

► Telemedicine room design

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Summary

Proper design of rooms for telemedicine store-and-forward and realtime interactive consultations is critical. The challenge is to incorporate communication technology into medical practice to facilitate efficient communication and effective patient care. If this is done properly, the technology becomes unnoticeable to those involved in the telemedicine interaction. This article describes some of the steps that can be taken in a telemedicine room design to achieve this goal. Room location, treatments, background, lighting, power and telecommunications aspects are reviewed. Although every room design will have its own unique challenges, adhering to these basic principles will provide an excellent foundation to begin with.

Introduction

This article provides some basic guidelines for designing and setting up a room for the practice of telemedicine. The design principles apply for both prerecorded (i.e. store-and-forward) and realtime (i.e. interactive) applications. Telemedicine facility design basically involves building small television studios in a clinical setting. The aim is to create a functional, yet comfortable, space for both the clinician and patient. Professional TV work uses special effects to create a mood or communicate information, whereas telemedicine uses these techniques to communicate medically accurate information.

There are several factors that influence the design of the space used for telemedicine. The location of the room can be critical, but its size and furnishing can be more important. Bigger is definitely better and a large room is necessary when providing both clinical and educational applications. The types of clinical services being offered can dictate the size of the space as well as its location within the health-care facility, so it is important to let the function help guide the design. Several room treatments should be performed before

any telemedicine equipment is installed in order to prevent possible problems when using microphones (e.g. echo) and cameras (e.g. glare and reflections) in a clinical setting.

Location

Location is everything in real estate. This is also true in telemedicine. The location of the room can be the key to success for the clinical services being offered. One of the most successful telemedicine sites in the Arizona Telemedicine Program (ATP) is the Tuba City Regional Health Care Corporation in Tuba City, Arizona. The telemedicine room here is located in a walk-in clinic that is centrally located for all patients and clinicians, making it easy to walk there from any office or central check-in desk. There are other ATP sites that have the telemedicine equipment located in their only conference room, which is situated away from the main patient visitation areas and examination rooms. Such rooms are not easy to get to for either the clinician or the patient, and are often not available because of meetings being held there. This means that the equipment is not accessible or used very often. Any room identified as a telemedicine clinic needs to be in a suitable location and to be accessible for both the patient and the health-care provider.¹ Ideally, it should be designated specifically for telemedicine so that it will always be available when needed.

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Clinical applications

It is important to decide what specialty consultations or services will be provided when determining how the space will be designated for telemedicine use. In other words, how many computers and how much telemedicine equipment will fit into one small clinic room? Telemedicine clinic rooms need to be versatile enough to be set up and re-set for specific clinics. For example, if only store-and-forward teledermatology services are going to be offered, the patient room does not have to be very large. However, in a paediatric orthopaedic videoconference to fit a child with a new prosthesis, it may be necessary to empty the patient telemedicine room except for the trolley and a chair or two for family members. Since it is an orthopaedic clinic, it will probably be necessary to perform gait studies and therefore enough space is needed for the patient to take 8–10 steps. Thus, the telemedicine room must have about 5 m of unimpeded walking space. If the telemedicine room is only 3 m × 4 m, then a gait study may need to be done by walking up and down the hall outside the telemedicine clinic room. Long camera and microphone cables help with this, but clearing the hallway of other pedestrian traffic may present a problem. All distractions need to be eliminated in order to communicate clearly with the specialist. The key is to understand the space and location requirements *before* starting clinical services, rather than realizing halfway through a consultation that there is not enough room to carry out the required parts of the examination.

Clinic rooms for telemedicine applications can be used for both sending and receiving information. The videoconferencing display equipment can be the same to accomplish both tasks. Specialists interviewing patients in a videoconference session may want a large 81 cm monitor to improve their view of the patient. The clinician who is presenting the patient may need or want a smaller monitor if space is severely limited, although it should still be big enough to be seen clearly from about 2 m away.

There are no standards regarding display requirements for realtime interactive telemedicine. The ordinary cathode ray tube (CRT) display will suffice, but liquid crystal displays (LCDs) save space, although they are more expensive at present. Most commercially available monitors will have sufficient spatial resolution (1600 × 2100 pixels; 32-bit), contrast resolution (many monitors exceed 1000:1) and colour fidelity to be used in most settings.² Monitors should be calibrated regularly. The GretagMacbeth ColorChecker Chart is available as a jpeg image file for installation on the computer driving the display. For realtime

videoconferencing, the originating site should point the camera at the chart. The persons at the receiving site can tune their monitor by comparing the displayed image with a physical copy of the chart. This is a simple and effective technique that does not require technical skills or knowledge.²

In terms of the videoconferencing unit, there are usually several video inputs that can be used to connect almost any medical device that has a video output. It is preferable to connect devices using S-video leads rather than composite video leads, if possible.³ The crux is whether or not the specialist at the consulting end considers the quality of the image to be diagnostic.

In many cases, telemedicine rooms take over space that was once used for something else. For example, at the St Elizabeth's of Hungary Clinic in Tucson, Arizona, a relatively small biohazard waste closet was turned into a telemedicine room (see Figure 1 a and b). Physicians, nutrition counsellors (see Figure 2) and nurses all come here to videoconference with their patients. It has made a rather cosy telemedicine suite, but they look good on video to their patients and that is what matters most.

Ideally, when a clinic room is designated as a telemedicine suite, there will be room to expand. Success means more specialty services, which therefore require more space for equipment. If resources are available, a second room can be designated for telemedicine or educational applications. Ideally, one would want to keep separate the spaces used for clinical versus educational applications and administrative meetings. The ATP offers a wide variety of interactive educational opportunities for clinicians via videoconference. Often, these are offered at lunchtime with topics relevant to the clinic that afternoon. Space is needed for clinicians to relax, eat and enjoy the educational programme during their lunch hour. A telemedicine room with sufficient space for educational programme viewing, from Douglas, Arizona, is shown in Figure 3. The room is approximately 4 m wide × 5 m deep. The front one-third of the space is used for clinical consultations and the rest of the room provides space for rows of chairs for the educational programmes. Combining clinical services with education in the same room works very well at this location.

Room treatments

Regardless of the space which is available, it can usually be improved for telemedicine purposes, with relatively inexpensive room treatments. There are some basic production elements that can make or break

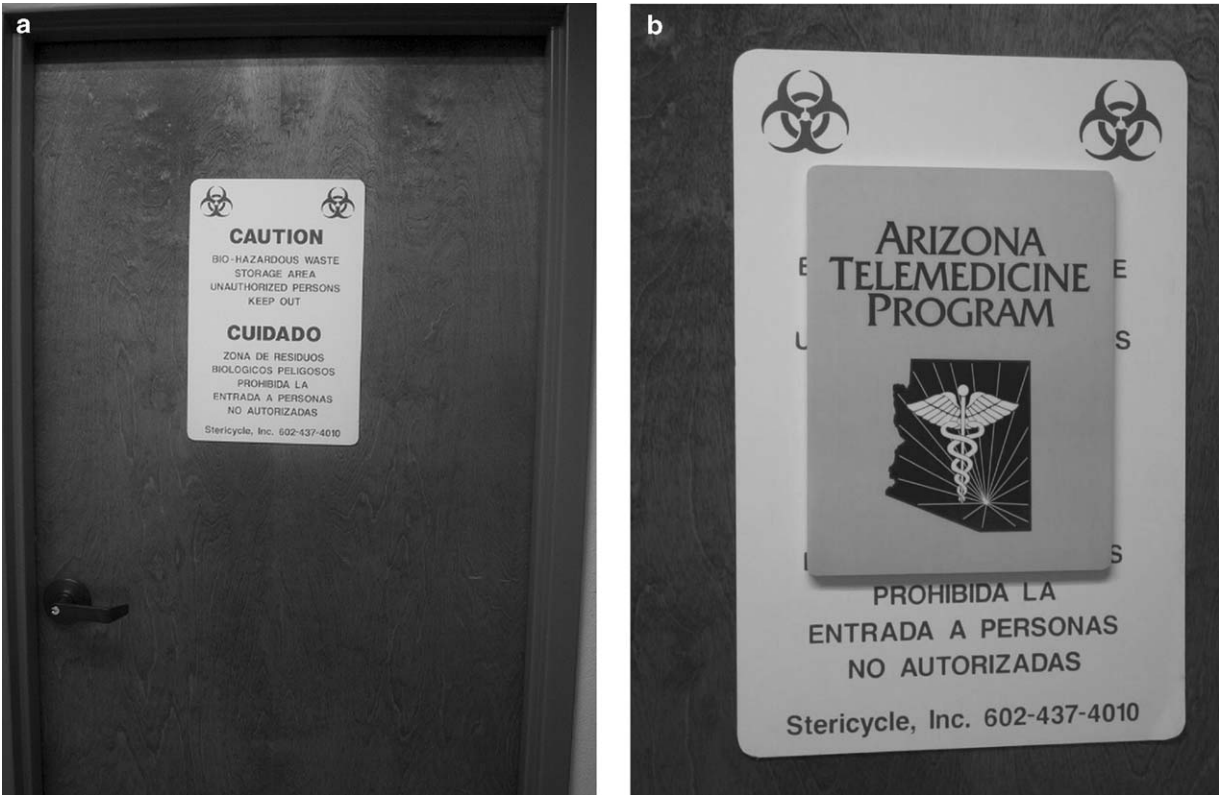


Figure 1 (a) The room chosen for telemedicine at the St Elizabeth's of Hungary Clinic in Tucson, Arizona, prior to renovation was a biohazard waste room. (b) After the renovation, signs of its previous use were still evident



Figure 2 The nutrition specialist at the St Elizabeth's of Hungary Clinic in Tucson, Arizona, giving a lecture from the telemedicine room. Note the relatively small workspace she has available



Figure 3 A typical telemedicine room used for clinical videoconferencing, store-and-forward applications, educational broadcasts and administrative meetings

conversations and consultations via videoconference. One is the colour of the room. The first telemedicine equipment installed by the ATP in Tuba City, Arizona, was in a room that had been painted a striking shade of pumpkin-orange. This did not photograph well and typically distorted the skin colour of those being

photographed with it as the backdrop. Room colour can make a dramatic difference to the quality of the video or digital images. Light blue looks excellent on video and can provide the perfect background for taking digital images for store-and-forward applications such as teledermatology. The ATP has successfully



Figure 4 A typical telemedicine room showing a clinician with the site identification sign behind him

convinced the relevant authorities that a light blue colour should be used for the walls in their telemedicine rooms. The biggest challenge in fulfilling our request has been to obtain a matt paint. Institutions prefer semi-gloss paint because of its shine and ease of cleaning, but cameras do not, because of the inherent glare.

Background

The background in a telemedicine room can potentially make or break the conversation and interaction between a clinician and a patient. Imagine that you are a patient in a gown talking to a specialist via video. You notice that there is a door behind the specialist. Who is going to walk through that door? Maybe no one, but as you sit there half-naked you may find it difficult to stop thinking about it and it could detract significantly from the interaction and trust between you and the specialist. The job of telemedicine staff is to use technology to facilitate a productive conversation between a clinician and a patient. This means paying particular attention to video production details like the background. The ATP protocol is to include a sign with the name of the site in the background of all patient and consulting sites (see Figure 4). This helps keep everyone oriented since a specialist may see patients at several sites within a single scheduled clinic. It is also very helpful for the patients and the clinicians, and assists the conversation flow.

Audio

Audio is very important in telemedicine,⁴ particularly with regard to patient confidentiality. Proper

placement and use of the microphone requires continuing staff training. It is useful to have the ability to turn the microphone on or off. Paying particular attention to audio will prevent any unintentional broadcasting of personal phone calls or patient information. The quality of the audio can make or break the conversation. One can eliminate a lot of echo and increase the quality of the audio simply by carpeting the clinic room. However, you need to consider what the camera will potentially see with regard to the colour and pattern of the carpet. Light blue or grey without an ornate pattern is best. If the walls are bare and made of a hard material (e.g. bare concrete or plaster), it is advisable to cover them with a sound-dampening material such as acoustic material, corkboard or even a thick curtain material. Note that any wall coverings or curtains will need to comply with local fire regulations.

Lights

Another critical component of successful telemedicine is the lighting.⁵ It is important that the lighting be even and consistent in terms of colour temperature. It is easy to colour-correct any existing light fittings to warm, white light (3200–4000 K). To ensure the light is evenly distributed throughout the room, the existing lighting should be supplemented with standard fluorescent fixtures if possible. This is most important for dermatology and other specialties where colour information is likely to affect diagnostic accuracy. It is important not to create unwanted special effects with the colour or angle of the lighting fixtures.

Power and telecommunications

Any room designed for telemedicine must have sufficient electrical power, including emergency back-up power for services involving videoconferencing. Computer network connections will be required to both the telemedicine network and the in-house network and patient database. There also needs to be an in-house telephone line that may be part of the internal PBX (n.b. it is often helpful to have a telephone with a silent ring, e.g. a lamp, to announce incoming calls). A telemedicine clinical room also requires at least one direct telephone line to the room for technical support, and a fax machine to support telemedicine telecommunications. These services enhance the efficient flow of information within a

health-care facility as well as among providers in multiple locations.

Conclusion

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In telemedicine room design, the challenge is to incorporate communication technology into medical practice to facilitate efficient communication. If this is done properly, the technology becomes unnoticeable to those involved in the telemedicine interaction.

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