

# Telediagnosis with Confocal Microscopy

## A Reality or a Dream?

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### KEYWORDS

• Telemedicine • Teledermatology • Tele-confocal • Confocal microscopy • Dermoscopy

### KEY POINTS

- Reflectance confocal microscopy (RCM) is a noninvasive tool allowing in vivo evaluation of cutaneous lesions at near histologic resolution.
- RCM has been shown to have high accuracy in diagnosing both pigmented and nonpigmented lesions and is increasing in popularity among the dermatology community.
- There is a need to evaluate diagnostic accuracy and safety of teleconfocal in real-world settings.
- Proper training programs and reading standards should be implemented and developed to ensure safe diagnostic sensitivity and avoid misdiagnosis of malignant lesions in telemedicine settings.

### INTRODUCTION

The improvement of technology and modernization of medicine has completely changed the arena that doctors enter in everyday clinical practice. With the introduction of Internet-based communication, touch-screen mobile phones, and large data storage that can be streamed instantaneously, the demand to access information by both patients and their doctors has risen exponentially in the past decade.<sup>1–3</sup> The term *telemedicine* dates back to 1974 when Mark and colleagues<sup>4</sup> highlighted the potential for improving the traditional practice of exclusive face-to-face doctor-patient contact in a dedicated facility to other settings where a doctor could review patient information collected previously by a third party, such as another doctor, nurse, or technician, that could be reviewed at a later time.<sup>5,6</sup> Throughout the years telemedicine practice improved and

made around-the-clock access to both general medical data and imaging, which allowed for improvement of patient care, scope of practice, and cost-benefit.<sup>7–9</sup> Telemedicine has enabled the rapid spread of interest in dermoscopy allowing a consultative expert opinion that was once done primitively by USB pendrive or e-mail and currently through secured Internet-based server software programs.<sup>10–13</sup> Mobile applications can be downloaded free of charge that provide either computer-based algorithm screening of melanocytic nevi photographed with a camera phone or human interpretation for a service fee.<sup>14–17</sup> With the ability for both doctors and patients to obtain nearly instant gratification, the question is if this connectivity can be transferred effectively and safely to more advanced tools in dermatology beyond those encompassing clinical imaging and dermoscopy.

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Reflectance confocal microscopy (RCM) is a noninvasive screening technique permitting in vivo view of cellular morphology at patients' bedside with relatively rapid acquisition of high-resolution images that can be used for real-time evaluation or subsequent review at a later time.<sup>18</sup> RCM has proven to be a reliable tool for improving diagnostic accuracy at patients' bedside and over the past decade has seen a substantial increase in interest among the dermatology community worldwide.<sup>19,20</sup> Thanks to streamlined confocal terminology and evaluation of RCM application to both pigmented and nonpigmented lesions in a large variety of studies, we can see a steady diffusion of RCM into clinical practice. Instead of replacing traditional biopsy with histopathology evaluation, RCM augments and bridges the clinico-dermoscopic presentation to the gold standard of pathology both improving earlier diagnosis and potential for significant reduction in unnecessary excisions.<sup>21–24</sup> The evaluation of RCM images requires specialized training that is not readily available despite the numerous publications in this field. The application of telemedicine with RCM (teleconfocal) may help overcome the deficit of experts through electronic learning (e-learning) training platforms as well as connect patients to experts at a distance.<sup>25</sup>

### PRINCIPLES OF TELEMEDICINE

The principle of telemedicine use in dermatology is the use of telecommunication technology to send skin disorder-related medical data over a distance for the purpose of administration, research, disease prevention, patient management, and education. Teleconfocal provides access to particular dermatologic specialist knowledge that would be otherwise unavailable at a particular location by transferring the information via a store-and-forward (SAF) technique.<sup>26–28</sup> SAF teledermatology allows a referring physician or third party, such as a nurse or technical assistant, to acquire digital still images with accompanying patient data. In the case of teleconfocal, the collection of data includes patient information and a full set of images, including digital dermoscopy, 3 to 4 mosaic maps at the epidermis, dermal-epidermal junction (DEJ), and dermis as well as, a minimum of 4 VivaStacks® (Mavig, Munich, Germany) 2 in the center and 2 at the periphery of the lesion, with the option to add an RCM movie. These data are subsequently sent to a data storage unit (server) to be assessed by the reader, or reviewer, at a later time. As storage, retrieval, and privacy of information are crucial, the available confocal server (Vivanet) uses a secure server that secures information with Digital

Imaging and Communications in Medicine–(DICOM) and Health Insurance Portability and Accountability Act–(HIPAA) compliant security in the United States, preventing intrusion and ensuring consistency in the presentation and sharing of information seamlessly between medical professionals.<sup>29,30</sup> During the initial implementation of the Vivanet, special single-purpose computer desktops with dual high-resolution monitors were connected by a virtual private network that allowed a secure 2-way interface between information being accessed and the user serving as a safety gate through which select information was passed. The limitation of this system relied on the large data size transfer (ranging from 300 mb to 1 Gb) and the high up-front expense of using a dedicated hardware desktop system to perform off-site telemedicine reads.<sup>31</sup>

### CLOUD-BASED TELEMEDICINE

Recently the RCM manufacturer has updated the reading system through the use of a cloud-based server that relies on secure high-speed third-party servers, similar to well-known services, such as Dropbox, WeTransfer, and Gmail.<sup>32</sup> The latest version of the RCM hardware units are programmed to instantaneously upload the full set of images from the microscope to a distant cloud server through high-speed Internet connection (100 mbps recommended) (**Fig. 1**). This new cloud-based Vivanet is more advantageous because it requires minimal (or no) investment in hardware but still allows access to powerful processing and storage technologies resulting in a much more cost-effective solution. With the Vivanet cloud, the reader can access the required imaging and information via any computer, tablet, or mobile phone that is connected to high-speed Internet cable or WI-FI. Thanks to incorporation of similar software used in services, such as Google Maps, the large imaging files can be streamed in real time permitting fast scanning of mosaic maps and zoom-in and zoom-out functionality similar to what can be performed on the actual microscope units. From the authors' own experience, it is recommended to perform teleconfocal evaluation using a large high-resolution computer monitor; but in instances when a desktop is not available, similar effectiveness can be completed with a high-resolution laptop or large tablet. The DICOM- and HIPAA-compliant Vivanet cloud user interface is accessed securely through a URL (<https://vivanet.caliberid.com>) where the user is asked to input their dedicated username and password (**Fig. 2**). Once the user accesses the home screen, there is a patient list that shows

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