# Patient Exam Cameras

This toolkit looks at devices that serve as handheld examination cameras. Devices included under the broad category of "exam cameras" have a video output that can be routed into either a live videoconferencing or store-and-forward system.

About This Technology – Includes a Technology Overview which explains and examines the various technical aspects of patient exam camera technology. It also contains guidelines for Deploying and Supporting the patient exam cameras that you end up selecting for your Telehealth program. A section on Resources & Standards provides some recognized industry and clinical resources that were utilized while preparing this toolkit.

Assessment Process – Includes a Whitepaper that examines various aspects of patient exam camera performance and various possibilities for patient exam camera configurations that might be applicable to your Telehealth program. The Assessment Guide examines the entire assessment process used by the TTAC while assessing patient exam cameras for this toolkit. In the Product Information section, you can find specific information on each patient exam camera that the TTAC assessed, along with some recorded images and videos in the Sample Media section.

Assessment Results – Compiles the evaluation that we have completed for this toolkit in a Summary. It includes the PowerPoint presentation and Webinar recording that accompanies the 2010 patient exam camera toolkit.

# Patient Exam Cameras – Technology Overview

Video has long been a staple of telehealth systems. General purpose videoconferencing cameras, dedicated specialty scopes, handheld examination cameras, and recorded video files have all been used with great success in telehealth applications. This toolkit looks specifically at devices designed as handheld examination cameras.

Examination cameras extend the view of the telehealth provider: supporting live and still imaging of wounds, dermatological conditions, neurological exams, and a variety of other imaging use cases. The technologies designed to support these processes can vary from simple moderate resolution cameras with a built-in light source, to highly sophisticated multi-function exam tools supporting high resolution imagery and streaming. Understanding the basics of how these devices work, common component

and functions they support, and most importantly the use case these device needs to fill are all key elements in adding exam cameras into your telehealth toolbox.

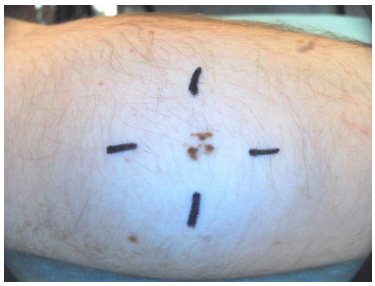
# Exam Camera Basics

## Devices

Devices that are being included under the broad category of "exam cameras" have a video output that can be routed into either a live videoconferencing or store-and-forward system and a form factor that comfortably fits in one hand. Within this larger exam camera group there are two common subgroups, general exam cameras and multi-function exam cameras. We will also discuss the ability to use webcams and smartphones with and without specialized software to perform exam camera functions. Alternatively, Pan-Tilt-Zoom cameras are also discussed for their potential application as a general exam camera.

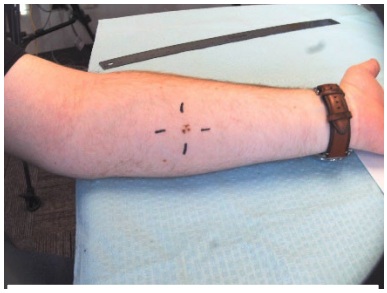
## General Exam Cameras


Devices that fall under the category of patient exam cameras have a few distinct features, including built-in lighting that surrounds the lens, the ability to "freeze" or "pause" the video and a minimalistic interface. Devices may use automatic focus or have controls for adjusting the focus of the image manually. General exam cameras may also feature white balancing, and polarization tools that ensure the image captured is as accurate as possible. Compared to multi-function devices General Exam Cameras are typically less expensive, and easier to use (as they only support one exam mode).



Medium Distance

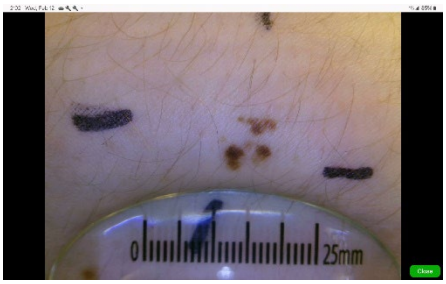
Close



Far

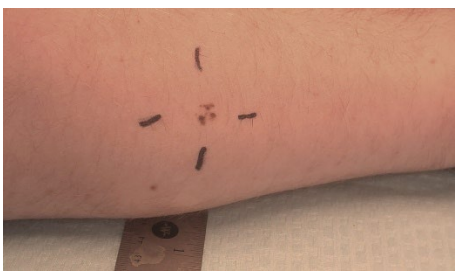
## Multi-Function Exam Cameras

Multi-function Exam Cameras can support a variety of exam types, generally using interchangeable lenses that attach to the main body of the device. The type of exam selected is based on what sort of lens is attached. Common lens types include: dermatology or contact dermatology lens, general exam lens, and otoscope lens (with disposable specula). Other more specialized lenses or attachments can be found as well, including ophthalmology and intraoral attachments. Many of these devices will support more involved controls and settings including light adjustment, polarization, freeze frame, and zoom capabilities. Some devices are designed to be used with a wired connection for power and streaming video, others




Dermatological Exam

Otoscope Exam



General Exam

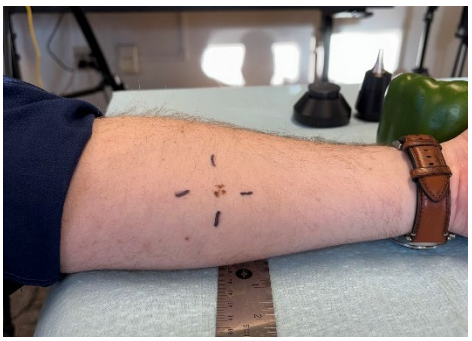
# Mobile Devices (Phone Cameras)

Built-in Mobile Device (Phone and Tablet) Cameras have created access to high-quality, accessible, and easy-to-use cameras that can be used in a variety of locations and situations. In general, smartphones and tablets can provide excellent quality digital images for most use cases.

There are challenges in using mobile phones for clinical imaging, however. Primary among these is the challenges presented when users use personal devices to collect patient images. This can constitute a major violation of patient privacy and confidentiality. These issues can be resolved by using organizationally owned and secured devices, or by using mobile device management software that secures devices, and restricts where patient images can be captured, stored, and transmitted. Either of these solutions will require additional training and programmatic oversight to ensure best practices are being followed.

Other challenges in using mobile devices include challenges around moving images into and out of an Electronic Health Record or other secure storage locations. Variability between devices can also create issues as each brand, and each model within a brand can support different cameras, software, and light sources- creating differences in the captured images. Additionally, most consumer devices will include built-in image filtering that will adjust color quality, saturation, and contrast. These settings can be useful in getting a good personal snapshot but can create inaccurate clinical images if not adjusted.

Overall Mobile Devices can make good exam camera solutions, but additional care needs to be taken to make sure that images are secure, of good quality, and accessible to the reviewing provider.



Far Distance

Medium Distance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## Webcams

For some programs simply using a webcam that can be moved closer to the patient can satisfy the required use case needs. Webcams will generally provide a satisfactory resolution and framerate for clinical imaging, and setup is generally very straightforward and easy to manage through video conferencing or photo software. However, there are considerable drawbacks. Webcams are video streaming cameras and lack controls to assist with focusing and framing the desired subject when being moved. Additionally, while some may, most webcams will not have a light source for illuminating subjects. This in combination with the lack of general one-handed ergonomics (webcams being designed for static mounted use) means that webcams can be used in a pinch but generally should not be the primary clinical imaging devices for most telehealth applications.

## PTZ Cameras


Pan-Tilt-Zoom cameras offer a way to capture stable, clear, and highly detailed images by moving the camera lens on a motorized gimbal mount. Adjustment to the camera viewing angle can be done using a physical device remote or camera control software. A local (or remote) provider can move the image left or right (Pan), up or down (Tilt), or closer or further from the subject (Zoom). Because the camera itself does not need to be touched, this can provide a very stable imaging platform for high-detail video or captured images. Most PTZ will support some level of digital or optical zoom, allowing closer observation of the targeted physical feature. While PTZ units still tend to be significantly more expensive than their webcam counterparts, prices continue to come down for these devices, and their stability and flexibility make them valuable imaging platforms.

# Video Technology

The following section discusses some key distinguishing features that need to be considered when reviewing and selecting an exam camera. While by no means a complete list this section should help you navigate the differences between different brands, models, and types of exam camera units.

## Resolution

A measure of the quality, size, and detail level of an image resolution is the number of pixels an image contains. The number of pixels that make up a digital will range from hundreds of thousands to tens of millions of pixels. Rather than provide the total pixel count, most resolution standards focus on the number of pixels in width and height an image has. Below is a list of some common resolution sizes.

Standard Definition (SD): 720 x 480 pixels
High Definition (HD): 1920 x 1080 pixels
Ultra-High Definition (UHD): 3840 x 2160 pixels (4k) or
8K Ultra High Definition: 7680 x 4320 (7680 x 4320)

When considering resolution, it is important to realize that resolution needs to be considered not only for the camera, but also for the screen that the camera image will be displayed on as well as the streaming capability of whatever software is transmitting the image or video. For example, if an Ultra High Definition (UHD) image is displayed on a High Definition (HD) screen the image will be displayed in HD as that is what the screen can support.

It can be useful to have higher-resolution cameras to support digital zoom. When zooming into a digital image you are effectively reducing the number of pixels being displayed. A higher resolution allows more zooming to occur before the image begins to lose clarity and detail.

## Frame Rate

Videos consist of still images played back at a high rate. The eye interprets the rapidly changing snapshots as motion. Many devices support recording and replaying content at a range of speeds, with standard offerings being 30 and 60 frames per second (fps). Most video platforms and displays will support up to 60 fps but may reduce this rate (and resolution) if bandwidth is low. Higher frame rate video will seem smoother to the viewer movements will seem more natural and lifelike. Like resolution, camera frame rate can be limited by the screens and software the video signal will be sent through.

## Color Accuracy and White Balance

Special care should be taken to ensure the accuracy of the colors captured by imaging devices is of particular importance in exam cameras. The nature and quality of the ambient light in the exam space can significantly impact the ability to collect good images. For Dermatology, Wound Care, and Oral images color accuracy is highly important as images that appear overly red, or blue can result in poor clinical decision-making. For example, if a camera is inaccurately over-representing red in a dermatology image the provider may assume inflammation or irritation to the skin that isn't present. Worse yet, an overly blue image may cause the provider to miss redness/discoloration, make the skin appear sickly or to look as if it is suffering from poor circulation.
Most exam camera devices will support an ability to correct or balance the color using either an automatic or manual White Balance processes. White balance is the process of setting a white color value that the device can use as a starting point for representing other colors.

### *Automatic White Balance*

Automatic white balancing uses software in the device to attempt to correct inaccurate colors. If you are using an exam device and the color shifts suddenly, this is likely the automatic white balancing adjusting the image. There can be a high amount of variability in the quality and speed of automatic white-balancing features.

### *Manual White Balance*

Manual white balance, as the name suggests, is a more user-driven process. The camera operator selects a white sample (often a sheet of non-glossy white paper) and the camera uses this white value to adjust internal color values. Manual white balance needs

to be completed often, adding extra steps, but can be highly accurate, providing confidence on how image colors are being reproduced.

### *Other Considerations*

The quality of the camera light source and the ambient lighting in the exam space are both key factors in accurate color capture. Taking steps to ensure exam spaces have adequate ambient light quality is important. Equally important is to ensure that that users are aware of how to adjust camera light sources on the specific exam device.

Very Under Lit | Under Lit | Well Lit | Overexposed

## Controls and One-Handed Usability

Most exam cameras are designed to be used by a trained user using a single gloved hand leaving the other hand free to interact with the patient. The ability to comfortably, accurately, and quickly perform key device functions are key to the usability of the device. Some key elements to consider when looking at usability include:

- Layout and quality of controls
- Comfort of device use for users with larger or smaller hands
- Easy to read status indicators (like battery charge, or brightness settings)

There is no substitute for having end users get hands on time with these exam devices. Collecting this sort of feedback early in the device selection process can help ensure that the selected device works in the desired way and gets frequent and effective use.

# Use Cases

## Videoconferencing

Patient exam cameras can be useful as video inputs in video conferencing software, allowing for a real-time exam that moves the camera around a patient, as opposed to moving the patient around in front of a fixed webcam or other video source. Most exam

cameras will support USB based Universal Video Camera (UVC) standards, allowing them to function as a webcam. This means that selecting the exam camera in a live video visit can be as straightforward as switching the camera video feed in the videoconferencing software.

## Store-and-Forward

While not as common as live video, asynchronous or Store-and Forward telehealth systems are still widely used particularly in specialty consultations. The ability to capture still images and forward them to a consulting provider can be an efficient way to deliver care. Cameras with on-board storage can make this process more straightforward as images can be taken from the device and uploaded into an Electronic Health Record, or secure Telehealth software. In contrast, streaming cameras will require software to take a still image from the video stream.

Improvements in smart phone and tablet technologies have allowed these common devices to become viable platforms for to capture and send still images. It should be noted that these devices will lack many key exam camera functions, like single hand use, adjustable light source, and controls for white balance and focus. Care must also be taken to ensure that the images stay secure, and the use of unsecured personal devices for capturing and transmitting patient images is never recommended.

## Conclusion

Exam cameras are often one of the first solutions selected by programs seeking to expand telehealth services beyond general videoconferencing. Being able to extend the remote providers ability to see the patient in detail is an important ability. With each device there are costs and benefits; deciding on which device to implement depends on an organization's needs, users, and personal assessment of the quality and functionality of the various devices. For more information on how to evaluate telehealth technology see our Technology Assessment 101 toolkit here: Click here