Remote Wound Consultation Series
PART 1:

Clinical Digital Photography:

## Tips and Techniques for Community Nurses

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Clinical digital photography is used increasingly in the community for the purposes of wound documentation and remote consultation.[1,2,3] The power to augment written notes with quality photos that detail the wound bed characteristics and wound edges is unsurpassed in its usefulness to provide a baseline record, to track wound progression[4,5,6] and to provide supportive evidence in the case of a lawsuit.[6] As the health-care workforce is put under greater pressure to increase capacity, more clients with chronic wounds are cared for by a greater variety of care providers. The ability to send a wound image with data to a wound management consultant or physician through electronic means facilitates the achievement of best practice care and collaboration between professionals and paraprofessionals.[7,8] It is not only beneficial for patients and professionals in rural and remote settings, but also for the care of urban patients with barriers to specialist access.[9]

In contrast to hospital and clinic settings, community practice brings unique constraints to clinical digital photography. Challenges arise related to the environment, equipment limitations and the lack of agency policies and procedures to support this practice. There are scarce resources available to assist home care nurses in producing high-quality photo documentation of wounds.[1] Digital wound images are frequently required for medico-legal purposes,[6] and achieving best quality is imperative and challenging.[8,10] This first of a two-part series will outline some practical tips and advice for the achievement of reliable and accurate digital wound images that take into account some of the restrictions related to this unique practice context. The second article in the series will address medico-legal, professional and patient privacy considerations for remote wound consultation policy development.
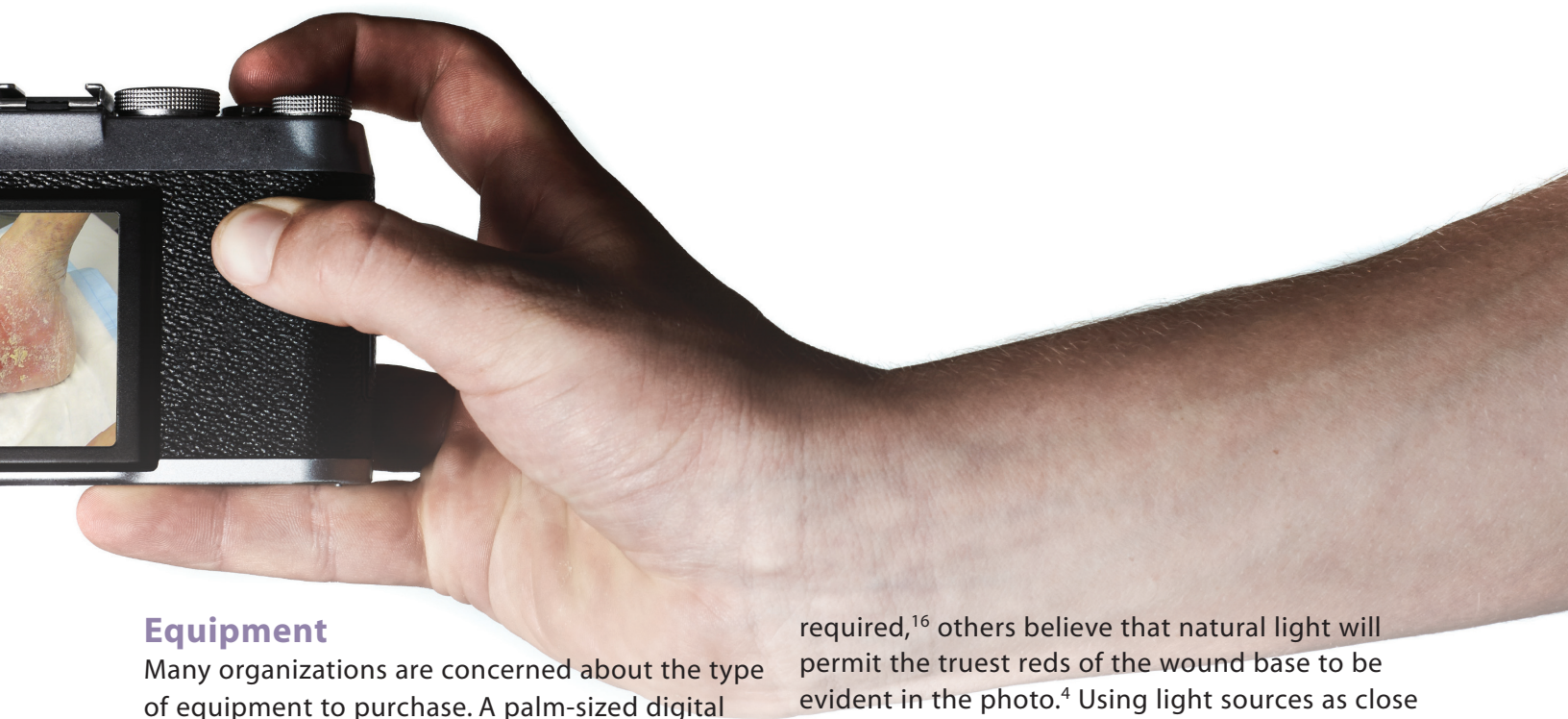
Equipment

Many organizations are concerned about the type of equipment to purchase. A palm-sized digital camera can produce high-quality images when space and weight constraints are an issue for a mobile health-care provider.[12,13] Camera features, such as a manually adjustable white balance to enhance true colours, can be helpful, but many of the value-added features of today's compact cameras, such as Wi-Fi or high-power optical zooms, are not. The most useful wound photos will be taken with the macro setting,[14] so purchase decisions should focus on cameras with a good macro ability, and that produce high-quality images.

A smooth, hard carrying case that is easily cleaned is essential for infection control purposes.[6] Some home care nurses find it practical to wear a headlamp when providing wound care in low-light situations, and these are small, inexpensive and portable. A tabletop tripod or monopod can also be helpful.

Mobile phone use for photography is regarded as posing unacceptable risks to patient security and confidentiality, which creates a potential for legal action against an individual clinician or organization.[6]

Tips for Lighting

Difficulty distinguishing true wound bed colour is one common challenge in digital photography, which is highly dependent on the source and amount of lighting available during photography.[4,8,15] While some argue that a flash is required,[16] others believe that natural light will permit the truest reds of the wound base to be evident in the photo.[4] Using light sources as close to white as possible is advised (fluorescent daylight or full spectrum bulbs rather than incandescent).[14] A visual comparison of skin tone with flash and without flash is presented in Figures 1A and 1B. To enhance the ambient light, position the client close to a window, turn on overhead lights and lamps and/or wear a headlamp while taking the photo with the flash turned off. Be aware that mixed sources of lighting can cause a colour cast (refer to the sidebar White Balance for an explanation of colour cast).

Macro photos taken with a flash can produce variable results in particular because wound exudate tends to create glare that reflects back the light, thereby obscuring wound bed colour and texture. However, in some homes, ambient light cannot be improved. In these cases, the author has found that putting a piece of "paper" tape partially or fully over the flash to mask it during photography can dampen the glaring effect and improve image quality. To solve the flash dilemma, some experts recommend the use of a ring flash,[16] although this equipment is used with a D-SLR camera more suitable in a fixed clinic environment.

Preparing Your Client

The client should be put in a comfortable position that allows the wound to be in a neutral, non-distorted position, in particular in wounds over joints and on the abdomen. Enlist help to hold limbs or

Flash

Most digital cameras come equipped with a built-in flash. This can be a useful feature in situations with poor lighting, but for the purposes of wound photography, the problems accompanying flash photography (glare, harsh shadows, overexposure, colour shift and more) can outweigh the benefits. If the flash can be turned off, or at least have its intensity decreased, and you can instead rely on existing lighting, you can usually sidestep the problems associated with the use of flash.

If you need to use the flash on your camera, or if your camera does not permit you to turn off the flash, you can almost always improve the photos you take by making the light from the flash more diffuse. Fasten something translucent over the flash (e.g., translucent tape, paper or tissue, making sure it is either white or uncoloured) or buy a commercially available snap-on flash diffuser. If your flash can be redirected away from the subject, then bounce it off a white ceiling or wall. Anything you can do to cause the concentrated point-source of light from the flash to become diffuse and reach the subject from many angles will result in softer shadows and less glare.

Be aware though that anything that lessens the amount of light available can result in longer exposure times, which can lead to blurred images, and/or a larger aperture setting, which can cause parts of the image to be out of focus. If you are using a tripod (see main article), a longer exposure isn't likely to be a problem. However, a larger aperture will result in a shallower depth of field, which is usually not what you want. (See more on this in the Focus and Depth of Field sidebar.)

Flash overexposure   No flash; daylight only

use rolled towels or pillows to support the patient and avoid patient fatigue. The wound should be thoroughly cleansed before photos are taken.

It is crucial to label the photo in order to link the photographic record to the patient. Remote consultants put themselves at risk by providing advice on an unlabelled photo. It is recommended to use a disposable measuring tape to record the date and a unique client identifier. In addition, the inclusion of a paper measuring tape in the image allows the viewer to compare an actual measuring tape to the one in the photo to judge if a 1:1 (actual wound size) or greater size (magnified) ratio was achieved when the macro setting was used.[14] Placing this scale in the same focal plane as the wound is important, as this is the only section that will be in focus.[6] This means that the camera should face the wound straight on and not at an angle. If the wound wraps around a rounded body part, several photos may be necessary to capture the entire skin defect. An arrow on the label indicating the direction of the patient's head provides wound orientation, and if there is more than one wound, the number assigned to the wound should be indicated on the label, or the wound location should be specified. Written notes should correspond to the same wound numbers indicated in the photo.

Camera Settings

Once the patient is comfortable and optimal lighting has been arranged, the camera can be removed from the case and the settings adjusted. The focus limit on the regular setting of a camera can be as great as 45 cm, which means that any photos taken closer than this distance will be out of focus.[11] The regular setting is appropriate when taking photos that include the surrounding skin and contralateral limbs, but photos of the wound bed should be taken using the macro setting.

Macro photography is a close-up photo that results in an image that is life-sized or greater-than-life-sized.[11] However, closing the distance between the camera and the wound also reduces the amount of light on the wound[11]

and requires greater stability; when light levels are lower, the lens stays open slightly longer. Finding the optimal distance between the camera and the wound using the macro setting will require some experimentation. Variables that affect the distance include the type of camera, size of wound, amount and type of light, and can vary with each patient.

Figures 1A & B. Effects on flesh tone colours between no flash (A, left) and flash (B, right) (automatic white balance)

The optical or digital zoom features should not be used in conjunction with the macro setting.[14] If it is necessary for the nurse to hold the patient in position and there is no help available, the use of the camera's self-timer feature can be helpful. Be sure to use a tabletop tripod, or place the camera on a hard surface.

Fluorescent lighting will tend to cause a greenish or bluish tinge in the photo, whereas incandescent bulbs will create a yellowish tinge. Some cameras come equipped with a white balance feature that allows the user to get the most true-to-life colours. It is worth consulting the user manual to learn how to use the white balance feature, if it is not set automatically.[14]

Tips for Background

The background colour can affect the true reds in the photo. Non-reflective blues and greens are recommended.[6,14] The home-care nurse can use coloured towels, pillow cases or blue incontinence pads. See Figures 2 A, B, and C for a comparison of the same skin taken under the same lighting conditions with different backgrounds. It has been suggested that a colour reference chart or colour calibration label be placed in at least one of the photos to assist the remote consultant in distinguishing true colour.[8,16] This recommendation may be impractical unless a good source of inexpensive disposable charts is sourced.

Tips for Stability

While using a tripod for close-up photography is ideal, it is not typically practical in a home care environment. A monopod may be simpler to employ. Otherwise, if possible, rest the camera on a hard surface to take the photo, or use a tabletop tripod. Bracing your arms against your chest and taking the photo after exhaling and while holding your breath briefly can help, as can bracing the camera against something solid, like a door jamb or bureau, especially in low-light situations or when using macro settings. The use of the self-timer feature can also help when it is difficult to achieve stability while holding the camera.

Figures 2A, B & C. Comparison between (A) white, (B) blue and (C) green colour backgrounds; photos taken under same lighting conditions (automatic white balance)

White Balance

What is it?

The type of light illuminating your patient will affect the overall colour of a photo, so if you need true colour (especially important in accurately recording the condition of wounds), you need to correct the camera's colour balance to compensate for any colour shift caused by the lighting. This correction technique is referred to as setting the white balance.

For example, regular tungsten incandescent bulbs impart a distinct yellow tone (also referred to as yellow cast) to your photo; fluorescent causes a green (or sometimes bluish-green) cast. Even the light reflected off painted walls or fabric can cause a colour cast. The naked eye sees the colour cast, but the human brain does a very good job at correcting for this without even realizing any sort of colour cast is present. The reality that a digital camera captures what it sees means that the colour cast in the photo becomes obvious—if left uncorrected—when viewing the photo later under different lighting conditions.

Incandescent lighting

Why does it matter?

In a clinical setting, the colour of a wound can be an indicator of its current state, so accurate colour is essential.

What can you do about it?

Read your camera's manual and learn how to set the white balance. It is usually very simple, and a little practice is all it takes to master the steps needed. Get into the habit of resetting your camera's white balance for each set of photos or each lighting set-up. Some cameras will adjust white balance automatically and perhaps also offer preset white balance settings, such as sunlight, shade, fluorescent, etc., but you will not necessarily get the results you need or expect. On most digital cameras, white balance can be set manually by taking a test photo of something known to be neutral.

Cloudy daylight lighting

"White balance" is a bit of a misnomer, because it can actually be set with a neutral shade of grey just as effectively as with white. What is essential is that the colour is *neutral*. Many people use a plain sheet of white paper or piece of fabric, but many papers and fabrics have artificial brighteners to make them look cleaner and whiter to the human eye. The camera does not detect these brighteners the same way as the human eye though, and so something that looks plain white may not actually be neutral white; photos corrected to this supposedly "neutral" white may have a distinct colour cast. A better solution is to buy a "white card" or a "grey card" from a camera store. These are made to be truly neutral and can be used to set your camera's white balance properly. They are not expensive and are usually available in a range of sizes. Your card need not be very large—just large enough for you to take a test photo and adjust your camera's settings. Something large enough to hold in the photo while you shoot is ideal. (You need to be able to hold the card without it touching the patient, to avoid cross-contamination.)

Fluorescent lighting

When should you do it?

It does not need to be done for every photo; just once for every lighting situation. Note that if your lighting changes, you need to reset the white balance. For instance, if you are using natural light (i.e., daylight coming in through a window) and suddenly conditions outside change from sun to cloud, the white balance setting should be adjusted.

White balance set properly

Step by step

1. Set up to take your photos.
2. Take your test shot first with the white card or grey card held near the point of interest in your photo.
3. Set the white balance using the test shot, as per your camera's instruction manual.
4. Take the rest of your photos.
5. Remember to reset your white balance every time your lighting situation changes.

It is possible to correct a photo's white balance after a photo is taken by using photo manipulation software, but because you must retain unedited, original files for medico-legal purposes, you reduce your file management obligations by setting up colour correction using white balance settings in the camera *before* taking any photos.

Tips for Infection Control

Infection control policies and procedures should be in place and address equipment and handling.[14] Ensure that the wound has been prepared and cleansed prior to removing the camera from the bag. Use hand sanitizer before and after taking the photo and avoid wearing gloves, as powder can damage the camera.[1] Treat the camera as you would a stethoscope or blood pressure cuff that is used with multiple patients during the day. Check with the manufacturer about the most appropriate means of cleansing the camera between clients, so as not to use chemicals that damage the screen or casing. Equipment should be carried in a hard case that is regularly cleaned.[6]

Tips for Wound Imaging

Not all wounds are amenable to photos for remote consultation purposes. Photos on hair-bearing skin, highly pigmented areas and mucosal lesions can pose challenges.[14] Ensure that the wound is cleansed before taking a photo to allow for a true image of tissue colours and textures. If there is concern, a photo of the back of the soiled dressing can be useful to record drainage colour, amount and consistency. Tunnels and undermining should be indicated using a cotton-tipped applicator placed within the wound, or parallel to it. Pre and post debridement photos are often taken.[6]

The entire wound should be in focus within the photo, and the depth of field should capture the entire depth of the wound[16] close enough so that underlying structures and tissue types can be identified. The focus should not be on the label, a common mistake. At least one photo should be taken that includes a large area of healthy surrounding skin in order to capture any subtle lines of erythema demarcation, which would otherwise be mistaken for normal skin tone, particularly in patients with rich skin colour. Alternately, an image that includes the entire limb taken with regular camera settings is suggested.

If the wound is on a limb, a photo that includes both limbs will allow contralateral

Focus and Depth of Field

Most digital cameras are equipped with autofocus and automatic exposure. They also allow you to turn off autofocus and to focus manually. If you are taking photos where the entire point of interest lies within the focal plane (see Glossary for a description), then autofocus will probably serve you well. But if your camera's autofocus insists on focusing on something other than your point of interest, then you should be prepared to focus manually.

What about depth of field (DOF) though? If your point of interest does not lie completely within the depth of field, you can improve the situation by deepening the depth of field, so that more of your subject is in focus. How do you do this? There are two main things that can conspire against you here: depth of field is shallowest when (a) you are at a close focal distance (which will be the norm for macro photos) and (b) the aperture is widest (which it will be when lighting is weak). Focal distance is something you may not be able to do much about if you need to be a particular distance from your subject to get the shot you require, but you can increase the depth of field (if your camera allows you to) by turning off the automatic exposure and manually adjusting to a smaller aperture (i.e., adjust to a higher F-stop). Be aware, though, that you can only do this successfully by increasing the length of the exposure (see the main article about using a tripod to stabilize your camera) and/or increasing the amount of light on your subject. A smaller aperture will result in less light entering the camera unless compensated for with longer exposure time and/or brighter lighting.


Shallow DOF

Deep DOF

File Compression

Digital files can be very large if they have high resolution. There are techniques for compressing photos so they don't contain as much data. The advantage is that they don't take as much space to archive and as much time to transmit electronically. However, some compression techniques alter the photo and may be unsuitable or even disallowed from the standpoint of retaining an unaltered original. JPG (or JPEG) file format is a very common and efficient compressed file format, but it alters the photo by permanently stripping out "unneeded" data—data whose absence goes unnoticed by the viewer. This is referred to as "lossy" compression (as opposed to "lossless" compression, where no data are permanently stripped out). Furthermore, JPG photos may have been compressed with too great a degree of compression, resulting in an obvious (and permanent) characteristic shimmer or visual "noise" in the image (see examples, below). A photo with this visual noise is referred to as having digital artifacts, which is unacceptable in a clinical context. Most digital cameras save photos in JPG format by default, but usually with a minimal (and unnoticeable) degree of compression. Your camera may offer lossless compression alternatives. Read the manual to find out if it does and be prepared to make a decision based on file size and quality vs. convenience and speed of transmission.
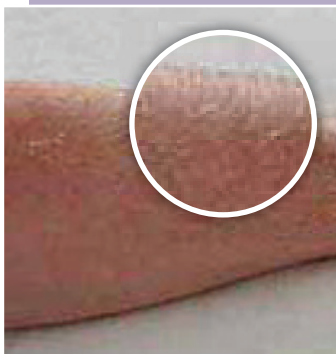
High JPG compression
(low quality)

No JPG compression
(high quality)

comparison of edema and colour. It is also advisable to avoid including any hands in the image, and when this is required, the hands should be gloved.[6]

It is helpful to review previous photos and chart notes in order to replicate views. This allows for accurate comparisons over the course of healing. The front of the camera should be held parallel to the wound surface.[6] In order to protect patient identity, the photo taken should avoid angles that would include the patient's face or identifying features such as tattoos or jewellery.

Tips for Charting

Ensure that a specific consent for the digital image has been signed and is on the chart if there is any likelihood that the photo will be used for education or publication purposes or when information is transmitted to a consultant outside the circle of care.[6] Wound photos used for clinical trials require specific information and a separate consent. When a digital image is used as part of the standard or electronic documentation, consent is considered "implicit,"[9] but all consent needs to be informed.[17] Patients must understand that once taken, the photos are the ownership of the agency or institution as part of legal documentation. Patients have a right to view or obtain copies of the photos, as with other records. Verbal consent should be recorded in the chart.[6] It is recommended that when consent for wound photography is obtained from an incapacitated patient's substitute decision maker, the resulting photos be used strictly for clinical purposes.[6] It is advisable to incorporate the photo consent form into the general treatment consent[4] as the practice of clinical digital photography becomes more prevalent.

Taking careful notes enables comparable repeated images.[6] Notes can include the position of the patient during the photo if it is likely to affect the appearance of the size and any other particularities relevant to repeat imaging such as the approximate distance between camera and wound. It is important to indicate in the chart that a photo was taken so that

this can be cross-referenced to the stored digital image (if the photo is not printed). If photos are printed, these should be securely attached to the patient chart as well as noted in the chart in print.

Evidence supporting the use of photos alone as an alternative to direct clinical exam is conflicting. In studies on pressure ulcers, photos alone could not reliably convey the characteristics of a wound without accompanying clinical data,[18,19] whereas a study involving burns concluded that digital photography was a valid and affordable alternative to direct clinical exam.[20] Differences between the studies include the professionals involved (nurses versus doctors) and chronic versus acute wounds. The Photographic Wound Assessment Tool (revised) has proved to produce reliable results comparable to bedside wound assessments.[13]

Tips for Photo Processing

It is recommended to have a defined local policy on image processing to assist in an audit trail.[6] All poor-quality photos should be deleted directly from the camera at the time of capture. All raw, unmodified photos should be downloaded as soon as possible and labelled, at a minimum, with the word *original*, the date, client ID and wound number if applicable. Alternately, watermarking software can be used to ensure that photos are not edited or manipulated without permission.[14] Photos are admissible as evidence in any medico-legal suit.[6] If any alterations are made to the photo once it is downloaded such as re-sizing, colour adjustments, etc., the photo should be labelled as "altered" when saved. It is important to consider the quality of the computer screen used for reviewing digital photos, as this can also affect subtle colour differences in wound images.[14]

Tips for Medical Record Management

It is recommended that cameras reserved for wound documentation be treated as carefully as one would treat a patient chart. Cameras should be kept with the nurse during visits, not left in the car. Images that are left on the camera are not

File Size/Photo Resolution

The size of photos is measured in megapixels (MP). Generally speaking, larger is better, because larger photos will have recorded more data and therefore better detail. File size is sometimes discussed in terms of resolution, but resolution is tied to the physical dimensions of the photo, and both must therefore be considered at the same time. Suffice it to say though, for a given physical dimension, high resolution means greater detail and is therefore generally more desirable. Preparing photos for publication and fully understanding the significance of resolution can be a very confusing and counter-intuitive undertaking for some, and a thorough explanation is beyond the scope of this article. However, many tutorials exist online that can help guide you.

Low resolution
(72 DPI)

High resolution
(300 DPI)
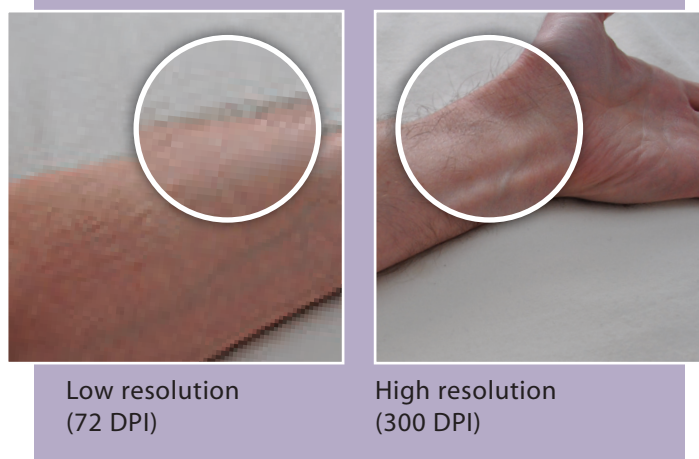
secure and there is a risk of a breach of confidentiality and patient privacy should the camera be stolen or viewed by someone outside the circle of care. Download images to a secure location as soon as possible and delete all images from the camera. If a patient asks to view their photos, be sure only their photos are seen while ensuring the privacy of other patients' images on the camera. Many patients request copies of their own photos; these requests should be treated as per institutional policies for any other part of the chart. An alternative is to offer to take a photo with the patient's own camera while in the home.

Patient photo documentation should be stored and kept using the same medical records policies that are in place for the institution or agency. If no policy exists for the storage of electronic files, it is recommended that these images be stored on a password-protected flash drive in a locked file drawer. Retrieval and transmission of images should be done over a secure network; and any exchange over public or non-secured networks should be encrypted.[14] Check with your email administrator to determine if your email network is secure for this purpose. Encrypting messages protects the privacy of the contents by scrambling the content into ciphered code.[21] It requires that the recipient have a private key that matches the public key used to encrypt the message. This service is normally found in the "options" tab. Instructions for encryption can be provided by email providers.

Conclusion

Clinical digital wound imaging is a home-care practice that holds much promise to improve care outcomes for patients by providing an extra communication tool between collaborating care providers. However, practice in the home environment comes with certain challenges. The tips, techniques and policy considerations presented in this article should facilitate the process of image capture to improve wound management and consultation. Remote consultation policy considerations will be covered in the second of this two-part series. ✋

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A Final Word

To improve your picture-taking skills, read the camera manual, look at online tutorials and practise! The biggest advantage of digital photography over traditional film photography is that, once you own the camera, the photos you take are free. So go crazy; take photos of the same subject and vary every setting and lighting variable possible to discover what works and what doesn't. And try some of the preset modes on your camera if it has them: for example, "landscape" mode sets up your camera with a deep depth of field; "portrait" mode sets up a shallow depth of field; "night" mode keeps the shutter open longer while reducing the flash. You may find using a preset other than "fully automatic" gives you a shortcut to the results you seek. All it takes is a little time and you'll become thoroughly familiar with your camera in the process.

Glossary

Macro

Loosely defined, macro photography refers to extreme close-up photography; it can also refer to photographs that are simply greater than life-size. For the purposes of this article, the term refers to macro settings on your camera that facilitate the taking of photographs at a close distance.

White Balance

White balance is a setting on your camera that compensates for lighting that is coloured slightly and causes a shift in a photo away from true colour. (The colour of the light is technically referred to as colour temperature, and sometimes the terms *white balance* and *colour temperature* are used interchangeably.) For example, incandescent, or tungsten, lighting will cause photos to look distinctly orange or yellow; fluorescent lighting will cause photos to look greenish or bluish. Setting the white balance on your camera will compensate for this colour shift, resulting in truer colours and making photos look more like the real thing.

Flash Ring

A flash ring is a flash unit in the shape of a circular ring that fits around the lens of a camera. Its purpose is to create softer shadows by casting light on the subject from many angles at once.

Focal Plane

Focal plane refers to an area that is the particular distance from the camera lens that appears in focus. Anything lying in the focal plane will appear perfectly sharp in a photo, and anything to the front or rear of the focal plane will appear out of focus, or blurry. The distance between the camera and the focal plane is referred to as the focal length or focal distance.

Depth of Field

The depth of field (DOF) of a photo is the range not in the focal plane (i.e., lies to the front and rear of the focal plane) but still appears *acceptably* sharp in a photo. In other words, a "narrow" (or "shallow") DOF will appear in focus only near the focal plane, with anything in the foreground or background appearing blurry; the farther away from the focal plane, the more blurry things will appear. A "wide" (or "deep") DOF will have a greater distance from the focal plane where objects still look acceptably sharp to the viewer. (Refer to the Focus and Depth of Field sidebar for examples.) For the purposes of wound photography, it will generally be desirable to have as wide a DOF as possible. The DOF is a perceptual characteristic of photographs, and as such there is no precise dimension that defines it.

Encryption, Encrypting

Encrypting is the process of encoding information so that only authorized parties can decode and read the information. Digital photographs are essentially just electronic information and can, therefore, be encrypted. For the purposes of digital wound photography, encryption would be used for the purpose of protecting photo files from unauthorized access while they are archived and during electronic transmission from one user to another.

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