treated or diagnosed in a year on individuals affected with skin cancer. However, a study from Australia shows that individuals across all age groups referred for NMSC treatment had an average of 1.87 NMSC lesions that needed treatment.21 Although our data indicate a small decrease in the rate of NMSCs per affected individual in the youngest Medicare age group, we chose to use the conservative estimate from the entire Medicare population (1.64 NMSCs per affected individual), which may result in an underestimation of affected persons when applied to the non-Medicare fee-for-service population. In addition, diagnosis and age estimates from the 5% Sample Data Set were extrapolated to the Total Claims Data Set in both the present study and our group’s earlier incidence study.2 However, given that the 5% Sample Data Set was designed as a nationally sampled and statistically representative data set for the Medicare fee-for-service population, we are confident that little error is added with these calculations. Another limitation is that it is unclear how the use of nonsurgical treatments of NMSC, including radiation
therapy and topical treatments such as imiquimod and fluorouracil, has changed in the years between the NMSC estimates.

**Conclusions**

The public health ramifications of increased US skin cancer incidence levels has been acknowledged by the federal government with the release of the US Surgeon General’s Call to Action to Prevent Skin Cancer. This call to action proposes a series of goals and strategies to increase education about the risk of UV radiation exposure; increase opportunities for UV radiation protection; and strengthen research, surveillance, and monitoring related to skin cancer prevention. Our current report provides the strongest NMSC estimate published to date. We hope that it provides further evidence and motivation to support skin cancer prevention and treatment efforts and that it underscores the need for a national system of sentinel registries to better track the incidence of the most common, and largely preventable, cancer in the United States.

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**ARTICLE INFORMATION**

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**Author Contributions:** Dr Rogers had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Rogers, Weinstock, Coldiron. Acquisition, analysis, or interpretation of data: Rogers, Weinstock, Feldman. Drafting of the manuscript: Rogers. Critical revision of the manuscript for important intellectual content: Rogers, Weinstock, Feldman, Coldiron. Statistical analysis: Rogers, Weinstock. Study supervision: Weinstock, Coldiron.

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**REFERENCES**


The global burden of melanoma: results from the Global Burden of Disease Study 2015

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7Dermatology of Epilepsy, Colorado School of Public Health, Aurora, CO, U.S.A.
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Summary

Background Despite recent improvements in prevention, diagnosis and treatment, vast differences in melanoma burden still exist between populations. Comparative data can highlight these differences and lead to focused efforts to reduce the burden of melanoma.

Objectives To assess global, regional and national melanoma incidence, mortality and disability-adjusted life year (DALY) estimates from the Global Burden of Disease Study 2015.

Methods Vital registration system and cancer registry data were used for melanoma mortality modelling. Incidence and prevalence were estimated using separately modelled mortality-to-incidence ratios. Total prevalence was divided into four disease phases and multiplied by disability weights to generate years lived with disability (YLDs). Deaths in each age group were multiplied by the reference life expectancy to generate years of life lost (YLLs). YLDs and YLLs were added to estimate DALYs.

Results The five world regions with the greatest melanoma incidence, DALY and mortality rates were Australasia, North America, Eastern Europe, Western Europe and Central Europe. With the exception of regions in sub-Saharan Africa, DALY and mortality rates were greater in men than in women. DALY rate by age was highest in those aged 70–79 years, 70–74 years and ≥ 80 years.

Conclusions The greatest burden from melanoma falls on Australasian, North American, European, elderly and male populations, which is consistent with previous investigations. These substantial disparities in melanoma burden worldwide highlight the need for aggressive prevention efforts. The Global Burden of Disease Study results can help shape melanoma research and public policy.

What’s already known about this topic?
- Melanoma incidence and mortality has been assessed in the past for individual countries or world regions.
The landscape of melanoma, the most deadly skin cancer, has changed dramatically in the twenty-first century. Prevention, including increased public education and awareness, early detection, genetic testing and substantial improvements in advanced melanoma therapies are examples of recent progress. To describe fully the effect of a disease on a population, metrics beyond incidence and mortality are needed. One approach is to estimate disability-adjusted life years (DALYs), which combine morbidity and mortality metrics.

For reference, one DALY is equivalent to 1 year of healthy life lost. Prior studies have applied DALYs to study melanoma burden among other cancers in world regions and also within individual countries. However, an up-to-date large-scale effort to quantify the comprehensive burden of melanoma, as well as the diversity of causes on global and national scales, is warranted. DALYs, in addition to standard metrics such as incidence, mortality and prevalence are estimated as part of the Global Burden of Disease Study (GBD). The GBD is a systematic scientific effort to quantify the comparative magnitude of health loss resulting from diseases, injuries and risk factors according to age, sex and geography over time. For GBD 2015, the burden of 310 diseases, injuries and conditions was estimated. This study presents the GBD 2015 melanoma incidence, mortality and DALY estimates by sex for 21 world regions encompassing 195 countries and territories.

### Materials and methods

Detailed GBD methodology is published elsewhere. A brief overview of the specific melanoma estimation strategy is presented here. Data sources include vital registration systems and cancer registry incidence data that were first transformed to mortality estimates using separately estimated mortality-to-incidence (MI) ratios. Briefly, incidence and mortality data were matched by cancer, age, sex, year and location. Multiple logit random effects models were tested, comparing mean MI predictions and mean root-mean-squared error to determine a final model output. After removing outliers (data points that unrealistically influenced the model) and space-time smoothing (spatiotemporal regression to smooth residuals over space, time and age), a Gaussian process regression was performed, which interpolates nonlinear trends. Final MI ratios with 95% confidence intervals (CIs) were generated by back-transforming 1000 draws from the posterior distribution. Cancer registry data were obtained either by contacting cancer registries directly or accessing publicly available data sources such as CI5 (Cancer Incidence in Five Countries). Data sources were used as input into a cause-of-death modelling tool (i.e. cause-of-death ensemble model approach), which combines many possible models into an ensemble with more accurate trends and smaller error than a single model.

To improve estimates for melanoma mortality in areas with sparse data, the following covariates were used: income per capita, years of education per capita, latitude, smoking, alcohol intake, animal fat consumption, fruit and vegetable consumption, mean body mass index and diabetes prevalence. Melanoma mortality together with all other single-cause estimates were adjusted to fit into the separately estimated all-cause mortality. For melanoma incidence estimates, final melanoma mortality estimates were divided by the MI ratios.

The 10-year prevalence was estimated using melanoma incidence and survival estimates. Melanoma survival was estimated by transforming MI ratios into an access-to-care variable and scaling each incidence cohort between a ‘best case’ and ‘worst case’ survival. The ‘best case’ survival curve was derived from Surveillance, Epidemiology, and End Results (SEER) programme 2010 data, while the ‘worst case’ survival curve was derived from the 1950 U.S. Mortality Files and Cancer Survival programme in Africa, Asia, the Caribbean and Central America (SurvCan). Prevalence was divided into the following four disease phases: (i) diagnosis and treatment, (ii) remission, (iii) metastatic and (iv) terminal. A constant duration for the diagnosis and treatment phase (2 months), metastatic phase (7-18 months) and terminal phase (1 month) was used for all ages, countries and times, owing to a lack of data regarding stage distribution and treatment in a majority of countries. Prevalence of remission was estimated by subtracting the sum of the remaining phases from the total prevalence by location, age, sex and year. Prevalence estimates were multiplied by distinct disability weights, derived from population surveys and an open access web-based survey, to generate years lived with disability (YLDs). Years of life lost (YLLs) were calculated by multiplying the number of deaths in each age group by the corresponding standard life expectancy. The normative standard life expectancy was based on the lowest age-specific
The global incidence of melanoma in 2015 was 351,880 cases (95% CI 281,633–445,036) with an age-standardized rate of five cases per 100,000 persons (95% CI 4–7). Melanoma was responsible for 1,596,262 global DALYs (95% CI 1,293,447–1,801,732) with an age-standardized rate of one DALY per 100,000 persons (95% CI 0.7–1). With 100% representing total burden from all conditions studied by GBD 2015, melanoma was responsible for 0.065% of all DALYs.

The five world regions with the greatest incidence rates were Australasia [54 (95% CI 41–78)], North America [21 (95% CI 16–31)], Western Europe [16 (95% CI 11–20)], Central Europe [8 (95% CI 7–11)] and Eastern Europe [8 (95% CI 6–10)] (Table 2). Similarly, these were the five world regions with the greatest DALY rates: Australasia [152 (95% CI 112–211)], North America [66 (95% CI 51–100)], Eastern Europe [65 (95% CI 51–85)], Western Europe [58 (95% CI 41–76)] and Central Europe [58 (95% CI 44–73)]. Mortality rates were also highest in these five regions: Australasia [6 (95% CI 4–8)], North America [2 (95% CI 2–3)], Eastern Europe [2 (95% CI 2–3)], Central Europe [2 (95% CI 2–3)] and Western Europe [2 (95% CI 1–3)].

Of the 195 countries studied, the five highest age-standardized incidence rates were in New Zealand [54 (95% CI 39–73)], Australia [54 (95% CI 41–78)], Norway [26 (95% CI 18–32)], Sweden [26 (95% CI 20–35)] and the Netherlands [25 (95% CI 17–30)]. The top-five highest age-standardized DALY rates were in New Zealand [165 (95% CI 119–228)], Australia [149 (95% CI 111–221)], Norway [107 (95% CI 77–145)], Sweden [54 (95% CI 37–79)] and the Netherlands [57 (95% CI 38–80)].

Table 1 Global Burden of Disease Study region classifications

<table>
<thead>
<tr>
<th>Global Burden of Disease Study region</th>
<th>Countries represented</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Asia</td>
<td>China, North Korea, Taiwan</td>
</tr>
<tr>
<td>Oceania</td>
<td>American Samoa, Federated States of Micronesia, Fiji, Guam, Marshall Islands, Northern Mariana Islands, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>Cambodia, Indonesia, Laos, Malaysia, Maldives, Mauritius, Myanmar, Philippines, Sri Lanka, Seychelles, Thailand, Timor-Leste, Vietnam</td>
</tr>
<tr>
<td>South Asia</td>
<td>Bangladesh, Bhutan, India, Nepal, Pakistan</td>
</tr>
<tr>
<td>Central Asia</td>
<td>Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Mongolia, Tajikistan, Turkmenistan, Uzbekistan</td>
</tr>
<tr>
<td>Central Europe</td>
<td>Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Serbia, Slovakia, Slovenia</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>Belarus, Estonia, Latvia, Lithuania, Moldova, Russia, Ukraine</td>
</tr>
<tr>
<td>North Africa and Middle East</td>
<td>Afghanistan, Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Palestine, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, Turkey, United Arab Emirates, Yemen</td>
</tr>
<tr>
<td>Western Sub-Saharan Africa</td>
<td>Benin, Burkina Faso, Cameroon, Cape Verde, Chad, Cote d’Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone, Togo</td>
</tr>
<tr>
<td>Southern Sub-Saharan Africa</td>
<td>Botswana, Lesotho, Namibia, South Africa, Swaziland, Zimbabwe</td>
</tr>
<tr>
<td>Eastern Sub-Saharan Africa</td>
<td>Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Rwanda, Somalia, South Sudan, Tanzania, Uganda, Zambia</td>
</tr>
<tr>
<td>Central Sub-Saharan Africa</td>
<td>Angola, Central African Republic, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon</td>
</tr>
<tr>
<td>Tropical Latin America</td>
<td>Brazil, Paraguay</td>
</tr>
<tr>
<td>Andean Latin America</td>
<td>Bolivia, Ecuador, Peru</td>
</tr>
<tr>
<td>Central Latin America</td>
<td>Colombia, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Venezuela</td>
</tr>
<tr>
<td>Caribbean</td>
<td>Antigua and Barbuda, The Bahamas, Barbados, Belize, Bermuda, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Puerto Rico, Saint Lucia, Saint Vincent and the Grenadine, Suriname, Trinidad and Tobago, Virgin Islands</td>
</tr>
<tr>
<td>Western Europe</td>
<td>Andorra, Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, U.K.</td>
</tr>
<tr>
<td>Southern Latin America</td>
<td>Argentina, Chile, Uruguay</td>
</tr>
<tr>
<td>North America</td>
<td>Canada, U.S.A.</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>Brunei, Japan, Singapore, South Korea</td>
</tr>
<tr>
<td>Australasia</td>
<td>Australia, New Zealand</td>
</tr>
</tbody>
</table>

Results

The global incidence of melanoma in 2015 was 351,880 cases (95% CI 281,633–445,036) with an age-standardized rate of five cases per 100,000 persons (95% CI 4–7). Melanoma was responsible for 1,596,262 global DALYs (95% CI 1,293,447–1,801,732) with an age-standardized rate of 23 DALYs per 100,000 persons (95% CI 18–28). Melanoma was also responsible for 59,782 global deaths (95% CI 47,602–72,671) with an age-standardized rate of one death per 100,000 persons (95% CI 0.7–1). With 100% representing total burden from all conditions studied by GBD 2015, melanoma was responsible for 0.065% of all DALYs.

The five world regions with the greatest incidence rates were Australasia [54 (95% CI 41–78)], North America [21 (95% CI 16–31)], Western Europe [16 (95% CI 11–20)], Central Europe [8 (95% CI 7–11)] and Eastern Europe [8 (95% CI 6–10)] (Table 2). Similarly, these were the five world regions with the greatest DALY rates: Australasia [152 (95% CI 112–211)], North America [66 (95% CI 51–100)], Eastern Europe [65 (95% CI 51–85)], Western Europe [58 (95% CI 41–76)] and Central Europe [58 (95% CI 44–73)]. Mortality rates were also highest in these five regions: Australasia [6 (95% CI 4–8)], North America [2 (95% CI 2–3)], Eastern Europe [2 (95% CI 2–3)], Central Europe [2 (95% CI 2–3)] and Western Europe [2 (95% CI 1–3)].

Of the 195 countries studied, the five highest age-standardized incidence rates were in New Zealand [54 (95% CI 39–73)], Australia [54 (95% CI 41–78)], Norway [26 (95% CI 18–32)], Sweden [26 (95% CI 20–35)] and the Netherlands [25 (95% CI 17–30)]. The top-five highest age-standardized DALY rates were in New Zealand [165 (95% CI 119–228)], Australia [149 (95% CI 111–221)], Norway [107 (95% CI 77–145)], Sweden [54 (95% CI 37–79)] and the Netherlands [57 (95% CI 38–80)].
Table 2 Age-standardized incidence, disability-adjusted life year (DALY) and mortality rates for 21 world regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Incidence rate (95% CI)</th>
<th>DALY rate (95% CI)</th>
<th>Mortality rate (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australasia</td>
<td>54-1170 (40.7429-77.8116)</td>
<td>151-5096 (112.1229-220.9776)</td>
<td>5-6255 (4.0817-7.9069)</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>7-8326 (6.2571-9.8118)</td>
<td>65-2106 (50.9055-84.6727)</td>
<td>2.2749 (1.8017-2.9094)</td>
</tr>
<tr>
<td>Western Europe</td>
<td>15-6651 (11.3721-20.1230)</td>
<td>58-2175 (41.0157-75.8866)</td>
<td>2.0665 (1.4470-2.5908)</td>
</tr>
<tr>
<td>Central Europe</td>
<td>8-3560 (6.4831-10.5992)</td>
<td>57-7440 (43.5435-72.7666)</td>
<td>2.0795 (1.5600-2.5592)</td>
</tr>
<tr>
<td>Southern Sub-Saharan Africa</td>
<td>6-3628 (4.9125-7.8282)</td>
<td>33-6285 (25.9907-39.0645)</td>
<td>1.4286 (1.1162-1.6328)</td>
</tr>
<tr>
<td>Southern Latin America</td>
<td>5-2630 (3.8661-7.1943)</td>
<td>32-5243 (23.5926-45.1229)</td>
<td>1.2726 (0.9299-1.7071)</td>
</tr>
<tr>
<td>Tropical Latin America</td>
<td>5-5221 (4.1212-6.5629)</td>
<td>27-6028 (20.9512-30.5295)</td>
<td>1.0908 (0.8410-1.1969)</td>
</tr>
<tr>
<td>Central Asia</td>
<td>3-6565 (3.1654-4.5980)</td>
<td>20-1091 (17.9108-25.5499)</td>
<td>0.7797 (0.6910-0.9922)</td>
</tr>
<tr>
<td>Central Latin America</td>
<td>3-2885 (2.4786-4.3273)</td>
<td>17-7484 (13.3281-23.6114)</td>
<td>0.7234 (0.5479-0.9377)</td>
</tr>
<tr>
<td>Andean Latin America</td>
<td>2-8237 (2.3764-3.5472)</td>
<td>16-6716 (14.4629-20.9201)</td>
<td>0.7467 (0.6502-0.9372)</td>
</tr>
<tr>
<td>Oceania</td>
<td>2-5894 (1.8813-3.8080)</td>
<td>15-8802 (11.3658-24.2364)</td>
<td>0.3597 (0.4788-0.9624)</td>
</tr>
<tr>
<td>Caribbean</td>
<td>2-8244 (2.4326-3.6637)</td>
<td>14-6916 (12.7388-18.8543)</td>
<td>0.5985 (0.5202-0.7801)</td>
</tr>
<tr>
<td>Central Sub-Saharan Africa</td>
<td>2-1923 (1.4123-3.2689)</td>
<td>12-6024 (8.4114-19.7562)</td>
<td>0.4690 (0.3047-0.6881)</td>
</tr>
<tr>
<td>Eastern Sub-Saharan Africa</td>
<td>2-1221 (1.6561-2.6536)</td>
<td>11-5941 (9.0618-14.4732)</td>
<td>0.4628 (0.3671-0.5796)</td>
</tr>
<tr>
<td>Western Sub-Saharan Africa</td>
<td>2-2212 (1.7434-3.0505)</td>
<td>10-6301 (8.5621-14.7869)</td>
<td>0.4833 (0.3906-0.6635)</td>
</tr>
<tr>
<td>North Africa and Middle East</td>
<td>2-1660 (1.4458-2.2101)</td>
<td>10-4575 (9.2637-14.3409)</td>
<td>0.4237 (0.3753-0.5721)</td>
</tr>
<tr>
<td>East Asia</td>
<td>1-4307 (1.0586-1.7655)</td>
<td>10-2859 (7.5003-11.5445)</td>
<td>0.3731 (0.2953-0.4085)</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>1-3100 (1.0986-1.7015)</td>
<td>9-2136 (7.8837-11.9697)</td>
<td>0.3352 (0.2855-0.4343)</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>0-7130 (0.5524-0.9494)</td>
<td>7-7359 (5.7688-10.8982)</td>
<td>0.3089 (0.2295-0.4173)</td>
</tr>
<tr>
<td>South Asia</td>
<td>1-1088 (0.8943-1.4254)</td>
<td>6-4210 (5.5115-8.3923)</td>
<td>0.2313 (0.2014-0.2954)</td>
</tr>
</tbody>
</table>

CI, confidence interval.

70–133], the Netherlands [98 (95% CI 65–120)] and Sweden [97 (95% CI 71–135)] (Fig. 1). Age-standardized mortality rates were also highest in New Zealand [6 (95% CI 4–8)], Australia [6 (95% CI 4–8)], Norway [4 (95% CI 3–5)], Sweden [4 (95% CI 3–5)] and the Netherlands [3 (95% CI 2–4)].

The global age-standardized DALY rates resulting from melanoma were 27 (95% CI 18–38) in male patients and 19 (95% CI 17–21) in female patients. DALY rates were greater in men than in women in all world regions with the exception of Central, Eastern and Western Sub-Saharan Africa, where melanoma DALY rates were greater in women (Fig. 2). Differences in melanoma mortality rate by sex followed a similar pattern to DALY rates (Fig. 3). For DALY rate by age, the following groups demonstrated the highest rates: 75–79 years, 70–74 years and ≥ 80 years (Table 3).

Discussion

We reveal that the greatest burden from melanoma falls on New Zealand, Australia, Europe, the elderly and male populations. Reasons for the disproportionate burden of melanoma in Australasia have been well documented and include a predominantly fair-skinned population, living with high ambient solar ultraviolet (UV) radiation levels, and having a cultural emphasis on tanning.16 A similar study investigating burden of disease metrics for 27 cancer groups in 12 world regions found the highest DALY rates from melanoma in Australia and New Zealand, followed by Northern Europe, North America, Western Europe, Southern Europe and Eastern Europe.17 These findings agree well with those of our current study. In addition, the burden of melanoma on many regions of Europe, particularly Western Europe, has been recognized. A prior study in the Netherlands found that from 1991 to 2010 there were 96% and 75% increases in melanoma DALYs in men and women, respectively.4 Specific to Scandinavian populations, despite living with low ambient UV, the higher incidence of melanoma may be predominantly attributed to a high-risk phenotype (fair skin, hair and eye colour), combined with a tanning culture favouring high levels of UV exposure with sunny holidays and indoor tanning.17–19 Regarding age differences, the higher DALY rates observed in elderly populations are likely a result of peak incidence rates owing to prolonged lifetime cumulative risk factors.20 Sex differences in melanoma incidence and mortality are well documented, as men tend to have worse sun protection behaviours and reduced skin screening, as well as biological differences in tumours.21

It is of interest to compare the differences in melanoma burden between three high-income countries, i.e. Australia, New Zealand and the U.S.A., particularly in regard to national policy efforts. Of the 195 countries, New Zealand and Australia ranked first and second, respectively, while the U.S.A. was ranked 18th in melanoma DALY rates. Remarkably, the age-standardized melanoma DALY rate in New Zealand was almost 2.5 times greater than that in the U.S.A. The burden of melanoma in the Australasian region can at least partly be attributed to predominantly fair-skinned populations with high ambient UV and cultural habits of outdoor recreation and sun tanning.22 However, Australia has undertaken aggressive and comprehensive skin cancer awareness campaigns for over three decades to reduce the burden of skin cancer.16,23 Following the International Agency for Research on Cancer classification of UV-emitting tanning devices as class I
‘carcinogenic to humans’, Australia became the second nation after Brazil to enact a nationwide ban on commercial tanning beds.\(^\text{24,25}\) In contrast, New Zealand has lagged behind Australia in skin cancer prevention efforts and implementation of protective behaviours. Tanning beds are not currently partially or fully banned and a recent study revealed 176 businesses nationwide offering commercial tanning beds to consumers.\(^\text{26}\)

In addition, regarding the paediatric and adolescent populations, which spend high-UV hours at school, multiple investigations found that only 50% of New Zealand schools had an established sun policy behaviour and that sun barriers such as sunscreen and hats were poorly used at outdoor school activities.\(^\text{27–29}\) Researchers from these studies note that while multiple nongovernmental charities have been actively involved in
sun protection efforts, there is a need for New Zealand government collaboration to promote universal sun awareness and protection policies.\textsuperscript{28}

Regarding national melanoma treatment guidelines, a review article comparing the U.S.A., Canada, Europe, Australia and New Zealand, found that the Australian Cancer Network (ACN), responsible for guideline generation in Australia and New Zealand, produced the strictest follow-up recommendations for patients with melanoma of any stage, including the use of ultrasound in surveillance of lymph node recurrence.\textsuperscript{30}

While the National Comprehensive Cancer Network (NCCN) does not issue a consensus on routine melanoma screening, the ACN has recommended against population-based screening. The ACN and NCCN generally share recommendations regarding biopsy and excisions guidelines.\textsuperscript{30}

The GBD relies on the premise that estimates based on high-quality analyses and prediction models, while imperfect, are better than no data at all. Estimations for areas lacking cancer data are dependent on covariate selection and regional patterns. This highlights the importance of a global effort to improve vital registration systems and cancer registries. There are a number of limitations to the use of the DALY in regard to melanoma. As mentioned above, because the stage of diagnosis is not incorporated, melanoma DALYs may change with time, as increased early detection leads to a higher proportion of detected melanomas at an early stage. Similarly, with recent progress in advanced melanoma treatment and prognosis, the disability from melanoma is likely to change over time, making temporal DALY comparisons difficult.

A recent report investigated DALYs from melanoma by stage among a large cohort of patients from the Belgian Cancer Registry.\textsuperscript{31} Melanoma mortality, expressed as YLLs, was divided among the melanoma stages as follows: 28% stage I, 33% stage II, 24% stage III, and 15% stage IV.
stage II, 26.2% stage III and 13% stage IV. Over half of melanoma morbidity, expressed as YLDs, was attributed to melanomas with node metastases, while 35% was attributed to localized melanomas and 13% to melanoma with distant metastases. For GBD 2015, stage of diagnosis was not incorporated into the GBD disability estimates. Melanoma stage of diagnosis could be included in future GBD 2015 data for high-income countries. Another area of consideration in future GBD iterations is the particular burden imposed by early detection and preventative activities. Regardless of its shortcomings, the GBD provides high-quality, comparative estimates of melanoma burden. As GBD results are now produced on an annual basis, the global collaboration continually works to improve existing estimates and incorporate new studies. Epidemiological assessments such as the GBD have the potential to influence research and public policy regarding melanoma pathogenesis, prevention, diagnosis and treatment.

References
5 Institute for Health Metrics and Evaluation. About GBD. Available at: http://www.healthdata.org/gbd/about (last accessed 3 November 2016).
January 17, 2018

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Fax:(916) 734-6795
Email: dbeisen@ucdavis.edu

Janet A. Fairley, MD
President, American Board of Dermatology
2 Wells Avenue
Newton, Massachusetts 02459

Dear Dr. Fairley,

The Dermatologic Surgery Section of the Association of Professors of Dermatology represents the academic dermatologists involved in the education of dermatology residents and fellows in all aspects of surgical dermatology and the treatment of cutaneous malignancies. As such we have observed and participated in the evolution of Mohs Surgery and Dermatologic Oncology into a mature sub discipline of Dermatology with widespread ACGME accredited fellowships and a well-established, strongly defined curriculum representative of a progressively expanding body of knowledge.

On behalf of the Dermatologic Surgery Section of the Association of Professors of Dermatology, we respectfully request that the American Board of Dermatology continue with the development and establishment of certification in Mohs Surgery and Dermatologic Oncology to recognize individuals with advanced training and practice in this area. Just as with residency programs, a Board exam is an opportunity for those who have undergone specialty training to demonstrate competence in their field of study. This action would be consistent with the certification offered by the American Board of Dermatology for Dermatopathology and Pediatric Dermatology. Recognizing additional advanced training in Mohs Surgery and Dermatologic Oncology will serve the public by clarifying the role of all dermatologists in the diagnosis and treatment of cutaneous malignancies and leading patients to the best, most cost-effective treatment and serve Dermatology by formalizing the specialty’s expertise and leadership in the field.

We would be pleased to discuss the matter in greater detail, if desired.

Best regards,

Daniel B. Eisen, MD
Chair, Dermatologic Surgery Section of the Association of Professors of Dermatology
The Micrographic Surgery and Dermatologic Oncology Milestone Project

A Joint Initiative of

The Accreditation Council for Graduate Medical Education and

The American Board of Dermatology

July 2015
The Micrographic Surgery and Dermatologic Oncology Milestone Project

The Milestones are designed only for use in evaluation of fellows in the context of their participation in ACGME-accredited residency or fellowship programs. The Milestones provide a framework for the assessment of the development of the fellow in key dimensions of the elements of physician competency in a specialty or subspecialty. They neither represent the entirety of the dimensions of the six domains of physician competency, nor are they designed to be relevant in any other context.
Micrographic Surgery and Dermatologic Oncology Milestones

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David G. Brodland, MD
Laura Edgar, EdD, CAE
Allison T. Vidimos

Advisory Group
Thomas D. Horn, MD
Mary Lieh-Lai, MD
Nicole M. Owens, MD
Milestone Reporting

This document presents Milestones designed for programs to use in semi-annual review of fellow performance and reporting to the ACGME. Milestones are knowledge, skills, attitudes, and other attributes for each of the ACGME competencies organized in a developmental framework from less to more advanced. They are descriptors and targets for fellow performance as a fellow moves from entry into fellowship through graduation. In the initial years of implementation, the Review Committee will examine Milestone performance data for each program’s fellows as one element in the Next Accreditation System (NAS) to determine whether fellows overall are progressing.

For each period, review and reporting will involve selecting milestone levels that best describe each fellow’s current performance and attributes. Milestones are arranged into numbered levels. Tracking from Level 1 to Level 5 is synonymous with moving from novice to expert in the subspecialty. These levels do not correspond with post-graduate year of education.

Selection of a level implies that the fellow substantially demonstrates the milestones in that level, as well as those in lower levels (see the diagram on page v).

**Level 1:** The fellow demonstrates milestones expected of an incoming fellow.

**Level 2:** The fellow is advancing and demonstrates additional milestones, but is not yet performing at a mid-fellowship level.

**Level 3:** The fellow continues to advance and demonstrate additional milestones, consistently including the majority of milestones targeted for fellowship.

**Level 4:** The fellow has advanced so that he or she now substantially demonstrates the milestones targeted for fellowship. This level is designed as the graduation target.

**Level 5:** The fellow has advanced beyond performance targets set for fellowship and is demonstrating “aspirational” goals which might describe the performance of someone who has been in practice for several years. It is expected that only a few exceptional fellows will reach this level.
Additional Notes

Level 4 is designed as the graduation target and does not represent a graduation requirement. Making decisions about readiness for graduation is the purview of the fellowship program director. Study of Milestone performance data will be required before the ACGME and its partners will be able to determine whether milestones in the first four levels appropriately represent the developmental framework, and whether Milestone data are of sufficient quality to be used for high-stakes decisions.

Examples are provided with some milestones. Please note that the examples are not the required element or outcome; they are provided as a way to share the intent of the element.

Some milestone descriptions include statements about performing independently. These activities must occur in conformity to the ACGME supervision guidelines, as well as to institutional and program policies. For example, a fellow who performs a procedure independently must, at a minimum, be supervised through oversight.

Answers to Frequently Asked Questions about the Next Accreditation System and Milestones are posted on the Next Accreditation System section of the ACGME website.
The diagram below presents an example set of milestones for one sub-competency in the same format as the ACGME Report Worksheet. For each reporting period, a fellow’s performance on the milestones for each sub-competency will be indicated by selecting the level of milestones that best describes that fellow’s performance in relation to those milestones.

<table>
<thead>
<tr>
<th>Patient Care — Mohs Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1</strong></td>
</tr>
<tr>
<td>With direct supervision, performs simple first layer Mohs surgery with complete intact specimens</td>
</tr>
<tr>
<td>With direct supervision, creates a basic map and performs subdivision and marking of tissue specimen</td>
</tr>
</tbody>
</table>

Comments:

- Selecting a response box on the line in between levels indicates that milestones in lower levels have been substantially demonstrated as well as **some** milestones in the higher level(s).
- Selecting a response box in the middle of a level implies that milestones in that level and in lower levels have been substantially demonstrated.
<table>
<thead>
<tr>
<th>Patient Care 1 — Mohs Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1</strong></td>
</tr>
<tr>
<td>With direct supervision,</td>
</tr>
<tr>
<td>performs simple first layer</td>
</tr>
<tr>
<td>Mohs surgery with complete</td>
</tr>
<tr>
<td>intact specimens</td>
</tr>
<tr>
<td>With direct supervision,</td>
</tr>
<tr>
<td>creates a basic map and</td>
</tr>
<tr>
<td>performs subdivision and</td>
</tr>
<tr>
<td>inking of tissue specimen</td>
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<tr>
<td>Comments:</td>
</tr>
</tbody>
</table>

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### Patient Care 2 — Reconstruction

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>With direct supervision, performs simple and intermediate repairs</td>
<td>Offers appropriate options for wound management, including second</td>
<td>Selects most appropriate wound repair option</td>
<td>Independently uses advanced suturing techniques and performs complex</td>
<td>Independently designs and performs innovative reconstructive techniques</td>
</tr>
<tr>
<td>Applies knowledge of wound healing</td>
<td>intention healing and reconstruction</td>
<td>With moderate supervision, performs complex flaps and grafts</td>
<td>large, and two stage flap repairs and grafts</td>
<td></td>
</tr>
<tr>
<td>With direct supervision manages minor surgical emergencies (e.g.,</td>
<td>With moderate supervision, performs complex repairs and simple skin</td>
<td>Aware of the impact of patient comorbidities and social circumstances</td>
<td>Consistently considers patient comorbidities and social circumstances</td>
<td></td>
</tr>
<tr>
<td>intra-operative bleeding, vagal reactions)</td>
<td>grafts</td>
<td>in managing wounds</td>
<td>in managing wounds</td>
<td></td>
</tr>
<tr>
<td>During medical emergencies, competently implements basic life support</td>
<td></td>
<td>Manages acute complications</td>
<td>During medical emergencies, competently implements basic life support</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recognizes long-term complications (e.g., scar contraction, functional</td>
<td>measures</td>
<td></td>
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<td></td>
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<td>deficit, nerve damage)</td>
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</tbody>
</table>

**Comments:**

Not yet achieved Level 1
### Patient Care 3 — Mohs Histopathology

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifies normal structures and simple tumors histopathologically</td>
<td>Identifies normal structures, artifacts, and simple tumors on frozen section</td>
<td>Identifies normal variants and less common tumors on frozen section</td>
<td>Identifies unexpected findings, and rare and unusual tumors on frozen section</td>
<td>Competent in the use of immunohistochemical stains</td>
</tr>
<tr>
<td>With direct supervision, mounts, freezes, and orients tissue specimens</td>
<td>With minimal supervision, cuts and stains a frozen section on simple tissue</td>
<td>Reaches significant concordance with faculty in interpretation of frozen sections</td>
<td>Reaches near complete concordance with faculty in interpretation of frozen sections</td>
<td>Creates innovative tests or techniques in Mohs histopathology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Independently prepares frozen section slides, including difficult tissue (e.g., fat, cartilage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Achieves competence to manage a frozen section laboratory and prepare for laboratory accreditation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:** Not yet achieved Level 1 □
## Patient Care 4 — Diagnosis and Management

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifies common malignant and pre-malignant lesions</td>
<td>Identifies many malignant and pre-malignant lesions and performs appropriate confirmatory diagnostic tests or procedures</td>
<td>Identifies majority of malignant lesions (basal cell carcinoma, squamous cell carcinoma, melanoma), including uncommon clinical variants</td>
<td>Identifies rare and unusual malignant lesions (e.g., angiosarcoma, Merkel cell carcinoma, dermatofibrosarcoma protuberans)</td>
<td>Designs and completes a research project which results in alteration in the diagnosis and/or treatment of cutaneous malignancy</td>
</tr>
<tr>
<td>Aware of the adjuvant therapy options for high-risk malignancies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Considers referrals for diagnostic testing, adjuvant therapy options or peri-operative co-management</td>
<td>Appropriately refers patients for adjuvant therapy (e.g., radiation therapy, chemotherapy, nodal dissection)</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identifies patients who may benefit from chemoprophylaxis for cutaneous malignancy</td>
<td>Designs appropriate treatment plans for patients with multiple tumors, locally advanced tumors, syndromes, and comorbidities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recognizes the impact of various comorbidities (e.g., immunosuppression, syndromes) on cutaneous malignancies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:** Not yet achieved Level 1

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<table>
<thead>
<tr>
<th>Medical Knowledge 1 — Mastery of Dermatologic Surgical Curriculum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1</strong></td>
</tr>
<tr>
<td>Demonstrates basic knowledge of wound healing, basic surgical anatomy, local anesthesia, universal precautions, sterile technique, closure materials, laser physics, and applications</td>
</tr>
<tr>
<td>Demonstrates knowledge of the methodology and science associated with invasive cosmetic dermatologic procedures, such as laser resurfacing, hair transplantation, and liposuction</td>
</tr>
<tr>
<td>Demonstrates knowledge of the concepts and principles of non-invasive cosmetic procedures, such as botulinum toxin injections, soft tissue augmentation, and some light-based therapies</td>
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</table>

**Comments:** Not yet achieved Level 1
### Medical Knowledge 2 — Mastery of Cutaneous Oncologic Curriculum

<table>
<thead>
<tr>
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<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrates basic knowledge of cutaneous oncologic surgery and evidence of self-learning and participation in didactic sessions</td>
<td>Demonstrates practical understanding of learned concepts and the ability to apply it to patient care</td>
<td>Synthesizes clinical judgment and surgical approaches or techniques based on fund of knowledge</td>
<td>Demonstrates comprehensive knowledge of clinical diagnosis, biology, and pathology of skin tumors, as well as laboratory interpretation related to diagnosis and surgical treatment</td>
<td>Performs a meta-analysis of a complex topic in cutaneous oncologic surgery</td>
</tr>
<tr>
<td>Demonstrates knowledge of tumor biology of common skin malignancies</td>
<td>Demonstrates understanding of specific gene defects as they relate to cutaneous oncology</td>
<td>Demonstrates knowledge of tumor biology of uncommon and high-risk skin malignancies</td>
<td>Demonstrates mastery of tumor biology of uncommon and high-risk skin malignancies</td>
<td></td>
</tr>
<tr>
<td>Demonstrates understanding of the role of and indications for physical, pharmacologic, biologic, and immunologic agents for cutaneous malignancies</td>
<td>Demonstrates understanding of mechanism of metastases</td>
<td>Demonstrates understanding of the appropriate use for physical, pharmacologic, biologic, and immunologic agents for cutaneous malignancies</td>
<td>Appropriately prescribes or refers for therapy using physical, pharmacologic, biologic, and immunologic agents for cutaneous malignancies</td>
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**Comments:**

Not yet achieved Level 1 □□
## Systems-based Practice 1 — Practices Cost-Conscious Care (for Patients and Populations)

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articulates awareness of health care costs</td>
<td>Demonstrates knowledge of how a patient's health care is paid for, and how this affects the patient's care</td>
<td>Articulates an awareness of common socio-economic barriers that impact patient care</td>
<td>Articulates an awareness of current debates/issues of health care financing and how they will affect patients, providers, third-party payers, and other stakeholders</td>
<td>Demonstrates the incorporation of cost-awareness principles into complex clinical scenarios</td>
</tr>
<tr>
<td>Aware of “Appropriate Use Criteria” for Mohs surgery</td>
<td>Considers cost and efficacy of Mohs surgery and alternative therapies, and incorporates this into therapy decisions and discussions with the patient</td>
<td>Articulates understanding of how cost-benefit analysis is applied to patient care (e.g., principles of screening tests and the development of clinical guidelines)</td>
<td>Identifies inherent biases of interactions with pharmaceutical and medical device industries</td>
<td></td>
</tr>
<tr>
<td>Articulates awareness of how a patient's health care is paid for, and how this affects the patient's care</td>
<td>Attempts to identify excess resource utilization and wastage, and to reduce this when possible</td>
<td>Identifies the role of various health care stakeholders, including providers, third-party payers, pharmaceutical industry and medical device companies, and their varied impact on the cost of and access to health care</td>
<td>Demonstrates the incorporation of cost-awareness principles into standard clinical judgments and decision-making</td>
<td></td>
</tr>
<tr>
<td>Consistently applies principles of coding (ICD-9/10) and reimbursement (Evaluation and Management levels/CPT) appropriate to medical record documentation</td>
<td>Consistently applies “Appropriate Use Criteria” for Mohs surgery</td>
<td>Consistently applies “Appropriate Use Criteria” for Mohs surgery</td>
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**Comments:** Not yet achieved Level 1
### Systems-based Practice 2 — Works Effectively within an Inter-professional Team

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifies members of the team who coordinate patient care</td>
<td>Appropriately communicates and coordinates care with the primary care and/or referral provider(s)</td>
<td>Delegates tasks appropriately to members of the health care team</td>
<td>Demonstrates how to manage, utilize, and coordinate the inter-professional team (e.g., tumor board)</td>
<td>Leads an inter-professional team</td>
</tr>
<tr>
<td>Describes own role as a member of the health care team</td>
<td>Describes unique contributions (knowledge, skills, and attitudes) of other health care professionals, and seeks their input for appropriate issues</td>
<td>Attends and contributes to academic department/division retreats (or similar organizational venue), as well as to clinic team/staff meetings at participating sites</td>
<td>Participates in an inter-professional team meeting for clinic or program improvement</td>
<td></td>
</tr>
<tr>
<td>Utilizes and consults with other health care providers in coordination of patient care</td>
<td>Facilitates checklist-guided briefings (for example pre-procedure time-outs) in health care activities</td>
<td></td>
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</table>

**Comments:**

Not yet achieved Level 1
### Practice-based Learning and Improvement 1 — Appraises and Assimilates Scientific Evidence

<table>
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<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without being directed, accesses appropriate print or electronic resources to find multidisciplinary medical information requested or assigned</td>
<td>Actively seeks appropriate resources to find medical information to answer clinical questions without being requested or assigned this task</td>
<td>Applies a set of critical appraisal criteria to different types of research, including synopses of original research findings, systematic reviews, meta-analyses, and clinical practice guidelines</td>
<td>Incorporates principles and basic practices of evidence-based practice and information mastery into clinical practice</td>
<td>Independently teaches and assesses evidence-based medicine and information mastery techniques</td>
</tr>
<tr>
<td>Navigates electronic databases of indexed citations and abstracts to medical sciences journal articles</td>
<td>Identifies critical threats to study validity and generalizability when reading a research paper or study synopsis</td>
<td>Critically evaluates information from others, including colleagues, experts, industry representatives, and patients</td>
<td>Identifies alternative resources to answer clinical questions (i.e., microbiology lab director, Evaluation and Management coding guidelines, Medicare policies, Centers for Disease Control and Prevention [CDC] reporting requirements)</td>
<td>Cites evidence supporting several common practices in his or her practice</td>
</tr>
<tr>
<td>Describes basic concepts in clinical epidemiology, biostatistics, and clinical reasoning, and can categorize the study design of a research study</td>
<td>Identifies well-conducted research that impacts patient care</td>
<td>Summarizes complex medical topics through effective information synthesis and presentation of material within time allotted</td>
<td>Prepares a manuscript for submission to peer-reviewed publication</td>
<td></td>
</tr>
<tr>
<td>Provides appropriate reference lists for prepared hand-outs or other program-specific assignments</td>
<td>Actively participates by leading article review discussion and by asking appropriate questions during journal club/journal review activities</td>
<td></td>
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</tbody>
</table>

Comments: Not yet achieved Level 1 □
<table>
<thead>
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<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has a basic understanding of the health care delivery systems and how improvements may be made</td>
<td>Identifies deviations from standards of care (for example, identifies when guidelines of care were not followed, and when over- or under-utilization of diagnostic testing and therapy has occurred)</td>
<td>Reviews local gaps in quality, and identifies systems and human errors that contribute to gaps in quality</td>
<td>Assesses outcomes of quality improvement efforts (e.g., infection control, medication errors, surgical site identification), and applies these towards continuous quality improvement</td>
<td>Develops and implements a major quality control and/or quality improvement initiative, and demonstrates improvement in care and/or savings in health care costs</td>
</tr>
<tr>
<td>Identifies the basic processes involved in quality improvement</td>
<td>Participates in quality improvement activities</td>
<td>Critically appraises current or proposed quality improvement interventions</td>
<td>Defines and constructs process and outcome measures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identifies some stakeholders involved in quality gaps</td>
<td></td>
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Comments: Not yet achieved Level 1
### Professionalism 1 — Giving and Receiving Feedback

<table>
<thead>
<tr>
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<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receives feedback constructively</td>
<td>Accepts feedback constructively and modifies practice in response to feedback</td>
<td>Provides constructive feedback</td>
<td>Exemplifies giving and receiving constructive feedback; encourages and actively seeks feedback to improve performance</td>
<td>Models giving and receiving constructive feedback; encourages and actively seeks feedback to improve performance</td>
</tr>
</tbody>
</table>

**Comments:**

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### Professionalism 2 — Accountability, Honesty, and Integrity

<table>
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<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completes assigned tasks on time</td>
<td>Dependably completes assigned tasks in a timely manner; assists team members when requested; respects assigned schedules</td>
<td>Anticipates team needs and steps in to assist as needed</td>
<td>Anticipates team needs and takes leadership role to independently implement solutions</td>
<td>Exemplifies effective management of multiple competing tasks, with reliable follow up; is source of support/guidance to other members of health care team</td>
</tr>
<tr>
<td>Behaves honestly and understand the concepts of ethical behavior; seeks counsel when ethical questions arise</td>
<td>Acknowledges personal near misses and errors, and putting the needs of patients first; engages in ethical behavior</td>
<td>Demonstrates honesty with all members of the health care team</td>
<td>Identifies, communicates, and corrects errors</td>
<td>Is viewed by members of the health care team as a role model in accepting personal responsibility, and in always putting the needs of the patient above his/her own interests</td>
</tr>
</tbody>
</table>

**Comments:**

Not yet achieved Level 1
## Interpersonal Communication and Skills 1 — Personnel and Conflict Management

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understands the challenge in managing clinical, clerical, and laboratory personnel (e.g., competency assessment, performance evaluation)</td>
<td>With substantial guidance, manages clinical, clerical, and laboratory personnel</td>
<td>With minimal guidance, manages clinical, clerical, and laboratory personnel</td>
<td>Independently manages clinical, clerical, and laboratory personnel</td>
<td>Develops job descriptions and competency assessments for clinical, clerical, and laboratory personnel</td>
</tr>
<tr>
<td>Understands the importance of conflict management</td>
<td>With substantial guidance, manages conflicts and complaints</td>
<td>With minimal guidance, manages conflicts and complaints</td>
<td>Independently manages conflicts and complaints</td>
<td>Teaches concepts of emotional intelligence and team building</td>
</tr>
<tr>
<td></td>
<td>Understands the importance of personal emotional awareness and empathy and its impact on team members</td>
<td>Understands the importance of a collegial and respectful atmosphere among all team members</td>
<td>Fosters a collegial and respectful atmosphere among all team members</td>
<td></td>
</tr>
</tbody>
</table>

### Comments:

Not yet achieved Level 1
### Interpersonal and Communication Skills 2 — Communicates with Patients, Families, and Health Care Providers

<table>
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<tr>
<th>Level 1</th>
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<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understands the importance of timely and effective communication with patients, families, and health care providers</td>
<td>With minimal guidance, provides timely and effective communication with patients, families, and health care providers</td>
<td>Independently provides timely and effective communication with patients, families, and health care providers</td>
<td>Empathetically communicates complex, difficult, or challenging information (e.g., errors, complications, adverse events, and bad news)</td>
<td>Serves as a role model for effective, compassionate, and professional communication to patients and health care providers</td>
</tr>
<tr>
<td>Understands the importance of empathy in the communication related to potential disfigurement or life threatening situations</td>
<td>Treats patients with dignity, civility, and respect regardless of race, culture, gender, ethnicity, age, sexual orientation or socio-economic status</td>
<td>Independently produces a clear and understandable written clinical and operative reports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understands the importance of privacy and confidentiality</td>
<td>Effectively utilizes the electronic health record</td>
<td></td>
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**Comments:** Not yet achieved Level 1
<table>
<thead>
<tr>
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<th>Number of On-Duty Residents</th>
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<tbody>
<tr>
<td>020</td>
<td>Allergy and immunology</td>
<td>79</td>
<td>307</td>
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<tr>
<td>040</td>
<td>Anesthesiology</td>
<td>150</td>
<td>6,423</td>
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<td>041</td>
<td>Adult cardiothoracic anesthesiology</td>
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<td>215</td>
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<tr>
<td>044</td>
<td>Clinical informatics (Anesthesiology)</td>
<td>1</td>
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<tr>
<td>045</td>
<td>Critical care medicine (Anesthesiology)</td>
<td>62</td>
<td>191</td>
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<tr>
<td>046</td>
<td>Regional anesthesiology and acute pain medicine</td>
<td>14</td>
<td>49</td>
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<tr>
<td>043</td>
<td>Obstetric anesthesiology</td>
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<td>530</td>
<td>Pain medicine (multidisciplinary)</td>
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<td>381</td>
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<td>042</td>
<td>Pediatric anesthesiology</td>
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<td>Colon and rectal surgery</td>
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<td>96</td>
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<tr>
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<td>Dermatology</td>
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<tr>
<td>100</td>
<td>Dermatopathology (multidisciplinary)</td>
<td>55</td>
<td>73</td>
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<tr>
<td>081</td>
<td>Micrographic surgery and dermatologic oncology</td>
<td>76</td>
<td>86</td>
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<tr>
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<td>Emergency medicine</td>
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<td>Emergency medical services</td>
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<td>Medical toxicology (Emergency medicine)</td>
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<td>Pediatric emergency medicine (Emergency medicine)</td>
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<td>Sports medicine (Emergency medicine)</td>
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<td>Undersea and hyperbaric medicine (Emergency medicine)</td>
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<td>Clinical informatics (Family medicine)</td>
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<td>125</td>
<td>Geriatric medicine (Family medicine)</td>
<td>46</td>
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<tr>
<td>540</td>
<td>Hospice and palliative medicine (multidisciplinary)</td>
<td>135</td>
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<td>Sports medicine (Family medicine)</td>
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<td>140</td>
<td>Internal medicine</td>
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<td>153</td>
<td>Adult congenital heart disease</td>
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<td>Advanced heart failure and transplant cardiology</td>
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<td>Cardiovascular disease</td>
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<td>Critical care medicine (Internal medicine)</td>
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<td>230</td>
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<tr>
<td>143</td>
<td>Endocrinology, diabetes, and metabolism</td>
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<td>Hematology and medical oncology</td>
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<td>Interventional cardiology</td>
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<td>Nephrology</td>
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<td>Medical oncology</td>
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<td>149</td>
<td>Pulmonary disease</td>
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<td>156</td>
<td>Pulmonary disease and critical care medicine</td>
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<td>Rheumatology</td>
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<td>Sleep medicine (multidisciplinary)</td>
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<td>Transplant hepatology</td>
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<td>Medical genetics and genomics</td>
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<td>131</td>
<td>Medical biochemical genetics</td>
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<td>13</td>
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<tr>
<td>190</td>
<td>Molecular genetic pathology (multidisciplinary)</td>
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<tr>
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<td>Neurological surgery</td>
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<td>1,419</td>
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<td>Endovascular surgical neuroradiology (Neurological survey)</td>
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<td>Brain injury medicine (Neurology)</td>
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<td>Clinical neurophysiology</td>
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<td>Epilepsy</td>
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<td>182</td>
<td>Endovascular surgical neuroradiology (Neurology)</td>
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<td>Neurodevelopmental disabilities</td>
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<td>30</td>
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<td>Neuromuscular medicine (Neurology)</td>
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<td>60</td>
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<td>Vascular neurology</td>
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<td>Child neurology</td>
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<td>Obstetrics and gynecology</td>
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<td>5,524</td>
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<td>Female pelvic medicine and reconstructive surgery</td>
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Note: Highlighted specialties represent specialties that lead to initial board certification, classified as the GME pipeline.
COMPREHENSIVE OBJECTIVES FOR MICROGRAPHIC DERMATOLOGIC SURGERY

This outline describes a curriculum of objectives for micrographic dermatologic surgery (MDS). It is a working draft that will be periodically updated and revised. Please note that any omissions or inaccuracies are unintended.

(Prepared by Stanley J. Miller, MD, as part of an initiative by the American Board of Dermatology to produce detailed content outlines for dermatology and dermatologic subspecialties. Original draft reviewed by a group of 16 dermatologic surgeons. Edited by Lela A. Lee, MD, for the ABD.)

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SECTION #1: GENERAL OBJECTIVES IN DERMATOLOGIC PRACTICE WITH SPECIAL RELEVANCE TO MSDO

Take a directed history and assess the physical findings to generate an appropriate working diagnosis and/or differential diagnosis.

- Recognize common and uncommon presentations of benign and malignant skin conditions.
- Distinguish characteristic patterns of benign versus malignant lesions using epiluminescence microscopy (dermoscopy).

Select appropriate laboratory tests and imaging studies when indicated.

- Know when skin biopsy is and is not appropriate.
- Know when to order imaging studies prior to biopsy or surgical treatment of lesions on the head, neck, and spinal area.
- Understand indications, strengths, limitations, and relative costs of plain films, ultrasound, CT scan, MRI, and PET-CT scan.
- Understand indications, strengths, limitations, risks, and relative cost of sentinel lymph node biopsy.
- Know when special stains and immunostains are useful, which ones to order, and their strengths and limitations for diagnosis of cutaneous lesions, including Merkel cell carcinoma, dermatofibrosarcoma protuberans, sebaceous carcinoma, apocrine carcinoma, extramammary Paget disease, microcystic adenocarcinoma, desmoplastic trichoepithelioma, atypical fibroxanthoma, surgical margins of lentigo maligna, cutaneous B and T cell lymphomas, and spindle cell neoplasm of unknown origin.
- Know when molecular testing is useful, which tests to order, and their strengths and limitations for diagnosis of cutaneous conditions, for example, melanoma (e.g., BRAF (V600E) mutation and c-kit mutation), cutaneous B and T cell lymphomas, familial atypical multiple mole and melanoma syndrome, xeroderma pigmentosum, Muir-Torre syndrome, dystrophic epidermolysis bullosa, and albinism.

Interpret skin biopsy findings in the context of the clinical findings.

- Recognize when a pathology report is discordant with the clinical findings, and know what steps to take.

Know when surgical treatment is and is not indicated.

- Recognize clinical settings in which no treatment or observation of skin cancer is a reasonable option, including patients at the end of life, inoperable advanced disease, uncertain diagnosis/unclear prognosis, and the correct operative site can not be identified.

Determine urgency of treatment and triage appropriately.

Recognize when referral is indicated.
Develop management plan in the context of the patient and the health care system.
  • Know strengths, weaknesses, and relative costs of treatment alternatives.
  • Know how to assess non-medical issues (logistical, cultural, caregiver, financial, family and patient concerns) that will affect medical care; solicit patient and family input about them; and integrate it all into a care plan.

Determine need and interval for follow-up care.

Monitor therapy properly.

Modify management plan, depending upon results.

Reassess diagnosis when necessary.
SECTION #2: BASIC SURGICAL PROCEDURES AND PRINCIPLES

Maintain the proper surgical environment.
- Understand the steps involved in, uses of, and strengths and weaknesses of disinfection and sterilization techniques for surfaces and equipment.
- Describe the strengths and weaknesses of moveable surgical lights versus fixed ceiling lights versus headlamps.
- Know the importance of ergonomic issues in surgery, including standing, sitting, and proper table height.
- Monitor and maintain high function in the operative suite of all devices, including electrical devices, sterilization techniques and equipment, and emergency devices.
- Monitor and maintain high function of all protocols, including emergency plans, bloodborne pathogen exposure protocols, and outcomes such as infection or complication rates.
- Follow universal precautions and use additional precautions when indicated.
- Understand the equipment and supplies necessary to provide emergent care in the office, how to keep them up-to-date and how to ensure that all physicians and staff members are regularly re-trained in their use.
- Know how to access the emergency medical system, obtain rapid vital signs, administer epinephrine emergently, perform BLS functions, use a defibrillator, provide oxygen and insert an intravenous catheter.
- Understand AAD guidelines of care for office-based surgery.

Evaluate the patient pre-operatively.
- Identify the location of the lesion requiring surgical removal by means such as physical examination, photographic documentation, diagrams, and triangulation measurements.
- Palpate tumors accurately to identify size, depth, and possible extension to underlying structures.
- Identify and properly palpate regional lymph node basins.
- Know when the pathology report is discordant with the clinical findings.
- Identify patients who are at increased risk for poor wound healing and instruct about how to minimize the risk, e.g., smoking cessation.
- Identify and respond to medical issues that may have an impact on cutaneous surgery, including anticoagulant treatment; implanted electrical devices; implanted artificial materials such as heart valves and artificial joints; cochlear implants; stated allergies to anesthetics, surgical preps, or wound dressing materials; pregnancy and lactation; smoking; anxiety; immunosuppression; diabetes mellitus; obesity; vascular disease; and lymphedema.
- Know how to assess peripheral arterial and venous disease, including clinical assessment, ankle-brachial index, transcutaneous oxygen measurement, toe brachial index, and pulse volume recordings with waveform analysis.
• Know the clinical settings in which pre-, peri-, or post-operative antibiotics are indicated.
• Know when multidisciplinary evaluation is required.
• Understand the important components of pre-, peri-, and post-operative education of patients.

Use proper surgical preps.
• Know how to prepare all body sites for skin surgical procedures.
• Understand the advantages and disadvantages of different surgical preps, including chlorohexidine gluconate, povidone-iodine, and isopropanol.

Select optimal anesthesia.
• Know the different members of the amide and ester classes of anesthetics, including their average time to onset, duration, effect of epinephrine, toxicities (including pregnancy-related and effects of hepatic and cardiovascular disease) and relative doses at which they occur.
• Know which local anesthetic is most appropriate in different clinical situations.
• Recognize and manage anesthesia toxicities.
• Minimize patient discomfort when injecting anesthetic by means such as use of small-gauge needles, buffering, heating, slow infiltration, entrance through areas of more distensible tissue first and/or proximally along sensory nerves, and ring blocks.
• Minimize the total dose of local anesthesia required when this is necessary, including using ring blocks and intradermal injection; and minimize total epinephrine dose when necessary, including dilution of the epinephrine to 1:200,000-1:800,000.
• Respond effectively to patients who are relatively resistant to local anesthesia and require additional injections.
• Know when longer-acting agents such as ropivacaine and carbocaine are useful.
• Know clinical settings in which epinephrine should be avoided.
• Recognize clinical settings in which topical anesthetics may be useful, and know their strengths, limitations, method of use, and how to monitor for and treat side effects.
• Know how to prepare and administer tumescent anesthesia, including knowing the concentration of lidocaine and epinephrine represented and the upper limit of the dose and volume that will minimize the possibility of toxicity.
• Identify anatomic landmarks for nerve blockage and safely administer nerve blocks in the supraorbital/supratrochlear, infraorbital, and mental regions.
• Employ effective nerve blockade techniques for nail surgery, including digital block, wing block, and transthecal block.
• Know how to dose, monitor, and manage side effects and toxicities of oral benzodiazepines and opioids used for conscious sedation.
Demonstrate competence in skin biopsy and excisions.

- Understand how to perform shave, punch, snip, saucerization, incisional, and excisional biopsies, and when each is most appropriate.
- Articulate the risks associated with skin biopsy, shave removal, and excisional surgery.
- Know the essential components of the pre-operative procedural pause (time out).
- Know what surgical margins are necessary for excision of various entities, including basal cell carcinoma, squamous cell carcinoma, atypical nevi, melanoma-in-situ, and invasive melanoma.
- Plan an appropriate width, length, depth, and orientation of excision for each suspected diagnosis and site.
- Understand the role of scouting biopsies to assess peripheral tumor extent, and in which clinical situations the procedure is useful.
- Understand proper closure technique, including when and how to undermine, suturing techniques to minimize wound tension and maximize wound strength, and how to create good eversion and apposition of wound edges.
- Know how to manage perioperative bleeding.
- Identify sites at higher risk for injury to nerves, vessels, or other underlying structures.
- Identify anatomic sites susceptible to force margin distortion.

Demonstrate competence in the use of surgical instruments.

- Hold and use surgical instruments properly.
- Identify instruments commonly used in excisional surgery and choose appropriate instruments for different applications.
- Understand the proper use of a skin hook.
- Choose surgical instruments with the proper balance of delicacy versus sturdiness for different body sites.
- Choose and properly use instruments for nail surgery.
- Know how to use less commonly employed instruments, including chalazion clamp, eye shield, doppler for artery localization, and ocular probe to identify lacrimal canaliculi.

Demonstrate competence in the use of closure materials.

- Choose sutures or staples with the proper balance of delicacy versus sturdiness for different body sites.
- Know the names of available sutures and their qualities, including size, absorbable versus non-absorbable, monofilament versus braided, strength, time to absorption, memory, elasticity, plasticity, and relative cost.
- Know the characteristics of available needles, including size, needle anatomy, curvature, and cutting versus reverse-cutting.
- Know indications for staples, how to apply and remove them, and how to manage complications.
Know how to use buried vertical mattress suturing to create wound edge eversion.
Know how to create wound edge apposition using surface suturing techniques, including simple interrupted, running, running locked, running subcuticular, and horizontal mattress sutures.
Know how to perform a deep pulley stitch when high tension is present.
Know how to use pleated stitching techniques when two sides of tissue of uneven lengths are sewn together, as in A-T flap.
Use deep/periosteal tacking and fascial plication sutures to decrease tension and prevent movement of adjacent free margins.
Employ figure 8 stitch to tie off arterial bleeding.
Use Frost suture to prevent ectropion.
Recognize and manage adverse effects of suture materials, including tissue strangulation, suture reactions, and granuloma formation.
Choose proper tissue adhesives and provide appropriate aftercare when tissue adhesives are used.

Promote effective wound healing.
- Instruct the patient in proper post-operative wound care.
- Identify and respond to factors that impact wound healing, including body site, circulatory problems, lymphedema, smoking, immunosuppression, diabetes mellitus, and a history of poor compliance with therapy.
- Know the components of surgical dressing and how to apply to them all body locations.
- Know how to apply specialized wound dressings such as pressure head wrap, eye dressing, nasal stent, and use of an avulsed nail plate in a nail bed.
- Provide wound care instructions in specialized situations, including initial elevation of distal extremity sites, use of elastic wraps for extremities to avoid the side effects of prolonged adhesive use, how to monitor for decreased perfusion in digits, use of bobby pins in hair bearing areas, sitz baths and proper direction of wiping in perianal and genital regions, importance of ointment use with exposed cartilage or bone.
- Understand how to apply pressure dressings that extend pressure to all aspects of the surgical wound, and know how to apply bolster dressing for skin grafts.
- Know when specialized dressings or wound healing techniques may be of value, including biologic, absorptive and antimicrobial dressings; pressure stockings; Unna boots; and hyperbaric oxygen.
- Know how to place, manage, and remove surgical drains to prevent hematoma formation.

Demonstrate competence in electrosurgical techniques.
- Know the definitions of electrosurgery, electrocautery, electrocoagulation, electrofulguration, electrodessication, electrosection, monopolar, bipolar, monoterminal, and biterminal.
• Know how to perform curettage and electrodessication, and details that produce higher cure rates (e.g., curetting in multiple directions).
• Know how to manage patients with implanted electrical devices.
• Avoid oxygen and flammable agents when electrosurgery is being performed.
• Know alternative methods of hemostasis, including direct vessel ligation, thrombin, gel foam, and direct pressure.

**Demonstrate competence in cryotherapy.**
• Know how to perform basic cryotherapy techniques, including spray and cotton-tipped applicator treatments.
• Know freeze and thaw times to destroy pre-malignant and malignant lesions.
• Understand the use of insulated peripheral barriers.
• Know how to place skin thermocouples to monitor temperature changes at desired depth.
• Instruct the patient in proper post-procedure care and possible side effects of therapy.

**Demonstrate competence in incision and drainage.**
• Know how and when to perform incision and drainage of abscesses and hematomas.
• Know how to pack wounds.
• Instruct the patient in proper post-procedure care.

**Manage surgical complications.**
• Identify and manage wound healing problems and complications, including suspected cellulitis, erosive pustular dermatosis, allergic or irritant contact dermatitis, tissue necrosis, dehiscence, motor nerve injury, incomplete skin graft take, granulation tissue formation, suture reactions, hypertrophic scars, keloids, prolonged healing, and chronic eyelid lymphedema.
• Know the likely outcome of common complications.
• Know when debridement is and is not necessary.
• Know when referral to other specialists or centers should be considered.
• Know what to do when the patient is unhappy with the cosmetic result, including additional communication; accelerated follow-up; consideration of further waiting; massage; use of over-the-counter products, topical bleaching products, steroids or retinoids; intralesional triamcinolone injections; surgical revision, dermabrasion, or laser; and referral to surgical colleagues.
SECTION #3: MOHS MICROGRAPHIC SURGERY, RECONSTRUCTION, AND SPECIAL PROCEDURES

Understand the basics of Mohs micrographic surgery.
- Describe the difference in specimen processing between Mohs micrographic surgery and routine breadloaf pathology.
- Articulate the advantages and disadvantages of Mohs micrographic surgery.
- Articulate Appropriate Use Criteria for Mohs Surgery.

Demonstrate competence in obtaining and processing MMS specimens.
- Obtain typical MMS specimens with beveled edges and proper marking.
- Conserve tissue while obtaining appropriate specimens for full examination, including obtaining thin first layers, narrow peripheral additional layers, and shallow deep additional layers.
- Know how to obtain MMS specimens in more difficult settings, including tumor involvement of cartilage, periosteum, and nail bed, and extension into the ear canal, orbit, or conjunctiva.
- Recognize rare settings in which MMS may need to be terminated without obtaining clear margins, including deep extension into the ear canal, orbit, sinuses or bone; inability to maintain adequate local anesthesia; concerns about excessive bleeding or patient safety; and extensive disease spanning multiple anatomic subunits.
- Understand how to section MMS specimens using a cryostat.
- Understand how to stain and immunostain MMS specimens.
- Understand how to use and care for MMS laboratory equipment, including cryostat, stainer, and microscope.
- Understand and comply with requirements of regulatory authorities for MMS laboratory and MMS.

Interpret findings on MMS slides.
- Interpret typical MMS slides, recognizing adequacy of skin edge and margin, common skin cancer growth patterns, and positive versus negative specimens.
- Recognize technical problems that impact slide quality, including epidermal "chatter" from a dull blade, fat or cartilage "drop out" when tissue block is not cold enough, thick cuts providing poor resolution, and poor staining quality indicating need to check quality of solutions.
- Recognize tumor simulators, including incidental nevi, syringomas, seborrheic keratoses, folliculocentric basaloid proliferation, normal stasis changes in lower extremity locations, granulomas, eccrine metaplasia, parotid tissue, salivary glands, and lacrimal canaliculi.
- Recognize subtle residual tumor presence, including superficial basal cell carcinoma or squamous cell carcinoma-in-situ, still-positive areas of highly
infiltrative tumors that filter out into single cell extensions, perineural extension, and dense inflammation possibly masking tumor.

- Recognize and know the importance of actively looking for unexpected rare tumor presence, including desmoplastic melanoma that can underlie melanoma-in-situ, the fibrosarcoma variant of dermatofibrosarcoma protuberans, and unanticipated perineural involvement by tumor.

- Identify situations in which recuts or special stains may be required, including a complete specimen (periphery and depth) has not been obtained; staining is inadequate; identification of cell type is difficult; inflammation is dense; initial biopsy diagnosis is suspect; discontinuous tumor growth is suspected; and perineural or intravascular tumor presence needs to be confirmed.

- Know diagnoses for which special stains may be useful, including melanoma-in-situ, extramammary Paget disease, sebaceous carcinoma, and dermatofibrosarcoma protuberans.

Select second intention healing for closure of the defect when appropriate.

- Understand general principles of healing by second intention, including which body sites and type of defect heal well by second intention (concave > flat > convex; smaller > larger diameter; shallow > deep).

- Identify additional sites where second intention healing is often used, including non-hair bearing scalp, lip defects inside vermillion border, dorsal hands and fingers, and shins.

- Educate the patient about what to expect, including likely length of healing time, wound care details, and anticipated cosmetic outcome.

- Manage complications, including ectropion, webbing, contracture, impaired nasal airflow, hypopigmentation, depressed scarring, and dissatisfaction with cosmetic result.

Demonstrate competence in intermediate and complex closures.

- Understand principles of closure along relaxed skin tension lines (RSTL), including the following: alignment of closure parallel to RSTL to maximize cosmetic result; typical axis of RSTL at different body sites; sites where RSTL run obliquely (mid-cheek, arms, and legs); sites where RSTL may vary from person to person (e.g., junction where pre-auricular cheek and lateral canthus meet); identification of RSTL by palpating of the area with the patient in the relaxed, neutral position (e.g., sitting or standing and looking straight ahead, not lying on stomach); and proper orientation to avoid distortion of free margins.

- Understand the value of S-plasty on curved surfaces such as cheek, arms and legs and the value of M-plasty in shortening the final closure length.

- Design and execute named complex closures, including S-plasty and M-plasty.

- Understand techniques that maximize cosmesis, including the following: drawing a 3:1 tangent-to-circle closure along relaxed skin tension lines; making all incisions 90 degrees to the skin surface to prevent beveling; using
the correct plane to undermine in at different body sites (e.g., with larger closures, in the subgaleal plane on the scalp, just above cartilage on the nose and ear, and just above fascia on the arms and legs); undermining adequately in all directions; and sewing with eversion, leaving a small portion of the most dependent side of the closure without surface sutures to allow egress of blood, if needed to prevent hematoma formation.

- Know the importance of pre-operative palpation of surgical sites on the legs with the patient weight-bearing, to ensure there is adequate laxity for closure.

**Understand general principles of reconstruction using flaps.**

- Identify advancement v. rotation v. transposition flaps.
- Understand the differences between advancement, rotation, and transposition in terms of force vectors: Advancement flaps have force vectors similar to those of a fusiform ellipse but alter where the dog ears are removed. Rotation flaps incompletely change that force vector direction approximately 90 degrees. Transposition flaps tend to share closure force vectors in multiple different directions.
- Know the location of tissue reservoirs in various anatomic areas of the face and how this impacts selection of a flap for reconstruction.
- Know the appropriate planes for undermining in various anatomic locations.

**Demonstrate competence in advancement flaps.**

- Design and execute named advancement flaps, including unilateral advancement, bilateral advancement, A-T/A-L (and variants), O-Z (and variants), and crescentic advancement.
- Know locations where advancement flaps may be useful, including suprabrow to prevent raising of the eyebrow, infraorbital to prevent ectropion, and upper lip to prevent eclabium.
- Understand how to use pleated stitching techniques when two sides of tissue of uneven lengths are sewn together, as in an A-T flap.

**Demonstrate competence in rotation flaps.**

- Design and execute named rotation flaps, including cheek rotation, lip rotation, dorsal nasal (glabellar) flap, Mustarde-style under eye, and spiral/shark flap in alar crease.
- Understand that rotation flaps often require a 4:1 or 5:1 ratio of flap length to defect diameter.
- Understand the importance of a back-cut in allowing a rotation flap to truly rotate and not just advance.

**Demonstrate competence in transposition flaps.**

- Design and execute named transposition flaps: including rhomboid, nasolabial, bi-lobed (and variants), and Spear.
- Prevent and treat trap-door defects, including techniques of extensive undermining, massage, intralesional triamcinolone, and surgical revision.
Demonstrate competence in pedicle flaps.
- Understand that pedicle advancement flaps with central pedicles must be based in regions with enough underlying subcutaneous fat and/or muscular base to allow adequate flap movement.

Demonstrate competence in interpolation flaps.
- Design and execute paramedian forehead and cheek interpolation flaps, including understanding the following: how to identify the supratrochlear artery using doppler techniques; techniques of pedicle dressing; typical time period before take-down; techniques to confirm existence of a new blood supply before take-down; how to thin the flap and perform revisions in additional procedures; simultaneous use of cartilage grafts; and techniques to repair mucosal defects in conjunction with interpolation flaps (e.g., fold-over flap, mucosal full-thickness skin graft).
- Know how to perform a scalp jump flap.

Understand general principles of reconstruction using skin grafts.
- Select appropriate candidate for skin grafting, including appropriate patient and appropriate surgical defect.
- Identify factors that impact graft survival, including body site, poor circulation, lymphedema, smoking, and diabetes mellitus.
- Know when to use full-thickness, split-thickness, and composite skin grafts, and the strengths and limitations of each.
- Educate the patient about appropriate postoperative wound care and expected healing times.
- Manage complications, including necrosis, prolonged healing, and hypopigmentation.

Demonstrate competence in full-thickness skin grafting.
- Understand the strengths and weaknesses of various full-thickness skin graft donor sites, including preauricular, postauricular, clavicular, conchal bowl, nasolabial fold, forehead, flexor forearm, and inner upper arm.
- Design and execute a full-thickness skin graft, including knowing how to correctly size, thin if needed, suture with a ship-to-shore technique, place basting stitches, and use a bolster.

Demonstrate competence in split-thickness skin grafting.
- Design and execute a split-thickness skin graft, including knowing how to correctly size; set the dermatome to proper thickness (0.015”) or design template for hand harvesting; lubricate and harvest at donor site; fenestrate if necessary; suture or staple into place; and properly dress the donor and recipient sites.
Demonstrate competence in composite skin grafting.
- Design and execute a composite graft, including knowing how to identify an appropriate auricular donor site, harvest and suture it into place, and provide immobilization for healing using nasal stents, bolsters or other means.

Demonstrate competence in tissue expansion techniques.
- Know strengths and limitations of various tissue expansion techniques.
- Understand principles of delayed tissue expanders and their strengths and limitations.

Demonstrate competence in scar revision.
- Know when intralesional corticosteroid should be used prior to or in lieu of surgical revision.
- Know when resurfacing is appropriate for scar revision.
- Know when specific surgical scar revision techniques are appropriate, and their strengths and limitations.
- Design and execute named scar revision techniques, including Z-plasty, V-Y-plasty, W-plasty, geometric broken line closure, re-creation of sulci, removal of inversions, and improvement of trap-dooring.

Demonstrate competence in nail surgery.
- Know nail anatomy, including location of matrix and extensor tendon.
- Know blockade techniques for nail surgery, including digital block, wing block, and transthecal block.
- Recognize when longer acting agents such as ropivacaine and carbocaine are useful.
- Know clinical settings in which epinephrine should be avoided.
- Know how to avulse a nail plate or a portion of one, including trap door, partial, and proximal techniques for avulsion.
- Understand nail biopsy techniques, including the strengths and limitations of punch, shave (tangential excision), lateral longitudinal excision, and nail fold biopsy.
- Know how to perform lateral matricectomies, including lateral longitudinal excision and chemical ablation (e.g., phenol, trichloroacetic acid, sodium hydroxide).
- Know how to perform nail excisions, including central longitudinal excision with flap closure, and en bloc excision of the entire nail bed and matrix with full thickness skin graft repair.
- Educate the patient about what to expect during surgery and postoperatively.
- Provide postoperative care and manage complications.
SECTION #4: BASIC SCIENCE RELATED TO MSDO

Understand fundamentals of carcinogenesis related to dermatology.
- Understand basic principles of carcinogenesis and terminology: e.g., DNA repair, oncogene, tumor suppressor, apoptosis, cell cycle, epigenetics.
- Identify predisposing factors relevant to dermatology: e.g., ultraviolet radiation, ionizing radiation, arsenic, human papillomavirus, Merkel cell polyomavirus, and immunosuppression.
- Understand what types of ultraviolet radiation exposure (acute, episodic, cumulative) relate to different types of skin cancer.
- Identify major cellular pathways involved in the development of skin cancers, including basal cell carcinoma, squamous cell carcinoma, melanoma, and dermatofibrosarcoma protuberans, and treatments related to these pathways.
- Understand how stem cells may be involved in carcinogenesis and how stem cell involvement may affect treatment decisions.
- Understand the concept of “field effect” in carcinogenesis and how this applies to actinic keratosis and squamous cell carcinoma development in human epithelia.

Understand principles of evidence-based medicine relevant to dermatology. (ABD code 1.3.2)
- Understand basic statistical terminology: type of variables (e.g., continuous); normal v. skewed distributions; mean, median, and mode; standard deviation and standard error of the mean; parametric v. non-parametric tests; statistical significance; power; confidence interval; type I and type II error.
- Understand basic clinical research terminology: types of clinical studies; bias and confounding; association v. causation; prevalence v. incidence; sensitivity v. specificity.
- Recognize strengths and weaknesses of various study designs.
- Understand the strengths and limitations of Cochrane reviews.
- Know the basic principles underlying the Strength of Recommendation Taxonomy (SORT) method for grading medical evidence in the literature.

Understand fundamentals of photobiology relevant to dermatology.
- Understand the concept of electromagnetic spectrum, where UVA, UVB, and ionizing radiation fit in that spectrum, and their impact on skin cancer risk.
- Understand the basic mechanism of action and potential side effects of photodynamic therapy.
- Know the mechanisms of photoprotection of chemical and physical sunscreens, and their optimal use.

Understand fundamentals of pharmacology relevant to MSDO.
• Know the mechanisms of action and side effects of pharmacologic agents used in dermatologic surgery.
• Know the general mechanism of action of pharmacologic agents potentially conferring an increased risk for complications in dermatologic surgery, for example, anticoagulants and immunosuppressive medications.

**Understand fundamentals of wound healing.**
• Articulate the four major phases of wound healing (hemostasis, inflammation, proliferation, tissue remodeling) and their chronology.
• Understand the roles of different cell types, including platelets, neutrophils, macrophages, and fibroblasts.
• Identify extracellular factors that promote or impede wound healing.

**Understand the physical effects of cryotherapy.**
• Know the temperature of liquid nitrogen.
• Know which cell types are most susceptible to destruction by liquid nitrogen.
SECTION #5: MEDICATIONS AND OTHER NON-SURGICAL TREATMENTS

Antimicrobial agents
- Know clinical settings in which prophylactic pre-, peri-, or post-operative antibiotics are indicated.
- Know or know where to find the cost, correct dose, and duration of prophylactic antibiotics.
- Recognize allergic contact dermatitis from topical antibiotics.
- Know when, if ever, topical antibiotics are indicated.

Retinoids
- Know strengths and limitations of topical retinoids in the treatment of precancerous and cancerous lesions.
- Know indications, strengths, limitations, risks, contraindications, details of use, and monitoring of oral retinoids for inhibition of development of squamous cell carcinoma in selected patients.

Corticosteroids
- Know how to administer intralesional corticosteroid, to include injection techniques, dosing, and frequency of reapplication.
- Recognize dermal atrophy from corticosteroids and its potential adverse effect on deep suturing.
- Know how much exposure to systemic corticosteroid is typically required to produce significant dermal atrophy (usually > 5 mg/day for > 1 year).

Immunomodulators
- Know the clinical settings in which topical immunomodulators are indicated, their strengths and limitations, relative efficacy, cost, dosing, monitoring for and treatment of side effects, and settings in which adjuvant post-operative therapy may be valuable.
- Know the clinical settings in which intralesional immunomodulators are indicated, their strengths and limitations, relative efficacy, cost, dosing, and monitoring for and treatment of side effects.
- Know the clinical settings in which systemic immunomodulators are indicated, their strengths and limitations, relative efficacy, cost, dosing, and monitoring for and treatment of side effects.
- Understand risks of carcinogenicity of different immunosuppressive agents, including combinations of immunosuppressive agents such as those used to treat organ transplant recipients.

Chemotherapeutic agents
- Know the clinical settings in which topical chemotherapeutic agents are indicated, their strengths and limitations, relative efficacy, cost, dosing, monitoring for and treatment of side effects, and settings in which adjuvant post-operative therapy may be valuable.
Know the clinical settings in which intralesional chemotherapeutic agents or chemowraps are indicated, their strengths and limitations, relative efficacy, cost, dosing, and monitoring for and treatment of side effects.

Know the clinical settings in which systemic capecitabine is indicated, its strengths, limitations, relative efficacy, cost, dosing, and monitoring for and treatment of side effects.

**Biologic modifiers**

- Know the indications, strengths, limitations, efficacy, relative costs, monitoring and side effects of hedgehog pathway inhibitors for basal cell carcinoma.
- Know the indications, strengths, limitations, efficacy, relative costs, monitoring and side effects of EGF receptor inhibitors for squamous cell carcinoma.
- Know the indications, strengths, limitations, efficacy, relative costs, monitoring and side effects of BRAF, MEK, and c-KIT inhibitors for melanoma.
- Know the indications, strengths, limitations, efficacy, relative costs, monitoring and side effects of imatinib for dermatofibrosarcoma protuberans.

**Anticoagulants**

- Understand the process of clot formation, intrinsic and extrinsic pathways, platelet plug formation, and the impact of different anticoagulants and hemostatic agents on the various stages of this process.
- Know the time frames required for discontinuing different agents to normalize coagulation, and the risks of causing postoperative bleeding associated with individual agents and combinations of causing postoperative bleeding.
- Know safe INR values for cutaneous surgery.
- Recognize when anticoagulation therapy is medically necessary, and understand the importance of not stopping medically-necessary anticoagulation therapy for skin surgery procedures.

**Other topical and systemic agents**

- Know the active ingredients in sunscreens, their strengths and limitations, the difference between chemical and physical agents, and their use.
- Know the clinical settings in which topical diclofenac is indicated, its strengths and limitations, relative efficacy, cost, dosing, and monitoring and treatment of side effects.
- Know the clinical settings in which topical ingenol mebutate is indicated, its strengths and limitations, relative efficacy, cost, dosing, and monitoring and treatment of side effects.
- Know the clinical settings in which oral nicotinamide is indicated, its strengths and limitations, relative efficacy, cost, dosing, and monitoring and treatment of side effects.
**Photodynamic therapy**
- Know the light sources and oral and topical photosensitizers that are available.
- Know how to perform photodynamic therapy, its indications, strengths and weaknesses, relative efficacy, cost, and how to monitor for and treat side effects.

**Radiation therapy**
- Understand the definitions and the relative strengths and limitations of ionizing radiation, electron beam therapy, and brachytherapy.
- Know the strengths, limitations, relative efficacy, and side effects of radiation therapy versus other therapies for definitive treatment of primary skin cancers.
- Know the setting in which radiation therapy is valuable as primary treatment and those in which it is valuable as adjuvant postoperative therapy.
- Know the relative frequency and duration of typical radiation therapy interval and relative cost.
- Understand the clinical settings in which radiation therapy is often contraindicated, including nevoid basal cell carcinoma syndrome, verrucous carcinoma, and certain body locations.
- Know the situations in which NCCN guidelines recommend radiation therapy for the treatment of primary, regional, and metastatic basal cell carcinoma, squamous cell carcinoma, melanoma, Merkel cell carcinoma, and dermatofibrosarcoma protuberans.
- Know details of AAD position statement on superficial radiation therapy and electronic surface brachytherapy.
SECTION #6: ETHICS AND COMMUNICATION

Practice in an ethical manner.
Involve the patient in decision-making.
Articulate clearly the risks and benefits of management choices.
Communicate clearly with the patient and/or the patient’s proxy.

- Understand the risks, benefits, and alternatives for all procedures performed, and communicate those effectively to the patient.
- Understand the natural history of each condition if left untreated.
- Know how to obtain proper informed consent from a patient.
- Know the communication responsibilities for informed consent for deaf patients, patients with limited capacity for understanding, those who speak only foreign languages, those who have legal guardians, and pediatric patients.
- Know when to involve pediatric patients in their care, and the difference between consent and assent.
- Know how to recognize and respond to issues created by difficult patients during the consenting process, including patients who are angry, passive-aggressive, narcissistic, sociopathic, have borderline personalities, or have body dysmorphic syndrome.
- Know how to respond to medical errors and/or adverse events, discuss them with a patient, and communicate them as needed to the medical community.
- Know AMA guidelines regarding appropriate versus inappropriate gifts, payments or other remunerations from industry.
- Recognize the importance of disclosing potential conflicts of interest to any party that would be affected by them.
- Educate patients about sun protection, sun avoidance, protective clothing, and sunscreen use.
- Educate patients about skin cancer and self-monitoring of skin lesions.

Practice ethical principles of coding and billing.

- Know how to choose appropriate CPT codes for all surgery-related procedures, including biopsies (all body sites); destruction; incision and drainage; nail surgery; skin excisions (benign and malignant); soft tissue excisions (all body sites); simple, intermediate and complex closures; adjacent tissue transfers; delayed interpolation flaps; and skin and cartilage grafts.
- Know how to use all surgery-related modifiers, including -25, -51, -59, -78, and -79.
- Know how to use surgery-related ICD-10 codes appropriately for all body sites, including codes for basal cell carcinoma, squamous cell carcinoma, squamous cell carcinoma-in-situ, melanoma, melanoma-in-situ, malignancy not otherwise specified, neoplasm of uncertain behavior, and actinic keratosis.
SECTION #7: QUALITY, SAFETY, AND SYSTEMS-BASED PRACTICE

Apply principles of quality and safety in clinical practice.
- Adhere to the JCAHO recommendations for pre-operative time-out with confirmation of correct patient, correct surgery, and correct site.
- Know how to use the concept of practice gaps to improve performance.
  - Understand the concept of practice gaps.
  - Understand the four-step Plan-Do-Study-Act process used to improve practice gaps.
  - Identify practice gaps in one's own clinical practice or institution.
  - Know where to find resources for practice improvement, e.g., ABD MOC practice improvement modules.
- Understand the importance of developing and maintaining individual systems-based practices to prevent errors, e.g., procedures for biopsy report follow-up, patient no shows, and proper documentation for billing and coding.
- Know the requirements for maintaining ABD certification.

Coordinate care with other care providers.
- Understand the importance of follow-up communication with other caregivers and involved in the patient's care.
- Articulate clearly to other providers the reasons for consultation, referral, or transfer of care.

Demonstrate familiarity with medicolegal issues.
- Know the most common situations associated with legal action by the patient in dermatologic surgery.
- Understand how communication, empathy, awareness of personality styles that can lead to interpersonal conflicts, preventing patient perceptions of abandonment, dealing appropriately with the angry patient, knowing how to apologize, and utilizing appropriate consultations can help prevent the initiation of legal action by the patient.
- Understand both the physician and the patient obligations once a patient-physician relationship has begun, and the required steps to take if termination of the relationship is desired.
- Know when, if ever, it is not necessary to send excised tissue for histopathologic evaluation.
- Understand requirements for consent and communication (see sections on ethical practice).

Comply with requirements of relevant regulatory authorities.
- Understand rules and regulations pertaining to scope of practice and billing for physician extenders such as nurses, nurse practitioners, and physician assistants.
- Understand HIPAA regulations for a dermatology office.
• Know how to communicate with patients in a HIPAA-compliant fashion by phone, mail, email, and social media, and how to handle third-party requests for information about patients.
• Know CLIA regulations for a Mohs micrographic surgery laboratory.
• Know OSHA regulations for worker safety that apply to a dermatology office and surgery.
• Understand the ADA regulations concerning the rights of individuals with disabilities in a dermatology office.
SECTION #8: SPECIFIC CONDITIONS RELATED TO MSDO

Choose appropriate management options for actinic keratosis.
- Know the details of using, and the strengths and weaknesses of, the various techniques available for treating actinic keratosis, including liquid nitrogen (spray and applicator), topical 5-fluorouracil, topical imiquimod, topical ingenol mebutate, topical diclofenac, photodynamic therapy (including daylight), chemical peels, lasers, 5-fluorouracil chemowraps, and curettage for hypertrophic actinic keratosis.
- Understand the concept of field cancerization and know when field treatment of lesions is appropriate.

Choose appropriate management options for keratoacanthoma.
- Know the natural history of keratoacanthoma.
- Know the association of keratoacanthoma with surgical scar and with genetic disorders.
- Know therapeutic options including observation, intralesional 5-fluorouracil intralesional methotrexate, and surgical removal.

Diagnose and appropriately manage non-melanoma skin cancer.
- Understand advantages and disadvantages of treatment options for non-melanoma skin cancer, including electrodesiccation and curettage, excision, cryotherapy, Mohs micrographic surgery, and radiation therapy.
- Understand what features indicate increased risk of recurrence or metastasis.
- Know how to modify management for immunosuppressed patients.
- Understand treatment and adjunctive options for advanced disease, including retinoids, immunomodulators, chemotherapeutic agents, biologic modifiers, radiation therapy, and sentinel lymph node biopsy.
- Know chemoprophylaxis options, e.g., nicotinamide, for high-risk patients.
- Know surgical issues, evaluation and management, and prognosis related to uncommon malignant adnexal neoplasms, including sebaceous carcinoma, microcystic adnexal carcinoma, eccrine carcinoma, and extramammary Paget disease.
- Know the clinical settings in which sentinel lymph node biopsy is potentially useful.
- Know guidelines of care.
  - AAD guidelines of care for non-melanoma skin cancer
  - Appropriate use criteria (AUC) guidelines for Mohs micrographic surgery
  - NCCN guidelines of care for basal cell carcinoma, squamous cell carcinoma, Merkel cell carcinoma, and dermatofibrosarcoma protuberans
  - AAD position statement on superficial radiation therapy and electronic surface brachytherapy
• Demonstrate familiarity with staging systems for cutaneous cancers.
  o AJCC staging of Merkel cell carcinoma and squamous cell carcinoma
  o Brigham and Women’s staging of squamous cell carcinoma

Evaluate and appropriately manage benign and atypical nevi.
• Understand prognosis for congenital, atypical, and Spitz nevi.
• Know areas of consensus and lack of consensus for treating and following congenital nevi, atypical nevi, Spitz nevi, atypical Spitz nevi, and deep penetrating nevi.
• Know methods of following patients with nevi.
• Know which congenital nevi, if any, should have evaluation for CNS involvement.

Diagnose and appropriately manage melanoma and melanoma-in-situ.
• Recognize epiluminescent microscopic (dermatoscopic) characteristics of melanoma.
• Know how to manage familial atypical multiple mole and melanoma syndrome.
• Know areas of consensus and lack of consensus about diagnosis and treatment of desmoplastic melanoma.
• Use Wood’s light to identify lentigo maligna melanoma margins.
• Know how to treat clinically ill-defined melanoma and melanoma-in-situ.
• Know areas of consensus and lack of consensus regarding margins for melanoma and melanoma-in-situ.
• Know guidelines of care and staging systems.
  o AAD guidelines
  o NCCN guidelines
  o AJCC staging system
• Know management options for advanced disease, including radiologic tests and sentinel lymph node biopsy, immunomodulators, chemotherapeutic agents, and biologic modifiers.

Diagnose and choose appropriate management for Kaposi sarcoma.
• Know the various clinical associations with Kaposi sarcoma.
• Understand the use of intralesional 5-fluorouracil, intralesional metrotrexate, and topical targretin gel.

Diagnose and choose appropriate management for angiosarcoma.
• Know the histochemical profile for angiosarcoma.
• Know therapeutic options including surgery, radiation, and anti-angiogenesis agents.

Diagnose and choose appropriate management for Merkel cell carcinoma.
• Know the characteristic clinical presentations and histochemical profile for Merkel cell carcinoma.
• Know therapeutic options including excision, wide excision, Mohs micrographic surgery, radiation therapy, and chemotherapy, and the role of lymph node evaluation.
• Know NCCN guidelines of care.

Diagnose and choose appropriate management for dermatofibrosarcoma protuberans.
• Understand the chromosomal abnormality underlying its development and its relationship to possible therapies.
• Know NCCN guidelines of care.
• Understand therapeutic options including excision, wide excision, Mohs micrographic surgery, radiation therapy, and imatinib.

Diagnose and choose appropriate management for atypical fibroxanthoma (AFX) and undifferentiated pleomorphic sarcoma (UDPS).
• Know the histochemical profiles of AFX and UDPS and how to distinguish the two.
• Develop an appropriate treatment plan for each.
• Know where each typically metastasizes.
• Understand complications that may occur from incising into the tumor.

Choose appropriate surgical therapies for cutaneous lymphomas.
• Identify situations where surgical therapy is indicated for cutaneous lymphomas.

Understand special considerations related to skin cancer risk in immunosuppressed patients.
• Understand which groups of patients are at risk, including organ transplant recipients, bone marrow transplant recipients, and patients with chronic lymphocytic leukemia, and know the individual risk factors within each group.
• Understand the importance of frequent and aggressive follow-up.
• Know which skin cancers show increased frequency and morbidity.
• Know therapeutic options for treatment of pre-cancers and early cancers, including topical therapies, photodynamic therapy, chemowraps, among others; and treatment options for skin cancers including destructive techniques, excision, Mohs micrographic surgery, and radiation therapy.
• Know the therapeutic systemic options for preventing further skin cancer development and/or disease progression including oral retinoids, capacitabine, EGFR inhibitors, and altering or decreasing total immunosuppressive levels.
• Understand relative carcinogenicity of the different immunosuppressive agents used in organ transplant recipients, and typical combination regimens.
Know how to work with transplant teams to care for organ transplant recipients, and the importance of dermatology input regarding transplant eligibility in patients with a history of squamous cell carcinoma or melanoma.

**Know how to recognize, evaluate, and manage patients with genetic syndromes or developmental anomalies conferring increased risk for skin cancer formation.**

- Nevoid basal cell carcinoma syndrome
- Keratoacanthoma syndromes
- Familial atypical multiple mole and melanoma syndrome
- Xeroderma pigmentosum
- Muir-Torre
- Dystrophic epidermolysis bullosa
- Albinism
- Rothmund-Thomson
- Bloom
- Rombo
- Bazex-Christol-Dupré
- Epidermodysplasia verruciformis
- Nevus sebaceous (benign and malignant tumors)