

# Proposed Technical Guidelines for the Acquisition of Clinical Images of Skin-Related Conditions

Anna Finnane, PhD; Clara Curiel-Lewandrowski, MD; Glen Wimberley, BDES; Liam Caffery, PhD; Chinmayee Katragadda, MBA; Allan Halpern, MD; Ashfaq A. Marghoob, MD; Josep Malvehy, MD; Harald Kittler, MD; Rainer Hofmann-Wellenhof, MD; Ivo Abraham, PhD; H. Peter Soyer, MD, FACP, FAHMS; On behalf of the International Society of Digital Imaging of the Skin (ISDIS) for the International Skin Imaging Collaboration (ISIC)

 [Supplemental content](#)

**IMPORTANCE** Standardizing dermatological imaging is important to improve monitoring of skin lesions and skin conditions, ensure the availability of high-quality images for teledermatology, and contribute to the development of a robust archive of skin images to be used for research.

**OBJECTIVE** To provide guidelines for the clinical application of the Standards for Dermatological Imaging set forward by the ISIC.

**EVIDENCE REVIEW** The ISIC recommendations were developed through a hybrid Delphi methodology. The methods for achieving consensus have been described previously. The practical application of these recommendations was evaluated by 2 clinical photographers with expertise in skin imaging. Images corresponding to each recommendation were taken by a clinical photographer and provided as visual examples of how these recommendations can be implemented in clinical practice.

**RESULTS** The Standards for Dermatological Imaging developed by the ISIC members could be followed in the clinical setting. Images showing appropriate lighting, background color, field of view, image orientation, focus and depth of field, resolution, and scale and color calibration were obtained by the clinical photographer, by following the detailed recommendations for regional, close-up and dermoscopic images.

**CONCLUSIONS AND RELEVANCE** Adhering to the recommendations is both feasible and achievable in practice. Adopting these Standards is the first step in achieving international standardization of skin imaging, with the potential to improve clinical outcomes and research activities.

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**Author Affiliations:** Author affiliations are listed at the end of this article.

**Group Information:** The International Society of Digital Imaging of the Skin (ISDIS)–International Skin Imaging Collaboration (ISIC) members are listed at the end of this article.

**Corresponding Author:** Clara Curiel-Lewandrowski, MD, Associate Professor of Medicine and Dermatology, Department of Dermatology, University of Arizona, 1501 N Campbell Ave, Tucson, AZ 85724 (ccuriel@email.arizona.edu).

Digital photographic documentation is increasingly common in dermatology practice.<sup>1,2</sup> Advances in both photographic and internet technology have improved clinicians' access to high-quality images at relatively low cost. Images are most often archived to monitor skin conditions over time or transmitted between clinicians using store-and-forward methods, enabling wider access to specialist diagnostic and treatment advice.<sup>2-6</sup> Telemedicine services are particularly well suited to dermatology given the skin can be easily viewed and imaged, the majority of cases are nonurgent, and there is high demand for dermatology services in both urban and remote areas.<sup>2,7</sup>

Digital photography offers additional benefits to traditional methods of assessing and treating a range of skin conditions. The ability to store images enables clinicians to review progress of chronic conditions and responses to treatment, monitor high-risk patients and contribute to ongoing research and education.<sup>1,7</sup> Total body imaging and teledermoscopy methods are increasingly being used

for skin cancer monitoring and follow-up,<sup>8,9</sup> but are also useful for long-term monitoring of chronic skin conditions, including psoriasis and cutaneous T-cell lymphoma.<sup>3,10</sup>

## Image Standardization in Dermatology

Optimizing the technological aspects of imaging, such as lighting, focus, and magnification, will ensure photographs accurately represent skin conditions.<sup>6,11</sup> Furthermore, paying adequate attention to aspects of photographic technique, including patient positioning, field of view, and camera resolution enables efficient clinical review and the development of image archives for long-term follow-up of patients when patients see multiple clinicians, or move to another state or country.

Without standardized and consistent approaches to imaging, clinicians and researchers risk limiting the usefulness of a large and

invaluable data source for research and clinical practice. For example, if 2 images are taken of a lesion 6 months apart in a different pose and lighting, this can completely preclude the ability to identify changes in the lesion over time. In addition to the **clinical benefit** of image standardization in dermatology, there is also an **economic benefit** because the exchange of images between, and hence the accessibility of clinical information to providers across settings, will **enhance process flow**, **avoid duplication**, and thus enable **cost-responsible care**.

There are existing clinical photography standards applicable to specific regions of the body and to other medical specialties.<sup>12,13</sup> In addition, the American Telemedicine Association (ATA) has recently updated the Teledermatology Practice Guidelines (previous version published in 2007) to incorporate new knowledge and currently available technologies.<sup>14</sup> In this update, the ATA provides guidelines for clinical practice, technical requirements, and administration to cover the different types of teledermatology consultations. However, these guidelines are most applicable for health care providers in the United States. The purpose of **International Skin Imaging Collaboration (ISIC)** is to achieve international standardization of skin imaging, which will strengthen international research collaborations in this field. These practical guidelines are intended to support implementation of the first International Consensus Standards for photographic and dermoscopic imaging in dermatology.

## The International Skin Imaging Collaboration

In March 2013 the ISIC was established across international academic, industrial, and community members "to develop and disseminate digital imaging standards and resources that will help to support efforts to reduce melanoma-related deaths and unnecessary biopsies by improving the early detection of this skin cancer." While the ISIC overall objective specifically includes melanoma as the driving clinical force to lead the standardization of imaging, the imaging acquisition technique working group effort has kept the needs of dermatological practice at large when developing the proposed recommendations in this article.

Specifically, ISIC is designed to address 2 significant gap areas in dermatological imaging: (1) the need for skin lesion **imaging standards**, and (2) the need for an **imaging archive** of validated skin lesions.

This article aims to translate the consensus guidelines developed by ISIC and provide considerations for the standardization of imaging acquisition techniques in dermatology practice, in terms of camera orientation, patient positioning, and image requirements.

## ISIC Consensus Process

The ISIC members used the Delphi method to draft technique recommendations and reach consensus among a larger group of members of the ISIC. First, a core group was created in July 2012 to specifically review current imaging acquisition practices in dermatology and to draft a series of recommendations. This core group included 7 academic dermatologists with expertise in clinical imaging, privacy and legal considerations, and a professional medical photographer. The draft recommendations were distributed to the expert group (17 ISIC members; 13 specialists in dermatology, 2 in medical informatics, 1 in both tech-

nology and dermatology, and 1 in primary care) and revised and reviewed (5 rounds in total), until consensus was reached. The design, development, analyses, and results of the Delphi consensus study, and the final set of 33 statements on which consensus was achieved are described in detail by Katragadda and colleagues.<sup>15</sup>

## ISIC Recommendations for Imaging Standardization

Standardizing image acquisition in daily practice requires consideration of **key patient-related factors** as well as the **technical aspects** of clinical photography. The recommendations are presented under **9 domains**, including **lighting**, **background color**, **field of view**, **image orientation**, **focus/depth of field**, **resolution**, **scale**, **color calibration**, and **image storage**. Overall, the ISIC group recommend that **consistent imaging standards should be implemented for dermatological imaging, regardless of the purpose of capturing the images**.<sup>15</sup> Based on the results from the consensus process, the following recommendations are suggested by the ISIC group for incorporation into daily clinical, educational, and research practice.

### 1) Lighting 9 domains

Lighting plays an important role in making sure the **skin color** and variations in **skin tone** are accurately captured. Direct light from a flash or lamp can whiten the skin tone, **reduce contrast**, and cause **reflections**.<sup>16</sup> While using natural light is best for regional and close up images, it is impractical to do so in many clinical settings. The use of broad spectrum lighting (rather than fluorescent lighting), **avoiding the use of a flash**, and **positioning the light source oblique to the skin surface is considered the optimal way of achieving even illumination across the area of interest** (eAppendix in the Supplement).

For **dermoscopic images**, clinicians and photographers have to decide whether to use **polarized** or **nonpolarized light**, and should be aware of the benefits and limitations of both light sources according to the specific lesion being photographed. Benvenuto-Andrade and colleagues<sup>17</sup> compared dermoscopic images with no additional light source, nonpolarized light, and polarized light with and without a liquid interface. They found different characteristics were better visualized using different types of light; for example, polarized light was preferred for imaging blood vessels and red areas, and it was the only modality permitting visualization of shiny white lines, clods, and rosettes.<sup>18,19</sup> In contrast, structures such as milium cyst are more conspicuous with nonpolarized light. The optimal light source therefore depends on the type of skin lesion being imaged.

In general terms, capturing at least 1 image with polarized light is recommended. However, the ISIC group advises the medical decision of selecting polarized vs nonpolarized light being left at the discretion of the individual capturing the image, based on the lesion characteristics described above.

### 2) Background Color

Reflection from objects in the background of an image can change the appearance of skin color in the area of interest, and should be avoided.<sup>6,13</sup> Health care providers should use a **solid background color** and aim for **contrast between the background and skin**. The optimal colored background can depend on skin color, with black providing the best contrast for lighter skin (eAppendix in the Supple-

ment) and sky blue for darker skin tones.<sup>13</sup> Any jewelry that could interfere with visualization of the lesion or area of interest should be removed.

### 3) Field of View for Dermoscopic Images

When positioning the camera for close-up or dermoscopic images, the aim should always be to center the lesion or area of interest (eAppendix in the Supplement). For close-up images, the camera should be held at sufficient distance from the skin to include the entire lesion and equal areas of surrounding skin at the periphery. If the longest axis of the lesion is larger than the field of view (FOV) that can be captured with the dermoscopic lens, multiple dermoscopic images should be taken to ensure all edges of the lesion are visualized and recorded (Supplement).

### 4) Image Orientation

The most important aspect of image orientation is consistency, to ensure that images can be compared over time. This is essential in both clinical and research settings.

There is expert agreement that cephalic orientation should be maintained for regional images; that is, with the subject's head toward the superior aspect of the image frame.

While vertical or horizontal orientation of the camera can be selected based on the body region and the positioning of the lesion or skin condition, the same orientation should be maintained for the regional image, close-up and dermoscopic image (eAppendix in the Supplement). For example, to capture images of a lesion on the forehead, it may be best to orient the camera horizontally to capture images of the lesion without including the patient's eyes (to maintain anonymity); whereas, for a patient with an eruption on the arm, vertical orientation may be more appropriate to include the wrist and elbow so the body region can be immediately identified as the arm. While the ISIC group focuses on consistency of orientation over time, McKoy

and colleagues<sup>20</sup> have included examples of image orientation for all body regions that provide a visual guide for health professionals.

### 5) Focus and Depth of Field

The depth of field is the distance between the objects nearest and furthest from the lens that appear in focus. If the depth of field is very shallow, the focus point will be sharp while areas of the skin further from and closer to the camera will appear blurred. The center of the lesion or area of interest should be used as the focus point. The camera should be positioned perpendicular (at a right angle) to the skin surface and a lens with a deep depth of field used so that the maximum area of the image is in focus.<sup>11</sup>

### 6) Resolution

Resolution refers to the number of pixels in an image, and is an indication of how much detail is captured.<sup>6</sup> Digital cameras enable the user to control the resolution, usually through quality or image size settings. Higher resolution images provide the level of detail appropriate for clinical photography, but result in larger file sizes. The ISIC group recommends a useful guide for selecting the appropriate resolution for the image type; that hair follicles be sharply depicted in regional images, skin markings (skin lines) be sharp in close-up images (eAppendix in the Supplement), and dermoscopic images should allow clear visualization of dots and regression structures when present. This generally equates to a joint photographic expert group

(JPEG) file at least 200KB in size.

### 7) Scale and Measurement Using Digital Imaging Software

Dermatologists may need to measure a lesion to report lesion size and changes in lesion dimension over time. Typically in dermatological imaging, adhesive rulers have been placed against the patient's skin to provide a scale to measure skin lesions. More recently, measurement scales have been incorporated into image acquisition devices and digital imaging software (eAppendix in the Supplement). Using a digital scale can avoid problems with physical scales including: skewed placement of rulers, creases in poorly placed rulers, and obscuring of surrounding skin.<sup>21</sup> Using a physical ruler is cumbersome when the patient has multiple lesions being imaged. When the dermatologist uses the software's measurement tool a distance measurement is automatically generated. In this context, accurate measurement can only be achieved if the lesion is exactly parallel to the camera sensor. For digital camera photography the object distance is not fixed but dependent on how far the photographer holds the camera from the skin lesion. Hence, a linear measurement cannot be geometrically calculated. To measure the lesion size in digital camera images the software's measurement tools is first calibrated to the physical or digital scale before measuring the lesion. Regardless of the type of measurement scale used, the scale should be placed in the same orientation as the camera (ie, vertical scale for vertical image frame) or dermatoscope.

### 8) Color Calibration

Accurately capturing color is essential in dermatological imaging. The color of images taken over time should be comparable to aid diagnosis and monitoring of skin lesions and other skin conditions. Equipment should be regularly calibrated according to the manufacturer's instructions to prevent changes in white balance and color calibration between follow-up time points (eAppendix in the Supplement).

### 9) Image Storage

Acquired digital images need to be stored for both regulatory and clinical reasons.<sup>22</sup> In many jurisdictions medical images (including dermatological images) need to be stored for the period of time mandated by local medical record retention legislation. Clinically, the review of previous imaging is an integral part of dermatological monitoring and diagnosis. Dermatological images can be stored using different file formats.

Images from digital cameras and smart phones are stored in standard image file formats, such as the JPEG format or tagged image file format (TIFF). These images contain some basic image acquisition metadata which is stored as part of the image file in exchangeable image file format (EXIF), but not patient metadata. Consequently, images need to be manually linked to patient information, for example, by attaching to electronic medical records.

An alternate format for storing dermatological images is the Digital Imaging Communication in Medicine (DICOM) format specified by the DICOM standard, an international, interoperability standard for the storage and transmission of digital medical images. The standard defines a DICOM file format that has 2 parts; the first is text-based metadata which describes patient, study, acquisition, and image attributes, and the second is the pixel data of the image which can be in any standard image file format, for example, JPG. The 2 parts are melded into a single file.<sup>23</sup> The ATA has published guidelines advocating the use of DICOM compliant systems for teledermatology.<sup>24</sup>

How does this work?

While there is currently no DICOM metadata definition specific to dermatology,<sup>25</sup> there are generic clinical photography metadata definitions that can be used for dermatological images.

Development of a specific dermatology metadata model would allow the technical parameter metadata recommended by this guideline to be stored as part of the image. This metadata could be used to audit compliance to the guideline and allow image acquisition parameters to be reproduced for subsequent photographic examinations of the skin.

## Conclusions

Standardizing imaging technique in dermatology and assuring compliance with international standards will **increase the clinical and research value** of digital photographs. Clinicians will have access to high-quality, consistently framed images to aid in the monitoring of lesions and other skin conditions. In addition, a central archive of

standardized skin images will provide benefits to researchers by making large, high-quality data sets accessible. Guidelines for standardized imaging can also be used by developers of new dermatological imaging technologies to ensure their currency and relevance in a rapidly changing field. The practical guidelines in this article provide instructions and examples to aid clinicians and photographers in meeting the recommendations developed by ISIC.

In practice, it often takes time for individuals to adapt to new recommendations and guidelines. **Barriers** to implementation of these guidelines include **clinic work flow**, **individual preferences**, and **resistance to change**. Clinicians and other imaging professionals who have developed and refined their own technique over years in practice may **not see the importance and benefit in investing the time** required for change. The benefits of standardized imaging should be promoted but additional strategies to minimize these barriers will likely be needed. These recommendations could be endorsed by regulatory organizations and used to guide development of position statements, to encourage change in practice.

## ARTICLE INFORMATION

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**Author Affiliations:** Dermatology Research Centre, The University of Queensland, School of Medicine, Translational Research Institute, Brisbane, Australia (Finnane, Wimberley, Soyer); Centre for Online Health, The University of Queensland, School of Medicine, Brisbane, Australia (Finnane, Caffery); Department of Dermatology, University of Arizona, Tucson (Curiel-Lewandrowski); University of Arizona Cancer Center, Tucson (Curiel-Lewandrowski, Abraham); Dermatology Department, Princess Alexandra Hospital, Brisbane (Soyer); University of Arizona Center for Health Outcomes and Pharmacoeconomic Research, Tucson (Katragadda, Abraham); Dermatology Service, Memorial Sloan-Kettering Cancer Center, New York, New York (Halpern, Marghoob); Department of Dermatology, Hospital Clinic of Barcelona, Barcelona, Spain (Malveyh); Department of Dermatology, Medical University of Vienna, Wien, Austria (Kittler); Department of Dermatology and Venereology, Medical University of Graz, Graz, Austria (Hofmann-Wellenhof).

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

**Concept and design:** Finnane, Curiel-Lewandrowski, Caffery, Katragadda, Halpern, Hofmann-Wellenhof, Abraham, Soyer.

**Acquisition, analysis, or interpretation of data:**

Finnane, Wimberley, Katragadda, Marghoob, Malveyh, Kittler.

**Drafting of the manuscript:** Finnane, Wimberley, Caffery, Katragadda, Malveyh.

**Critical revision of the manuscript for important intellectual content:** Curiel-Lewandrowski, Katragadda, Halpern, Marghoob, Malveyh, Kittler, Hofmann-Wellenhof, Abraham, Soyer.

**Administrative, technical, or material support:** Finnane, Curiel-Lewandrowski, Wimberley, Caffery, Katragadda, Halpern, Abraham.

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Brisbane, Australia; Allan Halpern, MD, Memorial Sloan Kettering Cancer Center; Rainer Hofmann-Wellenhof, MD, Medical University of Graz, Austria; Chinmayee Katragadda, MBA, University of Arizona Center for Health Outcomes and Pharmacoeconomic Research, Tucson; Harald Kittler, MD, Department of Dermatology, Medical University of Vienna, Austria; Josep Malveyh, MD, Hospital Clinic of Barcelona; Ashfaq Marghoob, MD, Memorial Sloan Kettering Cancer Center; H. Peter Soyer, MD, Dermatology Research Centre, The University of Queensland, Brisbane, Australia. The ISIC CG and EG members participating in the agreement process did not receive financial compensation for their contribution.

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## NOTABLE NOTES

## Topical Mercurials for the Treatment of Pediculosis

Justin D. Arnold, MMSc

Humans have been fighting lice infestations for millennia, and, until the advent of modern agents in the mid-20th century, pediculicides commonly contained mercury.

It has been reported that the use of mercury-based delousing therapies began as early as the Middle Ages. Confirmation of this use is provided by the mummified remains of a former King of Naples—Ferdinand II of Aragon—who died in 1496. His pubic and scalp hairs harbored high concentrations of mercury, as well as adherent nits and louse body fragments. Mercury was notably absent from the cranial and body cavities, and was detected only within the lice-infested regions, suggesting that the mercury was applied topically to provide relief from the infestation.<sup>1</sup>

The use of mercury for the treatment of pediculosis was subsequently detailed in one of the first dermatologic texts—*De Morbis Cutaneis: A Treatise of Diseases Incident to the Skin*—written in 1712 by English physician Dr Daniel Turner.<sup>2</sup> In the text, Turner described a young man “long labouring under a troublesome itching of the pubes and scrotum, so intolerable as to make him almost desperate” and that while surveying “the roots of the hairs... [I] perceived in their interspaces some of the crab-like vermin, so riveted as it were in the skin, that I could only raise two or three of them.” After advising the patient to apply a mercury-containing product, Turner noted the patient “had not used this method many days before he obtain'd his desire: the lice coming away and lying dead upon the dressings he took off daily.”<sup>2</sup>

Even with the wide availability of modern pediculicides, owing to its efficacy, mercury-based therapies are still being used. In 2015, 2 girls were

reported<sup>3</sup> to have applied a mercury-based pediculicide to their scalps from a herbal pharmacy in Iran and subsequently developed desquamation of the hands and feet, a miliaria rash on the trunk, diffuse musculoskeletal pain, and upper extremity tremors. Elevated urine mercury concentrations confirmed the diagnosis of acrodynia or “pink disease”—a syndrome common in children in the United States and Europe until the 1940s when calomel (mercuric oxide) was banned from teething powders and antihelmintic preparations.<sup>3</sup>

While there are safe and effective pediculicides available in most parts of the world, the use of mercury-containing products for the treatment of pediculosis has endured, and clinicians should be aware of its long history, continued use, and the subsequent clinical manifestations of acrodynia.

**Author Affiliation:** The George Washington University School of Medicine and Health Sciences, Washington, DC.

**Corresponding Author:** Justin D. Arnold, MMSc, The George Washington University School of Medicine and Health Sciences, 2300 Eye St NW, Ross Hall, Washington, DC 20037 ([jarnold@gwu.edu](mailto:jarnold@gwu.edu)).

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