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Telemedicine Room Design

PROGRAM GUIDE

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Program Guide

A Publication of:

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Introduction

Room design impacts the quality of the telemedicine services and should not be overlooked during the development of a telemedicine program. Good telemedicine room design will accomplish two major functions: it will create the visual and audio clarity and accuracy that is necessary to support clinical examination and diagnosis from a distance and a connection between the patient and the remote provider sites where the patient-clinician interaction, not the technology, is the focal point.

This document provides practical information and advice on the major components that need to be addressed in designing a telemedicine room. It will assist in selecting the best room for providing telemedicine services and identifying modifications that need to be made in the selected room. This guide includes a template that can be used in assessing the design of your telemedicine room. While the guide focuses on patient examination rooms, the same fundamentals apply to remote clinician rooms. A companion video is available at www.CTEConline.org.

Design Considerations

The challenge in creating a telemedicine room is to integrate the technology into the regular flow of an examination and to reproduce the images at the consulting clinician site with clarity and accuracy. There are a number of aspects to consider when designing a telemedicine exam room. The most important design considerations are:

- Room Location
- Room Size
- Placement of Equipment and Furniture
- Electrical and Telecommunications Connections
- Lighting
- Acoustics
- Wall Color

Since most patient sites will be adapting an existing room for telemedicine, it is important to select the best possible fit and to budget, if necessary, for room modifications.

Room Location

The telemedicine room should be in a quiet location, minimizing exposure to office noise, busy corridors, stairwells, parking lots, waiting rooms, restrooms or other sources of noise. Such noise can be picked up by microphones which can make it difficult for the remote site to hear. Rooms without windows are better for quality image transmission. Rooms with windows should have shades or blinds to reduce the light and glare.

Room Size

While there are no specific room size requirements, the optimal room size depends on the service being provided, as well as the type and size of the equipment in use. For example, clinical or patient education programs will require conference seating for many participants while specialty consultations will require examination tables and room for only a few people.

Telemedicine Patient Examination Room: A telemedicine exam room should be large enough to move around and work with patients comfortably. It should be large enough to accommodate an examination table, a couple of chairs, the telemedicine equipment, the patient, and the patient presenter. The patient should be able to sit in a chair as well as use the examination table; both should be within the cameras view. There should be enough room to easily use the telemedicine scopes and for the patient presenter to move around the patient during the examination. Most exam rooms should also contain a work surface for charting, a phone, a computer and when necessary, a fax machine available nearby.

The size of the room also impacts the camera viewing area. The distance between walls will determine the proximity of the camera and microphone to the patient. Ideally, the telemedicine camera should be located 6 - 8 feet from the patient. The camera needs to be able to pan out to a full view of the room with the patient and the patient presenter in the picture, and zoom in to have close-up views of the patient. A small room forces the camera to be located too close to the patient, limiting the consulting clinician's view.

Remote Clinician's Consultation Room: The remote clinician also needs to consider room design. The room design factors that impact a patient exam room generally impact the remote clinician's site as well. Room size can be smaller for a remote clinician site since the patient exam table is not necessary. They also need to consider the camera viewing area and angle of the camera, which is discussed under the Equipment Placement Section.

Clinical Education Rooms: Many telemedicine programs offer clinical education programs for clinicians or for patients. A well designed education room would follow guidelines for classroom development, which would include writing tables for attendees, lecterns, and white boards for the walls. From a videoconferencing perspective, the challenges are adequate audio feeds, camera coverage, and size of the viewing monitor. Many patient sites use the patient examination room to view clinician education programs. While this may be a necessity if a unit cannot be moved to a conference room, attendees may find this uncomfortable and it can impact the overall acceptance of the technology. Some programs install lines in both an examination room and a conference room to facilitate education programs. The small screen commonly used in an exam room may not be appropriate for viewing in a conference room. Early planning and budgeting can result in solutions that accommodate both needs.

Equipment Placement

Once an appropriate room has been located it will need to be evaluated for placement of the telemedicine equipment. The goal of placement is to optimize the camera's view of the patient, to allow staff to enter and exit without interrupting the visit, and to allow the presenter to easily use the scopes and peripherals. As you begin to consider placement of equipment, it may be helpful to create a drawing of the room with doors, windows, electrical outlets, and existing telecommunication connections.

Positioning the Exam Table: The camera and exam table should be positioned so the patient presenter can see both the patient and the monitor when using scopes that transmit images to the remote clinician site. There should be a place for a chair which is often used for the patient at the beginning and end of the visit. A second chair should be available, should a family member be in attendance during the visit.

The exam table or patient chair should not be placed in front of a window because backlighting can degrade the patient image at the remote clinician site. Shades or blinds generally can not reduce backlighting enough to be acceptable. The remote clinician should also not be placed in front of a window unless the backlighting can be adequately addressed to allow the patient a clear view of the clinican.

Clean and Uncluttered

An uncluttered background optimizes camera function and improves the view at the remote site. Wires, telephones, fax machines, monitors, computers, peripheral equipment and furniture can contribute to a cluttered and inefficient workspace. Make an effort to arrange and store them in an organized, efficient way.

Positioning the Camera: Cameras need to be placed so that both participants are looking directly at each other during a video call. If the camera is placed too close to the participant or mounted too high above the monitor, the person appears to be looking down at the monitor rather than directly at the remote participant, as shown in Figure A. This can occur at either the patient or the remote clinician side of the connection. The remote clinician site needs to be particularly aware of this affect when using a desktop computer with a camera mounted on top of the monitor. The distance can be too short resulting in the clinician looking down all the time. Correct camera positioning is shown below in Figure A.

Figure A: Impact of Camera Placement

Even though the patient is looking directly at the consultant, it does not appear that way because the camera is mounted too high. Mounting the camera too high makes it difficult for the consultant and patient to maintain eye contact.

When the camera is mounted at approximately the same height as the patient it produces a more precise view of the patient, allowing the patient and consultant to make eye contact.

Electrical and Telecom Outlets: Telecommunications and electrical outlets should be installed or expanded based on the best location for the exam table and telemedicine unit. Locating the telecommunications outlets near the unit will avoid long runs of cable on the floor. Depending on the complexity of equipment multiple outlets may be required for your equipment. Generally, a standard 120v outlet with a surge protector is appropriate for telemedicine equipment.

Lighting

Lighting is perhaps the most critical factor in designing a telemedicine examination room. Lighting impacts the clinician's ability to see the patient clearly with true color reproduction, which is critical for patient evaluation. The goal of lighting is to create images that have even lighting and accurately reproduce colors - where the images are not too dark, and do not have shadows.

Telemedicine programs sometimes fail to fully address lighting requirements assuming the camera will be able to correct for any lighting problems. The telemedicine camera alone will not be able to compensate for poor lighting systems. In fact, good lighting will dramatically improve image quality even when using less expensive cameras.

Optimal Lighting

Optimal lighting is a diffused light source that does not create shadows and depicts colors accurately.

Ideally, the telemedicine examination room will have both direct and indirect lighting. A good source of diffused light is needed in front of the patient shining diagonally toward the patient. Placing a light source in front of the patient reduces shadows that occur on the face if only overhead lighting is used or if there is a light source behind the patient. Spotlights or harsh directional lighting can create unwanted shadows, as shown in below Figure B.

Lighting Fundamentals

- Use diffused soft light falling in front of the patient
- Avoid backlighting from windows or overhead lights
- Avoid harsh lighting sources
- Consider full spectrum lighting
- Use supplemental lighting when necessary

Windows or other light sources behind the patient can cause deep shadows on the face that interferes with clinical evaluation as shown above in Figure C.

Figure B: Impact of Harsh Directional Lighting

Harsh directional lighting creates shadows and makes it difficult to see facial features.

Diffused lighting creates even lighting.

Figure C: Impact of Backlighting

Backlighting from windows and other concentrated light sources can create dark images and shadows.

Diffused light placed in front of the patient allows for a more accurate depiction of the colors and features in the image.

Most patient examination rooms have overhead fluorescent lighting as the standard lighting configuration. Fluorescent overhead lighting alone may not provide optimal lighting for telemedicine clinical visits. They can provide excellent diffused light if the tubes can be placed in front of the patient. An additional source of light may be needed because fluorescent lighting can create washed out images. Full spectrum fluorescent light tubes can also be purchased to support accurate color transmission.

Special lighting needs should also be considered to assure that images have adequate color reproduction, contrast, and definition. Dermatology, in particular, requires accurate color reproduction which may not be achieved when relying solely on ceiling mounted fluorescent lighting, as shown below in Figure D. A supplemental light source may be necessary to obtain accurate color reproduction. The image on the right of Figure D shows the same subject with additional lighting from a supplemental light source. (Please note that color accuracy is also affected by the white balance of the camera or peripheral scopes.)

Figure D: Impact of Supplemental Lighting

Images taken using only ceiling-mounted fluorescent light fixtures can lack dimension and contrast.

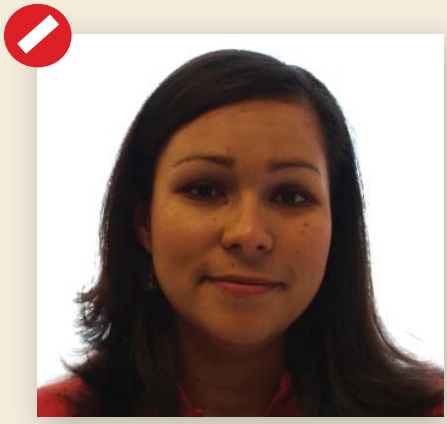
Supplemental lighting enables the subject in the image to stand out against the background.

Wall color

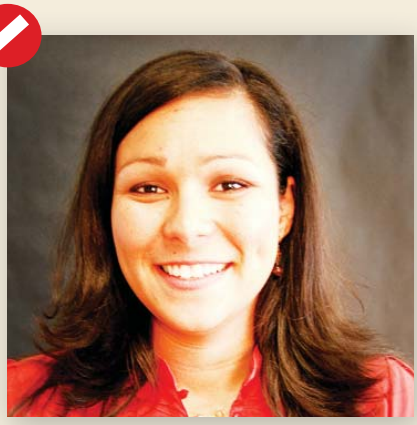
Wall color also impacts how patients look on video. White or light walls can darken faces, making features hard to see at the remote site. A dark wall color can lighten faces. This occurs because automatic aperture settings on video and still cameras react to the wall color. If the wall is light, the camera lets in less light resulting in darkened faces. If the wall is dark, the camera lets in more light making the faces become washed out or too light. Use flat paint to avoid any reflection off the wall. Figure E demonstrates the difference between light and dark-colored backgrounds.

As illustrated in Figure F, a robin's egg blue or light gray background works well on all skin tones. It can be very helpful to test the selected color before painting the entire wall. Different lighting conditions will affect the shade of the color. Seeing the color on the remote end can help select the color that best suits the room. It is not necessary to paint the entire room the selected color. It can be limited to the walls that will be the backdrop for the camera views. This may include more that one wall depending on the configuration of the room.

Figure E: Impact of Wall Color

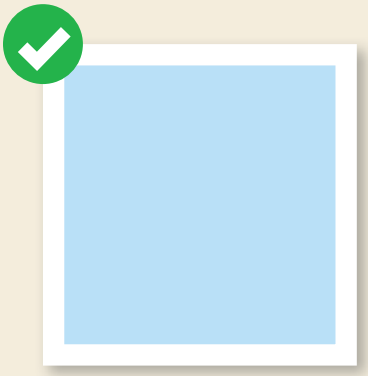


A light-colored background makes the image appear too dark.

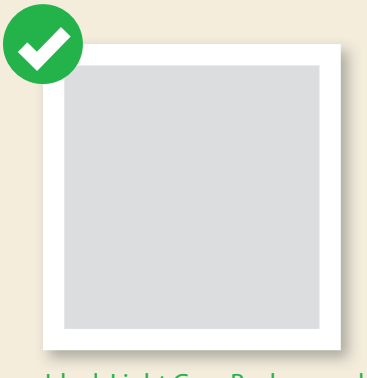


A dark-colored background makes the image appear washed out or too light.

Figure F: Ideal Wall Colors



Ideal: Light Blues



Ideal: Light Grey Background

Acoustics

Good acoustics design is also important to consider. Rooms that echo make conversation between the patient and remote clinician difficult. High ceilings and hard surfaces on floors and walls can create poor acoustics as can noises from facility mechanics and external sources. Installing materials that absorb or dampen sound will improve the acoustics of the room. Sound dampening is usually achieved by installing carpeting, drapes, tiles or paint. Since a clinic setting does not lend itself to carpeting or drapes, acoustic tiles can be installed on the ceiling or around the top of the walls.

Sound dampening wall paint is also available. Be sure to check on any facility licensing requirements before selecting a sound dampening solution. The remote clinician's room may be able to use carpeting and drapes if the room is not used for patient examinations.

It is important to consider the amount of outside noise when selecting a room because it can be difficult to reduce the level of noise that enters the room and it can become disruptive to patient visits. Unwanted noise from within the room often is the result of fans used to keep the telemedicine equipment cool. Fan noise can be reduced by installing the equipment inside a cart or case; however, any case needs to assure proper air flow or the equipment can overheat and be damaged.

Mobile Considerations

Telemedicine mobile units are becoming increasingly popular for disaster response and mobile clinics to reach migrant or remote populations. When setting up a mobile telehealth vehicle, be sure to consider the same key areas discussed for room design. Placement of equipment, lighting, and acoustics become an even bigger issue when your patient site has to be changed or moved regularly. Some mobile progrmas do not have a telehealth equiped vehicle and move equipment from loction to location, setting up upon arrival. Consider using the checklist in this guide each time the site is set up to ensure the success of the consultation. It may also be helpful to use one or two standard floor configurations for setup.

Telemedicine Room Assessment and Design Worksheet

Type of Telemedicine Room: ❒ Patient exam ❒ Remote clinician ❒ Education / classroom

What type of clinical services will be provided: _____

_____

Are there any special spaces or lighting considerations related to the services: _____

_____

Name of room selected for assessment: _____

Room Location:

Yes	No	
❒	❒	Quiet
❒	❒	Easily accessible
❒	❒	Minimal exposure to office and outside noise
❒	❒	Close to regular clinic operations

Room Size:

Identify the equipment that will be needed in this room.

- ❒ Telemedicine unit - specify size:_____
- ❒ Exam table
- ❒ Patient chair
- ❒ Other chairs – number:_____
- ❒ Work table
- ❒ Desk
- ❒ Computer
- ❒ Specialized lighting – specify type: _____
- ❒ Peripheral equipment
- ❒ Telephone
- ❒ Fax machine
- ❒ How many people does the room need to accommodate:_____

Yes	No	
❒	❒	Room is large enough to accommodate needed equipment with adequate room for the patient presenter to comfortably move around

Equipment Placement:

Yes	No	
❒	❒	Placement of plugs and lines will not interfere with movement or create hazard
❒	❒	Camera can be placed to provide full view of patient
❒	❒	Camera can be placed to create eye to eye contact
❒	❒	Scopes and peripherals can be easily assessable

Modifications that will be required: _____

_____

_____

_____

Estimated cost of modifications: _____

_____

_____

_____

Lighting:

Yes	No	
❒	❒	No windows in the room
❒	❒	If the room has windows, can shades or blinds mitigate impact of lighting
❒	❒	If the room has windows, can the exam table be placed to avoid backlighting
❒	❒	Lighting provides adequate direct and indirect lighting
❒	❒	Direct light source shines diagonally toward the patient
❒	❒	Supplemental lighting adequate
❒	❒	Full Spectrum light blubs are needed

Modifications that will be required: _____

_____

Estimated cost of modifications: _____

Room Color:

Yes	No	
❒	❒	Paint color is appropriate for telemedicine
❒	❒	Paint finish is flat

Modifications that will be required: _____

_____

Estimated cost of modifications: _____

Acoustics:

Yes	No	
❒	❒	Room has minimal outside noise
❒	❒	Room does not echo
❒	❒	Equipment noise levels are minimal
❒	❒	Facility license requirements allow modifications

Modifications that will be required: _____

_____

Estimated cost of modifications: _____

Clean and Uncluttered Room:

Yes	No	
❒	❒	Area is clear of clutter

Total estimated cost for room modifications: _____

About the Author

Christine Martin, MBA, PMP, MT, is the Executive Director of the California Telemedicine and eHealth Center (CTEC), the HRSA designated Western Regional Telehealth Resource Center. Ms. Martin has over 15 years experience developing and operating telehealth programs including 11 years developing and operating the Telemedicine Services Program for the California Department of Corrections and Rehabilitation.

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