

# Going Digital With Dermoscopy

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## PRACTICE POINTS

- Digital dermoscopy facilitates sequential digital monitoring, teledermoscopy, and machine learning.
- Important considerations in obtaining digital dermoscopy include image acquisition and standardization as well as protecting health information when taking and storing images.

Digital dermoscopy refers to the acquisition and storage of digital images from a dermoscopic examination. In this article, we delve into the innovative world of digital dermoscopy with a review of its potential uses as well as some nuances of adapting this technology in a clinical setting, including sequential monitoring, teledermoscopy, and machine learning. We also discuss the acquisition and storage of dermoscopy images in accordance with the Health Insurance Portability and Accountability Act (HIPAA).

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Dermoscopic examination has been proven to increase diagnostic accuracy and decrease unnecessary biopsies of both melanoma and nonmelanoma skin cancers.<sup>1,2</sup> Digital dermoscopy refers to acquiring and storing digital dermoscopic photographs via digital camera, smart image capture devices such as smartphones and tablets, or any other devices used for image acquisition. The stored images may then be used in a variety of ways, including sequential digital monitoring, teledermoscopy, and machine learning.

## Sequential Digital Monitoring

Sequential digital dermoscopy imaging (SDDI) is the capture and storage of dermoscopic images of suspicious lesions that are then monitored over time for changes.

Studies have shown that SDDI allows for early detection of melanomas and leads to a decrease in the number of unnecessary excisions.<sup>3,4</sup> A meta-analysis of SDDI found that the chance of detecting melanoma increased with the length of monitoring, which suggests that continued follow-up, especially in high-risk groups, is crucial.<sup>4</sup>

## Teledermoscopy

Teledermatology (telederm) is on the rise in the United States, with the number of programs and consultations increasing yearly. One study showed a 48% increase in telederm programs in the last 5 years.<sup>5</sup> Studies have shown the addition of digital dermoscopic images improved the diagnostic accuracy in telederm skin cancer screenings versus clinical images alone.<sup>6,7</sup>

Telederm currently is practiced in 2 main models: live-interactive video consultation and storage of images for future consultation (store and forward). Medicare currently only reimburses live-interactive telederm for patients in nonmetropolitan areas and store-and-forward telederm pilot programs in Alaska and Hawaii; however, Medicaid does reimburse for store and forward in a handful of states.<sup>8</sup> Similar to dermatoscope use during clinical examination, there currently is no additional reimbursement for teledermoscopy. Of note, a willingness-to-pay survey of 214 students from a southwestern university

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The eTable is available in the Appendix online at [www.mdedge.com/cutis](http://www.mdedge.com/cutis).

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health center showed that participants were willing to pay an average (SD) of \$55.27 (\$39.11) out of pocket for a teledermoscopy/telederm evaluation, citing factors such as convenience.<sup>9</sup>

Direct-to-consumer telederm offers a new way for patients to receive care.<sup>10</sup> Some dermatoscopes (eg, DermLite HÜD [3Gen], Molescope/Molescope II [Metaoptima Technology Inc]) currently are marketed directly to consumers along with telederm services to facilitate direct-to-patient teledermoscopy.<sup>11,12</sup>

## Machine Learning

Big data and machine learning has been hailed as the future of medicine and dermatology alike.<sup>13</sup> Machine learning is a type of artificial intelligence that uses computational algorithms (eg, neural networks) that allow computer programs to automatically improve their accuracy (learn) by analyzing large data sets. In dermatology, machine learning has been most notably used to train computers to identify images of skin cancer by way of large image databases.<sup>14-17</sup> One algorithm, a convolutional neural network (CNN), made headlines in 2017 when it was able to identify dermoscopic and clinical images of skin cancer with comparable accuracy to a group of 21 dermatologists.<sup>14</sup> In 2018, the International Skin Imaging Collaboration (ISIC) published results of a study of the diagnostic accuracy of 25 computer algorithms compared to 8 dermatologists using a set of 100 dermoscopic images of melanoma and benign nevi.<sup>15</sup> Using the average sensitivity of the dermatologists (82%), the top fusion algorithm in the study had a sensitivity of 76% versus 59% for the dermatologists ( $P=.02$ ). These results compared the mean sensitivity of the dermatologists, as some individual dermatologists outperformed the algorithm.<sup>15</sup> More recently, another CNN was compared to 58 international dermatologists in the classification of a set of 100 dermoscopic images (20 melanoma and 80 melanocytic nevi).<sup>16</sup> Using the mean sensitivity of the dermatologists (86.6%), the CNN had a specificity of 92.5% versus 71.3% for dermatologists ( $P<.01$ ). In the second part of the study, the dermatologists were given some clinical information and close-up photographs of the lesions, which improved their average (SD) sensitivity and specificity to 88.9% (9.6%) ( $P=.19$ ) and 75.7% (11.7%) ( $P<.05$ ), respectively. When compared to the CNN at this higher sensitivity, the CNN still had a higher specificity than the dermatologists (82.5% vs 75.7% [ $P<.01$ ]).<sup>16</sup> However, in real-life clinical practice dermatologists perform better, not only because they can collect more in-person clinical information but also because humans gather more information during live examination than when they are interpreting close-up clinical and/or dermoscopic images. In a sense, we currently are limited to comparing data that is incommensurable.

Machine learning studies have other notable limitations, such as data sets that do not contain a full spectrum

of skin lesions or less common lesions (eg, pigmented seborrheic keratoses, amelanotic melanomas) and variation in image databases used.<sup>15,16</sup> For machine algorithms to improve, they require access to high-quality and ideally standardized digital dermoscopic image databases. The ISIC and other organizations currently have databases specifically for this purpose, but more images are needed.<sup>18</sup> As additional practitioners incorporate digital dermoscopy in their clinical practice, the potential for larger databases and more accurate algorithms becomes a possibility.

## Image Acquisition

Many devices are available for digital dermoscopic image acquisition, including dermatoscopes that attach to smartphones and/or digital cameras and all-in-one systems (eTable). The exact system employed will depend on the practitioner's requirements for price, portability, speed, image quality, and software. Digital single-lens reflex (DSLR) cameras boast the highest image quality, while video dermoscopy traditionally yields stored images with poor resolution.<sup>19</sup> Macroscopic images obtained by other imaging devices, including spectral imaging devices and reflectance confocal microscopy, usually are yielded via video dermoscopy or a video camera to capture images; thus, stored images generally are not as high quality.

Smartphones are increasingly used for clinical imaging in dermatology.<sup>20</sup> Although DSLR cameras still take the highest-quality images, current smartphone image quality is comparable to digital cameras.<sup>21,22</sup> Computational photography uses computer processing power to enhance image quality and may bring smartphone image quality closer to DSLR cameras.<sup>22,23</sup> Smartphones with newer dual-lens cameras have been reported to further improve image quality.<sup>21</sup> Current smartphones have the option of enabling high-dynamic-range imaging, which combines multiple images taken with different exposures to create a single image with improved dynamic range of luminosity. It has been reported that high-dynamic-range imaging may even enhance dermoscopic features of more challenging hypopigmented skin cancers.<sup>24</sup>

## Standardizing Imaging

There has been a concerted effort to standardize digital dermatologic image acquisition.<sup>25,26</sup> Standardization promises to facilitate data analysis, improve collaboration, protect patient privacy, and improve patient care.<sup>13,26,27</sup> At the forefront of image standardization is the ISIC organization, which recently published its Delphi consensus guidelines on standards for lesion imaging, including dermoscopy.<sup>26</sup>

The true holy grail of image standardization is the Digital Imaging and Communications in Medicine (DICOM) standard.<sup>26-28</sup> The DICOM is a comprehensive imaging standard for storage, annotation, transfer, and display of images, and it is most notable for its use in radiology. The DICOM also could be applied to new

## Quick Tips for Securing Imaging Data (Including Digital Dermoscopy)<sup>a</sup>

- Fully encrypt all devices/hard drives
- Store de-encryption keys separate from their respective devices
- Use complex passphrases on all devices
- Activate the “erase data” feature on your smartphone (data will be erased after a certain number of failed passcode attempts)
- Keep written documentation of your security plan and all steps taken to secure data
- Ensure all apps and/or cloud-based storage services follow HIPAA guidelines
- Physically limit access to devices/drives (eg, keep under lock and key when not in use)
- Transfer images from unsecure cameras or devices in a timely manner
- Bitlocker (Windows) and FileVault 2/Disk Utility (Mac OS) are free and powerful encryption programs
- The US Department of Health & Human Services<sup>30</sup> recommends following the encryption guidelines set forth by the NIST<sup>31</sup>

Abbreviations: HIPAA, Health Insurance Portability and Accountability Act; NIST, National Institute of Standards and Technology.

<sup>a</sup>These tips are based on guidelines<sup>30,31</sup> and are not all-encompassing. Your institution may have specific data security regulations that may be even more stringent.

imaging modalities in dermatology (eg, optical coherence tomography, reflectance confocal microscopy). Past efforts to develop a DICOM standard for dermatology were undertaken by a working group that has since disbanded.<sup>27</sup> Work by the ISIC and many others will hopefully lead to adoption of the DICOM standard by dermatology at some point in the future.

### Protected Health Information

The Health Insurance Portability and Accountability Act (HIPAA) requires protected health information (PHI) to be stored in a secure manner with limited access that sufficiently protects identifiable patient information. Although dermoscopic images generally are deidentified, they often are stored alongside clinical photographs and data that contains PHI in clinical practice.

Image storage can take 2 forms: (1) physical local storage on internal and external hard drives or (2) remote storage (eg, cloud-based storage). Encryption is essential regardless of the method of storage. It is required by law that loss of nonencrypted PHI be reported to all potentially affected patients, the US Department of Health & Human Services, and local/state media depending on the number of patients affected. Loss of PHI can result in fines of up to \$1.5 million.<sup>29</sup> On the contrary, loss of properly encrypted data would not be required to be reported.<sup>30</sup>

As smart image acquisition devices begin to dominate the clinical setting, practitioners need to be vigilant in securing patient PHI. There are multiple applications (apps) that allow for secure encrypted digital dermoscopic image acquisition and storage on smartphones. Additionally, it is important to secure smartphones with complex passcodes (eg, a mix of special characters, numbers, uppercase and

lowercase letters). Most dermatoscope manufacturers have apps for image acquisition and storage that can be tied into other platforms or storage systems (eg, DermLite app [3Gen], Handyscope [FotoFinder Systems GmbH], VEOS app [Canfield Scientific, Inc]).<sup>28</sup> Other options include syncing images with current electronic medical record technologies, transferring photographs to HIPAA-compliant cloud storage, or transferring photographs to an encrypted computer and/or external hard drive. Some tips for securing data based on HIPAA and other guidelines are listed in the Table.<sup>30,31</sup>

### Conclusion

The expansion of teledermoscopy alongside direct-to-patient services may create additional incentives for clinicians to incorporate digital dermoscopy into their practice. As more practitioners adopt digital dermoscopy, machine learning driven by technological advancements and larger image data sets could influence the future practice of dermatology. With the rise in digital dermoscopy by way of smartphones, additional steps must be taken to ensure patients' PHI is safeguarded. Digital dermoscopy is a dynamic field that will likely see continued growth in the coming years.

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## APPENDIX

**eTABLE. Acquisition Devices<sup>a</sup>**

Manufacturer	Device	Imaging Technology <sup>b</sup>	Also a Standalone Dermatoscope? <sup>c</sup>
3Gen	Dermlite Cam	Built-in digital camera	No
3Gen	Dermlite DL1	Mobile device	No
3Gen	Dermlite DL200 (HR and Hybrid)	Mobile device or digital camera	Yes
3Gen	Dermlite DL4/DL3N	Mobile device or digital camera	Yes
3Gen	Dermlite FOTO System	DSLR	No
3Gen	Dermlite Foto II Pro	DSLR	No
3Gen	Dermlite HÜD <sup>d</sup>	Mobile device	No
Canfield Scientific, Inc	VEOS DS3	iPod Touch	No
Canfield Scientific, Inc	VEOS HD1/VEOS HD2	Mobile device	Yes
Canfield Scientific, Inc	VEOS SLR	DSLR	No
Derma Medical Systems Handels u. Entwicklungs GmbH	MoleMax HD	Built-in video dermoscopy	No
DermoScan GmbH	DermoGenius II	Digital camera	Yes
DermoScan GmbH	DermoGenius ultra	Built-in video dermoscopy	No
DermoScan GmbH	Dynamify Wireless Dermatoscope	Built-in video dermoscopy	No
DermoScan GmbH	Illuco IDS-1 100 Dermatoscope	Mobile device	Yes
Firefly Global	DE300 Polarizing Dermatoscope/ Dermascope	Built-in video dermoscopy	No
Firefly Global	DE350 Wireless Polarizing Dermatoscope/Dermascope	Built-in video dermoscopy	No
FotoFinder Systems GmbH	Handyscope with Handyscope 2 app	Mobile device	No
FotoFinder Systems GmbH	Medicam 1000	Built-in video dermoscopy	No
HEINE Optotechnik GmbH & Co. KG	NC2 Dermatoscope	Mobile device	Yes
Heine USA LTD	DELTA 20T Dermatoscope	DSLR	Yes
Heine USA LTD	iC1 Dermatoscope	Mobile device	No
Metaoptima Technology Inc	Molescope/Molescope II <sup>e</sup>	Mobile device	No
Visionmed AG	microDERM Luminis	Digital camera	Yes

Abbreviation: DSLR, digital single-lens reflex.

<sup>a</sup>Information obtained from manufacturer websites and product brochures. This list is thorough but is not exhaustive and includes devices from the most commonly referenced dermatoscope manufacturers.

<sup>b</sup>Mobile device refers to either smartphone, tablet, or iPod Touch.

<sup>c</sup>A dermatoscope that can be used without an image capture device to perform a clinical dermoscopic examination.

<sup>d</sup>Marketed to patients/consumers.

<sup>e</sup>Marketed to patients/consumers and physicians.