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# Project Final Report:

# *Providing Accessible Radiological Services to Underserved Pediatric Populations o*f rural Georgia

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## Overview

Access to quality healthcare in rural Georgia is limited by a variety of factors. Rural Georgia faces several issues common to rural areas throughout the world. Lack of access is caused by a variety of constraints including cost of health care, distance to providers, lack of primary and specialty providers, as well as lack of access to high cost care.

## Problem

What is the design of the "hub-and-spoke" model that will allow Children's Healthcare to leverage and extend its existing capacities through authentic telemedicine encounters to provide advanced specialty health-care and radiology services to rural pediatric populations in a fiscally sustainable manner?

Access to specialty pediatric care is limited in rural Georgia due to distance and cost limitations. Underserved pediatric areas in rural Georgia are primarily limited by lack of providers rather than lack of health coverage due to federal and state systems that ensure access to insurance through PeachCare for children. Previous attempts at providing access to specialty services has been limited by the financial and fiscal support available to rural faculties due to small catchment area.

Pediatric specialty care is both specialized and expensive due to the high costs of specialized pediatric medical equipment as well as costs to maintain a suitably trained staff. These constraints are particularly pronounced when considering radiology services. It has been difficult to attract providers to rural areas because they are unable to recoup their high costs of education and find the necessary population of patients.

While quality specialized medical care is often expensive in the short term, long term costs to the health care system are recouped by providing less expensive care earlier in the care cycle, identifying disease at earlier points in the disease progression, and limiting emergency care usage. Preventive care as well as accessible specialized care requires a strategic shift in how health care is provided but also offers substantial long term savings.

## Goals

One of the major challenges to providing rural care is how to structure the system both in terms of hard physical locations and staffing types to ensure financial success. By utilizing research regarding staffing policies, the patient volume necessary to breakeven per machine type, and physical structures that create authentic tele-health experiences we will be able to make recommendations regarding the physical space that will house the distributed health system.

Our research gathers the evidence based design criteria that will assist designers in creating a system that addresses the need for radiological services in rural Georgia.

Specifically we look into:

- Functional considerations of physical space designed to improve pediatric outcomes and satisfaction in tele-health and radiology environments

- Ergonomic considerations for pediatric populations receiving radiological and specialty care
- Demographic and sociological factors that go into choosing the proper location.
- Epidemiological considerations for the location of specific types of tests
- The existing radiological services available to pediatric populations
- The proper distribution patterns for radiological services given the demographics of rural Georgia
- Fiscal demands of the proposed testing sites.

### Solution Overview

Herein we propose a hub-and-spoke model for providing pediatric radiology services to Georgia's rural population. To accomplish this in a fiscally sustainable manner we propose using tele-radiology to decrease the overall staffing costs due to radiologists, while managing a group of mobile technicians trained by Children's to maintain the service level and quality. Tele radiology, a subset of telemedicine, generally is associated with the projection of digital imaging scans to radiologist at a remote location. We propose partnering with local institutions to provide a sustainable catchment area of patients and choose a location that does not have competitor pediatric radiology services, while simultaneously having the largest population that lacks access due to geographic location. Rehabilitated big box locations are chosen to minimize overall structural costs though we accept that radiology services have high set up costs both to establish the correct physical plant as well as purchase necessary equipment.

### Pediatric Radiology Overview

Providing pediatric radiology services is both expensive and specialized. Pediatric care in general is practiced by specialized providers who have specific subject area knowledge on the proper treatment of children. Pediatric family centered care involves taking into consideration the specific needs of pediatric patients and families when compared to adult patients. Research shows that pediatric patient care providers have a number of important additional care concerns including but not limited to potential signs of child abuse(Flaherty et al., 2014) and the effects of care and access on academic performance(Mouradian, Wehr, & Crall, 2000). While patients can be treated by providers without pediatric specialization, additional pediatric subject knowledge has the potential for add on value for patients.

Radiologists, who are trained in the specific considerations that should be afforded pediatric patients, provide additional add on value for patients in a number of ways. Research shows that radiology use creates a cancer risk that is higher than baseline (Berrington de González, Mahesh, Kim, & et al., 2009; Smith-Bindman et al., 2009). This risk is even more pronounced in pediatric patients because of an increased sensitivity to radiation (Brenner, 2002; Frush, Donnelly, & Rosen, 2003; Hall, 2002; Mathews et al., 2013). The associated risks of radiology practice for pediatric populations are balanced best by minimizing the dosage of radiation when possible and limiting tests to those that are clinically necessary, a task best accomplished by specially trained staff (Donnelly et al., 2001; Linet, pyo Kim, & Rajaraman, 2009; Macias & Sahouria, 2011; Weiser, Kaste, Siegel, & Adamson, 2013; Woodward, 2008). The importance of specially trained radiologists and technologists is not limited to simply the correct dosage; the quality of scan reading and rates of proper diagnostics is increased when using pediatric focused radiologists . Whether considering the proper diagnosing of sinusitis

(Anzai & Paladin, 2009), assessing pediatric osteoporosis(Wang et al., 2014), the maturation of white matter (Lee et al., 2013), or other pediatric cases; the patient experience is improved by working with specially trained and focused staff.

Successful radiology in this situation must include satisfying the needs of all stakeholders including staff, parents, Children's Health Care of Atlanta (CHOA), Georgia Peach care, other insurance companies, and most importantly rural pediatric patients. The diagram below illustrates the main concerns for successful teleradiology identified by literature review. The primary concernes that we will examine during the course of this study include the cost efficiency of the model, convenience of location, staff training, work environment and ergonomics, technical requirements, and the patient experience. The positive outcomes associated with our model (also identified by careful literature review) will include pediatric patient satisfaction, convenience of care, reduction of sedation, optimization of staffing resources, reduced radiation, staff and technician satisfaction, and improvements of care. Even though we did recognize the importance of staff training and technical requirements, they were not focus of our analysis. Some of the recommendations regarding these considerations can be seen in the Annex of the document.

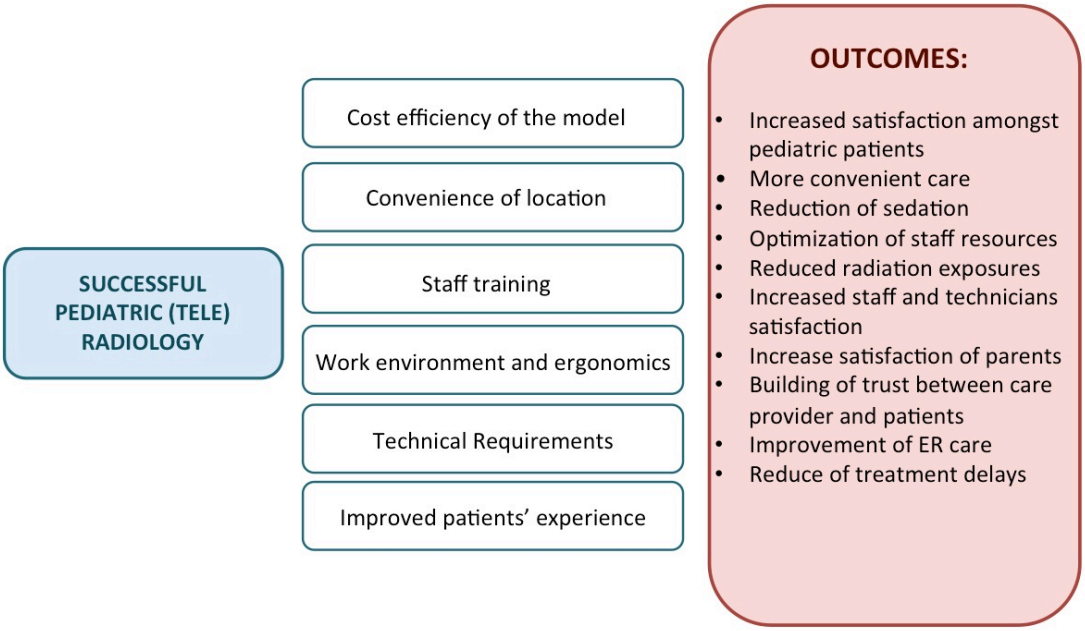


*Figure 1: Diagram of concerns and outcomes for successful tele-radiology*

### Financial Considerations

A critical feature of any plan necessitates the financial sustainability of a radiology center. A finance based approach to a sustainable infrastructure, staffing model, and service structure is critical to a successful intervention.

Academic radiology departments generally have three components, a clinical, teaching, and research component. This hub-and-spoke model would focus on projecting the clinical applications of CHOA's current radiology practice into the outlying rural areas of Georgia. (Cohen et al., 2000)

To accomplish this task in a fiscally sustainable manner it is important to consider which of CHOA's current radiology practices most need projection to outlying areas. While all services are important, the financial constraints of operating in rural areas necessitates careful consideration of what service to offer at our external locations. Research shows that some services are not financially sustainable without a proper catchment area that allows the facility to reach the breakeven point each month for staff salary and infrastructure costs. Certain services such as a PET scanner will simply not be financially viable in a "rural" Georgia hub location due to the volume of service (Cohen et al., 2000) (Berger, Gould, & Barnett, 2003; Cleemput, Camberlin, Van den Bruel, & Ramaekers, 2008; Keppler & Conti, 2001).

CHOA offers its patients a number of different value propositions at its current locations. When expanding to rural areas it is important to consider how a new location would compete with other local providers as well as fit into the CHOA system. Providers at CHOA merge aspects of product/service and customer intimacy to create a cohesive and competitive market advantage. Outpatient radiology clinics generally compete in the operational excellence model by minimizing cost to the consumer. CHOA will need to borrow some aspects of these practices to minimize cost and maintain financial stability while simultaneously maintaining the high level of service and specialty practice that mark its competitive advantage in this new market place (Enzmann & Schomer, 2013).

Another aspect of maintaining financial flexibility and sustainability is our proposal for the use of teleradiology. Telemedicine has been used successfully in a number of situations to expand services offered in rural areas while minimizing the total cost of the system (Hu, Chau, & Sheng, 2002; Martínez-Alcalá, Muñoz, & Monguet-Fierro, 2013; Poropatich, DeTreville, Lappan, & Barrigan, 2006; Sood et al., 2007). Tele-radiology is important financially for a variety of reasons. The most costly and hard to recruit staff for rural radiology, the radiologists, are able to work remotely and thus decrease overall cost of recruitment, retention, and salary. It is important to consider that unlike many other telemedicine applications, radiology has a high set up cost both for the physical plant and specific machinery and therefore operational savings need to be found in many other aspects of the operational design. While the physical machinery cannot always be moved, extending the services of a single radiologist to many locations, by both scheduling decisions and using multiple locations, means that the breakeven point of each individual machine can be reduced in the whole system (Barneveld Binkhuysen & Ranschaert, 2011; Jarvis & Stanberry, 2005; Ranschaert & Binkhuysen, 2013) Qualitative descriptions of flexible staffing models where radiologists are positioned remotely, and technicians and nurses rotate between a number of fixed clinics have been described in the literature, but the financial aspects of these models have not been rigorously studied in a pediatric radiology service. Further study on the nature of this problem is needed to validate the potential of this option.

## Design Considerations

### Location

Two design considerations are necessary when considering the physical space to be used. Both the proper geographic location and the specific physical plant where the locations of the hub-and-spoke model need to be chosen carefully. In this following section we will consider the locational needs and specific possibilities of a radiology hub trial. The state of

Georgia currently has a number of pediatric hospitals which provide radiology services including ones in Augusta, Savannah, Albany, and Macon. These locations provide an initial distribution of specialized pediatric radiology services. After overlapping data on children quality of life with data on available pediatric radiology services we narrowed the best potential trial sites to two counties: Jefferson and Ware. However, Ware County was chosen for several reasons:

- The geographic area with the least available service spatially is the south eastern corner of Georgia.
- Waycross, GA houses a Satellite medical facility of Mayo Clinic, Satilla Regional Medical Center, and also is the hub of the Southeast Health district.

If approached in the correct manner, these service providers can serve as partners to funnel pediatric patients to the specialized radiology services offered at a theoretical hub. This sort of partnership with outpatient radiology services are noted in the literature, though the particulars of local relationships are not clear.

Several examples of successful adaptive reuse of closed or underperforming shopping malls were analysed and used as case studies. Retail development traditionally followed the resident population and the growth of the suburban lifestyle after World War II prompted the development of thousands of enclosed regional malls, neighborhood strip centers and big box power centers. Across the country, these retail destinations were built with several common attributes: proximity to population centers, access to major roads (in most of the cases interstate access) and high visibility and ample parking. However, recent global economic downturn has hit hard commercial real estate- almost one-fifth of the nation's enclosed malls have vacancy rates 10% or more and over 3% of malls are considered to be dying — with 40% vacancies or higher(Schwartz, 2015). A combination of economic, lifestyle and consumer behavior changes are creating a new paradigm in the retailing environment, the result of which is that retail storefronts have become more accessible for alternate uses. One of the few ways developers can get funding for projects is by adding medical offices to the mix.

The example of Vanderbilt Health at One Hundred Oaks retrofitted Nashville's 100 Hundred Oaks Mall (originally built in 1968) is one of many successful cases of adaptive reuse of big-boxes for healthcare and medical services. The 100 Oaks Mall was experiencing serious decline when purchased in 2006. Vanderbilt University Medical Center had all of their outpatient clinics in their medical center located on their main hospital campus, which is an extremely dense, crowded area near midtown Nashville. As part of their plan for growth and development an aging mall is renovated into a mixed-use

*Figure 1: Vanderbilt Health One Hundred Oaks*
http://www.vanderbilthealth.com/100oaks/

medical center and 21 clinics[1] was moved from main campus. The location has good on-site parking (4,000 spaces), excellent visibility, recognition and interstate access. The 56 acres site is conveniently located: right off the I-65, 15 minutes from the university's campus, serving people from the region. 100 Oaks offers lower rental rates than can be found in properties in downtown: $12 per square foot vs. $30 per square foot. Building clinical space at the mall is also significantly cheaper than new construction on campus – around $150 per square foot vs. more than $400 per square foot. The retrofitting of the mall also included:

- Major traffic improvements were designed that result in more intuitive and safe site access
- Recycled construction waste
- Public transportation provided through Metro Nashville and Vanderbilt University
- Promotion of public health and wellness: Establishing a walking trail - pedestrian link to surrounding community and adding bike-racks

As a result, Vanderbilt Health:

- Has 20-25% increase in patients from more affluent zip codes
- Built 44% more space for same cost
- Estimated $37,000,000 savings over similar project on historic campus
- 89% increase in appraisal and taxes for the center
- 39% Increase in appraised value and taxes for the neighborhood (local economic development)
- 500 trees has been planted and rain-gardens established

A primary finding of this case study is that similar model can be applied in Waycross or other similar settings. With many big-boxes and strip malls around country being closed or having a high vacancy rate, opportunities exist for locating Pediatric radiology services in such facilities. Wal-Mart, the largest retailer in the country offers a online database for search of spaces for sale and rent[2]. Wal-Mart is frequently located in the rural areas and, in most of the cases uses standardized big-box that offers the highest flexibility for retrofitting.

The advantages of retrofitting retail big-box are following:

- Convenience of being close to (sub-urban) residential areas

[1] Services offered at Vanderbilt Health One Hundred Oaks are:
Adolescent and Young Adult Medicine, Au Bon Pain, Breast Centre, Comprehensive Care Clinic, Dermatology, Heart, **Imaging,** Internal Medicine, Medical Infusion, Medical Weight Loss, NICU Follow-up, Pain Management Centre, Pediatric Allergy, Pediatric Rehabilitation, Pediatric Dermatology, Pharmacy, Rapid Response Lab, Spine Centre, Sports Medicine, Surgical Weight Loss, University Paediatrics, Volunteer Services, Women's Health

[2] http://www.walmartrealty.com/listings/

- Foot traffic
- Convenient healthcare – it can be done while running errands
- Consumer demand for a better experience: shopping as distraction
- Good transportation connections: close to major highways and public transportation
- Good on-site parking
- Excellent visibility and accessibility: very often interstate access
- Typical architectural characteristics of the Big Box enable adaptive reuse: large, single-floor, free-standing[3]
- Retrofitting underperforming and dying shopping malls for more community-serving purposes
- Repurposing existing retail boxes (LED of the area)
- New emphasis in healthcare on throughput (retail equivalent of sales PSF)
- Recycled construction waste

LoopNet was used to search properties for sale and lease on the largest commercial real estate marketplace[4]. Following criteria for space were used:

- Proximity to Mayo Clinic System
- Big-box
- High vacancy rate or vacant
- Availability of ample parking

The map bellow shows that there is place for sale currently listed, Pinehill Crossing Shopping Center, a big box (former grocery store) located 2 minutes by car or 7 minutes by foot from main Mayo Clinic, with 57,740SF space available.

[3] Typical architectural characteristics include the following:
- Large, free-standing, rectangular, generally single-floor structure built on a concrete slab. The flat roof and ceiling trusses are generally made of steel, and the walls are concrete block clad in metal or masonry siding.
- The structure typically sits in the middle of a large, paved parking lot, sometimes referred to as a "sea of asphalt." It is meant to be accessed by vehicle, rather than by pedestrians.
- Floor space is generally more than 50,000 square feet (4650 m²), sometimes approaching 200,000 square feet (18,600 m²), though varying by sector and market.

[4] http://www.loopnet.com/

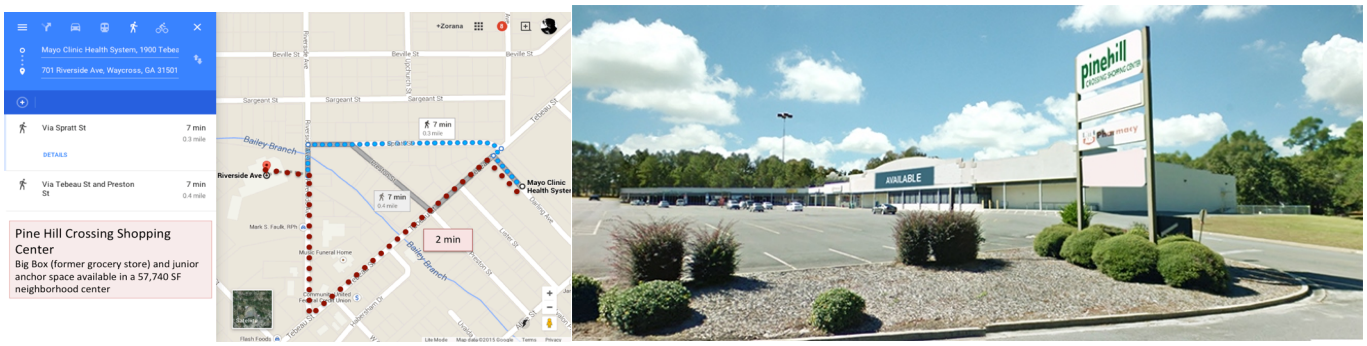


*Figure 3 is Google Map showing the distance of Pinehill from the Mayo Clinic Health System Waycross, GA.*

*Figure 4 shows: Pinehill Crossing Shopping Center, 701 Riverside Avenue, Center in Waycross*

### The Physical space

According to VA Design Guide Radiology Service (2010) the re-inhabitation of underused buildings already constructed in an area represents a strong opportunity to rapidly install the infrastructure necessary to provide service in the area. Reuse underperforming structures also opens an opportunity, if properly marketed, to promote the image of CHOA as working within a sustainability and community centered construct. Although the re-inhabitation of an underperforming retail building may impose some important aspects that must be considered in the design process in order to generate an improved space that results in a better experience to the patients and caregivers.

The adaptation of the retail building into a space adequate to tele-radiology must be aware of the construction aspects that will potentially represent the biggest interventions to be performed in the building. A retail *big-box*, has is defined by a large square building with no interior walls, which appears to be an aspect that allows an easy redefinition of its interior space. Although, interior materials and finishes become the main aspect of design process. In this case, the positioning of the partitions, floors, ceilings, wall protections and interior doors and hardware are important elements to be considered as well as the mechanical systems that in most cases will have to redesign since a retail building doesn't have the same requirements to operate than a space that provides radiology services. In this case, the electrical systems, HVAC, plumbing are important aspects of the project that need special consideration.

In terms of the interior occupation of the building the concern about possible expansions must be considered as it is a common problem faced by most health care facilities. As demands grow these facilities need to expand or optimize its interior spaces in order to provide a quality service. The radiology services should be strategically be planned in order to maximize efficiency by the adjacency of coherent services and functions. It needs avoid high costs through relocations and large scale interior interventions and also it must anticipate the possible need for expansion.

### The Patient´s experience: Distraction Techniques

Anastos (2007), affirms our study should focus on the analysis of evidence the places children as a fundamental stakeholder on the evaluation of the pediatric spatial performance in order to better understand the aspects that are related to the physical space and that can improve the patient´s experience in the context of pediatric. Major (2005) also states that the distraction techniques that are based on children´s stories and characters that are displayed on walls and equipment creating an infantile environment that can relieve anxiety and fear related with radiologic procedures. According to the research, pediatric distraction techniques for children of all ages have led to satisfied patients, high-quality images, and fewer cases where children required sedation for exams. The research also states that the customization of the pediatric radiology location has helped to manage pain, decreased the use of sedation and other pharmacological methods as it also builds trust between the staff and the patient, increasing the satisfaction of parents.

(Adams, Theodore, Goldenberg, McLaren, & McKeever, 2010; Anastos, 2007);(Major, 2005)

**Study 1: Children in the healthcare environment: Elements of Quality in Drawings**

Competing research has focused on the point of view of children on the evaluation of the healthcare environment. Pelander et al. affirms that the understanding of the perception of a child on the space is a central aspect of multidisciplinary methodologies that attempt to understand how design solutions impact the pediatric experience. The comprehension of the design aspects that can positively affect the children's experience is not only a matter of rescaling the space or to display cartoons characters or on multi-media devices installed on the walls. The outcomes of these studies were understood to be of great relevance to the consolidation of a design process that results in a space where the project intentions lead to better healthcare outcomes. Out of all the researchers analyzed, two of them elaborated significant methodologies with outcomes that can aid the architectural design process. Pelander et al.'s multidisciplinary research team asked patients to describe their interaction with the physical space through drawings by answering two specific questions: What do you think the ideal hospital for children should look like? And who should be there? The research was conducted with 35 kids between 4 and 11 years of age and the final research sample composed of 35 drawings that addressed the questions cited above.

*Figure 5: Distraction techniques:* ***Imaging Adventure Program:*** *Children's Hospital of Pittsburgh*

The drawings were analyzed using psychiatric methodologies that attempt to identify significant characteristics perceived by the eye of the children about the important aspects of the spaces they were treated. The drawings depicted elements that in a child's perspective should be present in the ideal healthcare space both in terms of the exterior image of the building and its interior spaces. Based on the drawings the researchers created a map with the main elements that were mentioned by the children with two main categories: "Building and surroundings" and "patient room". The research mentions that the elements registered in the drawings by the kids revealed a desire of to be treated in an environment created for children and in the presence of other children. According to the authors this suggests a social perspective that children have a better experience when treated with peers. This aspect becomes important evidence that must be considered in the pediatric health care design methodologies and strongly differs from the simplicity of rescaling the room or decorating it with cartoons. Also, the research map observes that the ideal pediatric space should be composed by homelike elements, and naturally include the presence of the parents and other children as much as possible. The drawings were explained by the authors and according to the researchers in many occasions children mentioned that they feel better when they visually see other children around. This perspective gives another dimension to the pediatric health care design process where the objective of the space is not just a radiology procedure or the distraction of the patient. Instead, the space must create a legitimate environment that establishes a relation with the family home and that allows children to interact with their peers.

(Pelander, Lehtonen, & Leino-Kilpi)

**Study 2: Kids in the atrium: Comparing architectural intentions and children's experiences in pediatric healthcare facilities**

The second significant research analyzed the impact of the spaces adjacent to treatment spaces in pediatric health care facilities, such as the atriums. The research observed the behavior of children as patients as they walked in the atrium of a health care facility. After that the children were asked to register in photographs the images that best explain their impressions of the atrium. The research was conducted with 80 children, 35 inpatient and 45 outpatient.

According to Adams et al., large scale reception spaces have very positive impact on the perspective of children because they symbolize a safe and reliable healthcare facility. The ease with which the atrium accommodates a larger number of people also was seen as positive, because strangers and staff could be asked for help or directions and also the idea that a large atrium could treat many children.

The openness of the atrium was an important aspect in the reports of the analyzed patients since it implied an idea of connectivity, surveillance and spatial orientation. Also, the social uses of the waiting areas were highlighted by children and youth as positive, since the possibility to socialize was mentioned as an important counterpoint to the solitude of their private sessions. The connection with the physical surroundings was

mentioned as an important aspect of the atrium as the patients could establish visual contact with the landscape.

Another aspect that was mentioned by the research is the positive impact of the association of the atrium´s space with other types of uses such as retail business. In the eyes of the children the presence of commercial activities in the atrium implied an idea of a day-by-day familiar atmosphere suggestion ways to act and fell.

The most relevant publications about pediatric health care design concluded that a new perspective new to be addressed by designers in order to achieve a better pediatric experience. Children have a better experience when treated in an environment that establishes a relation with other spaces familiar to theirs daily routine, such as a home or a familiar retail environment. Also, it was important to notice the importance of the socialization with other children as a manner to feel accepted and in a regular everyday situation.

(Adams et al., 2010)

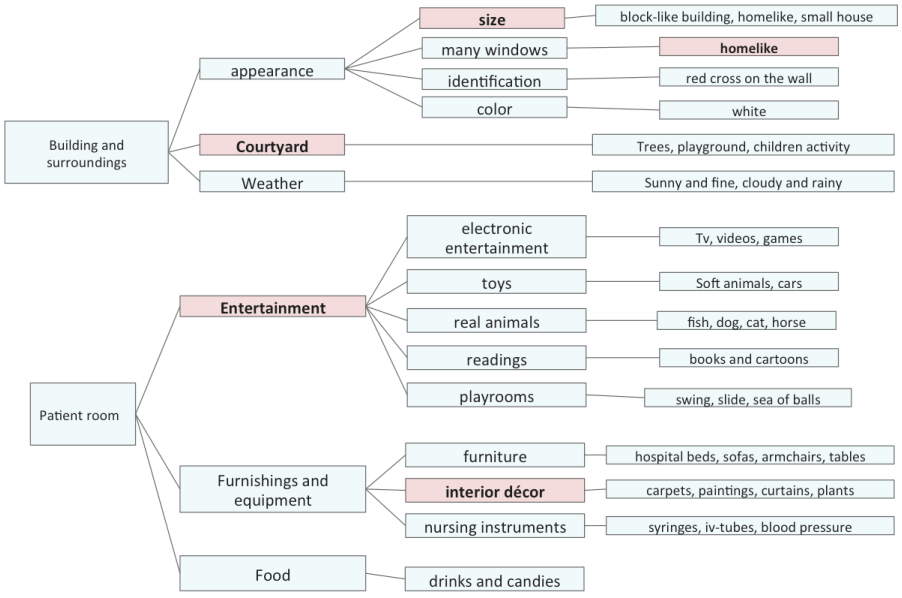


*Figure 6: Main factors for improved patients' experience identified by children in Children Perspective on Healthcare study*

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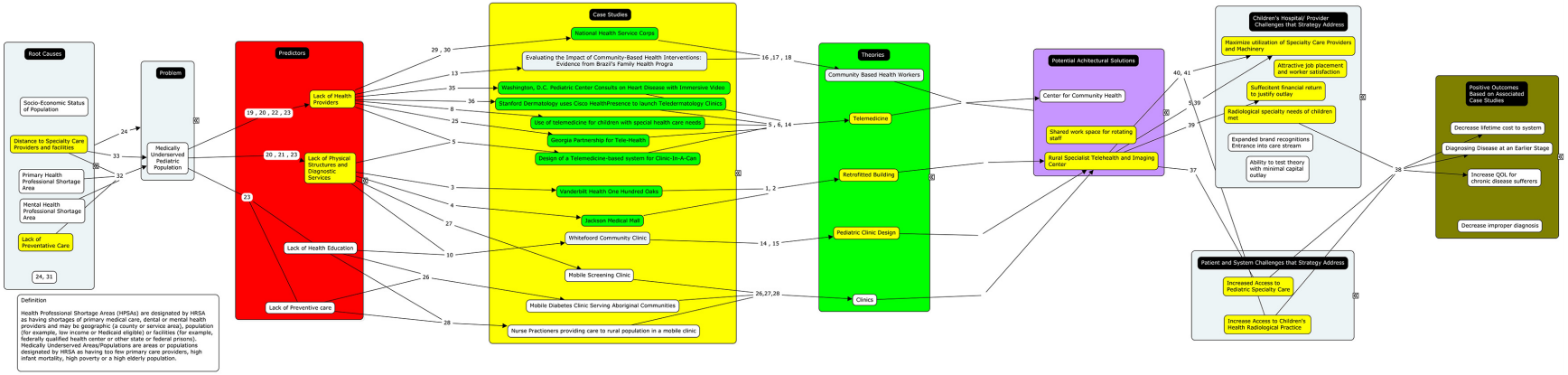
Ecology Map Regarding Lack of pediatric specialty care providers and testing facilities in Rural Georgia




Definition

Health Professional Shortage Areas (HPSAs) are designated by HRSA as having shortages of primary medical care, dental or mental health providers and may be geographic (a county or service area), population (for example, low income or Medicaid eligible) or facilities (for example, federally qualified health center or other state or federal prisons). Medically Underserved Areas/Populations are areas or populations designated by HRSA as having too few primary care providers, high infant mortality, high poverty or a high elderly population.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# Jefferson County, GA

The following Summary Comparison Report provides an "at a glance" summary of how the selected county compares with **peer counties** on the full set of **Primary Indicators**. Peer county values for each indicator were ranked and then divided into quartiles.

| | Better (most favorable quartile) | Moderate (middle two quartiles) | Worse (least favorable quartile) |
|---|---|---|---|
| Mortality | Chronic kidney disease deaths<br>Motor vehicle deaths | Alzheimer's disease deaths<br>Chronic lower respiratory disease (CLRD) deaths<br>Coronary heart disease deaths<br>Diabetes deaths<br>Stroke deaths<br>Unintentional injury (including motor vehicle) | Cancer deaths<br>Female life expectancy<br>Male life expectancy |
| Morbidity | Adult overall health status<br>Syphilis | Adult diabetes<br>Cancer<br>Gonorrhea<br>HIV<br>Older adult asthma<br>Older adult depression<br>Preterm births | Adult obesity<br>Alzheimer's diseases/dementia |
| Health Care Access and Quality | Primary care provider access | Cost barrier to care<br>Older adult preventable hospitalizations<br>Uninsured | |
| Health Behaviors | Adult smoking | Adult female routine pap tests<br>Adult physical inactivity | Teen Births |
| Social Factors | | Children in single-parent households<br>On time high school graduation<br>Poverty<br>Violent crime | High housing costs<br>Inadequate social support<br>Unemployment |
| Physical Environment | Drinking water violations<br>Limited access to healthy food | | Access to parks<br>Annual average PM2.5 concentration<br>Housing stress<br>Living near highways |

*Centers for Disease Control and Prevention 1600 Clifton Rd. Atlanta, GA 30333, USA*
*800-CDC-INFO (800-232-4636) TTY: (888) 232-6348 - Contact CDC–INFO*

# Ware County, GA

The following Summary Comparison Report provides an "at a glance" summary of how the selected county compares with **peer counties** on the full set of **Primary Indicators**. Peer county values for each indicator were ranked and then divided into quartiles.

| | Better (most favorable quartile) | Moderate (middle two quartiles) | Worse (least favorable quartile) |
|---|---|---|---|
| Mortality | | Alzheimer's disease deaths<br>Cancer deaths<br>Chronic lower respiratory disease (CLRD) deaths<br>Coronary heart disease deaths<br>Diabetes deaths<br>Motor vehicle deaths<br>Stroke deaths<br>Unintentional injury (including motor vehicle) | Chronic kidney disease deaths<br>Female life expectancy<br>Male life expectancy |
| Morbidity | Adult overall health status<br>Cancer<br>Syphilis | Adult obesity<br>Gonorrhea<br>Older adult depression | Adult diabetes<br>Alzheimer's diseases/dementia<br>HIV<br>Older adult asthma<br>Preterm births |
| Health Care Access and Quality | Cost barrier to care<br>Primary care provider access | Older adult preventable hospitalizations<br>Uninsured | |
| Health Behaviors | Adult female routine pap tests | Adult physical inactivity<br>Adult smoking | Teen Births |
| Social Factors | | Children in single-parent households<br>Inadequate social support<br>On time high school graduation<br>Violent crime | High housing costs<br>Poverty<br>Unemployment |
| Physical Environment | Drinking water violations | Access to parks<br>Annual average PM2.5 concentration<br>Living near highways | Housing stress<br>Limited access to healthy food |

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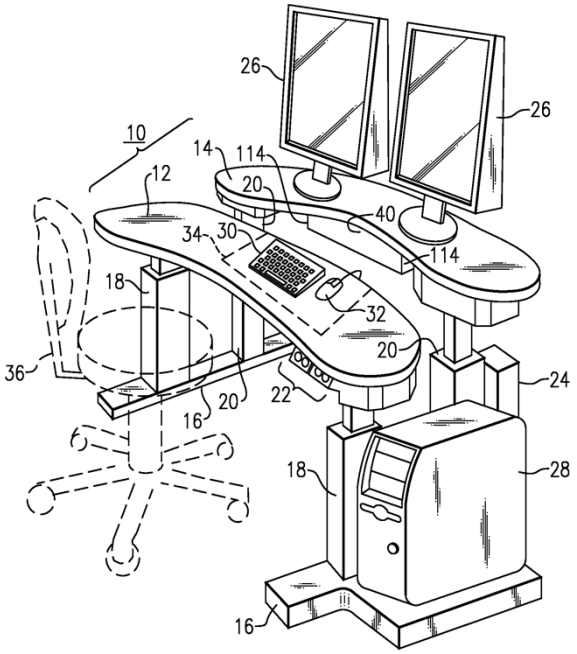
work environment
Radiology_1
By Philips Communications
4
1

## WORK ENVIRONMENT AND ERGONOMICS [9, 12]

- Appropriate working environment, including state-of-the- art computers, monitors and viewing software certified for diagnostic purposes.
- Attention should be given to room lighting (adequate ambient light preventing glare and potential interference with the optimal image quality staff should have control over the ambient light in the reporting room
- 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) [21]




<u>For teleradiologist:</u>

- Prevention of repetitive stress injuries, visual and even mental disturbance maximize comfort and safety for the tele-radiologist
- Design of working environment that enables frequent breaks (relax area outside of the examination room) [9]

While much has been written about the impact of reading room ergonomics on radiologist health and productivity, there has been little discussion about the benefits of optimizing the overall reading room environment and location. While ergonomic, well-designed furniture creates a critical foundation for maximum productivity, a well-designed and optimally located reading room environment must be the overall goal.

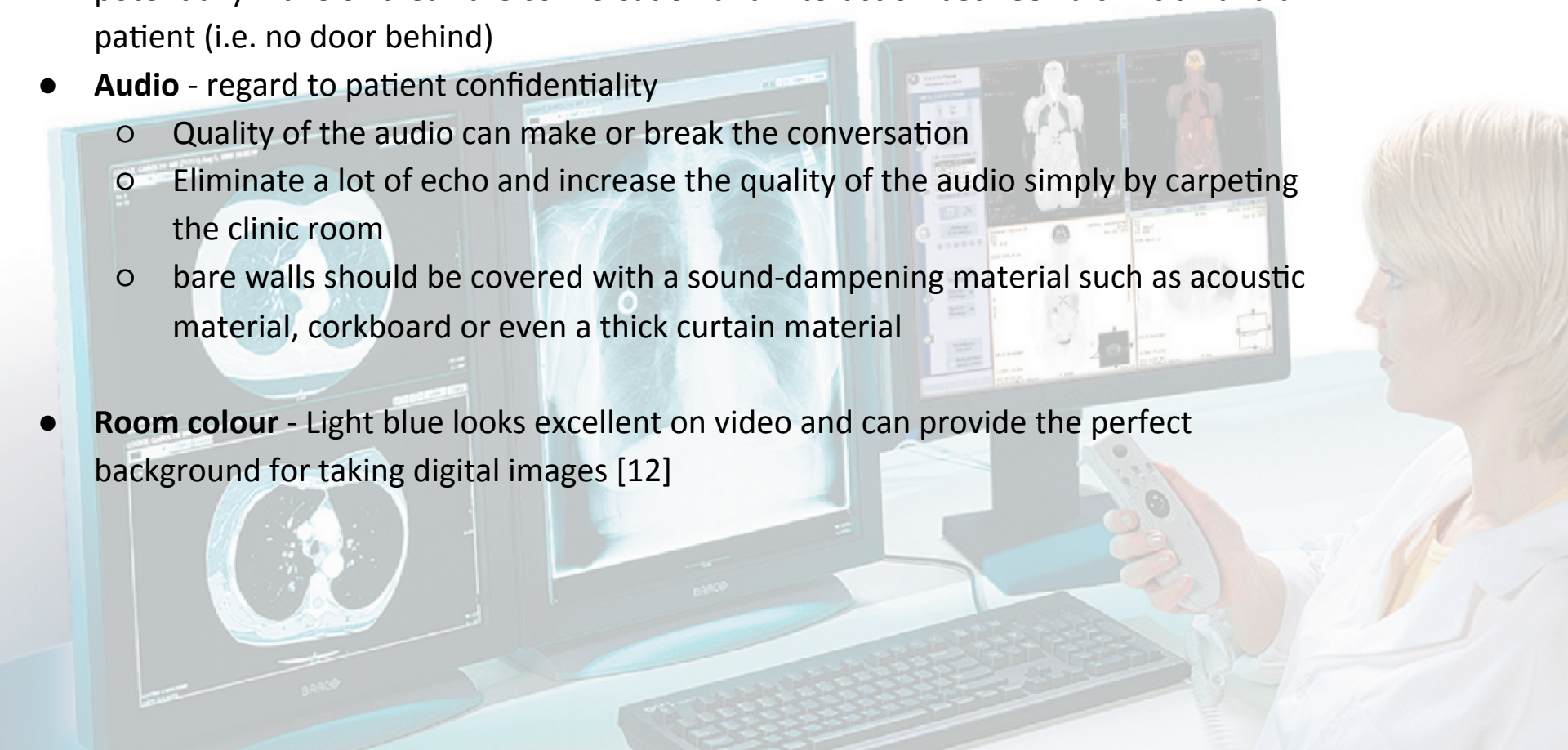
## Reading room: Designing an Optimal Environment

• **Noise abatement.** The room's noise level can be controlled by several means. Acoustic tiles on the ceiling and carpet on the floor are traditional sound absorbers. The addition of quiet music is a possibility, but this is no substitute for noise elimination.
• **Room temperature.** The temperature of the room should be well regulated and individually adjustable from within the radiology suite.
What is the ideal arrangement of this comfortable room? Consider the rectangular room in Diagram 1. This design is constructed around the need to both control light and to provide a comfortable work environment. Important elements are:
• **Diagnostic displays angled in toward the radiologist.** This layout promotes maximum contrast and prevents near-vision deficits by equalizing the distance to all parts of the displays.
• **Multiple workstations and any view-boxes** are arranged in a single line. There is an important reason for this. If the light from another display falls on the display in use, it will reduce the contrast of that display.
• **Ambient vicinity lighting** is placed to illuminate the wall behind the displays. This illumination minimizes the fatigue associated with looking back and forth between dark and bright.
• **Utility lighting** is required for cleaning and service. This is only used during display maintenance.
• **The illumination** in the anteroom should be moderate — a compromise between the nice, bright typical healthcare environment and the very dark reading room. It can often be achieved simply by taking out one of the bulbs in the overhead lights.
• **Walls** should be a medium or dark color. Many people are happy with a yellow or orange-yellow paint color for the wall behind the displays.
• **Carpeting** to absorb both sound and light.

## DESIGN OF TELEMEDICINE ROOM [12]

- Special attention should be given to the **background** in a telemedicine room can potentially make or break the conversation and interaction between a clinician and a patient (i.e. no door behind)
- **Audio** - regard to patient confidentiality
  - Quality of the audio can make or break the conversation
  - Eliminate a lot of echo and increase the quality of the audio simply by carpeting the clinic room
  - bare walls should be covered with a sound-dampening material such as acoustic material, corkboard or even a thick curtain material

- **Room colour** - Light blue looks excellent on video and can provide the perfect background for taking digital images [12]



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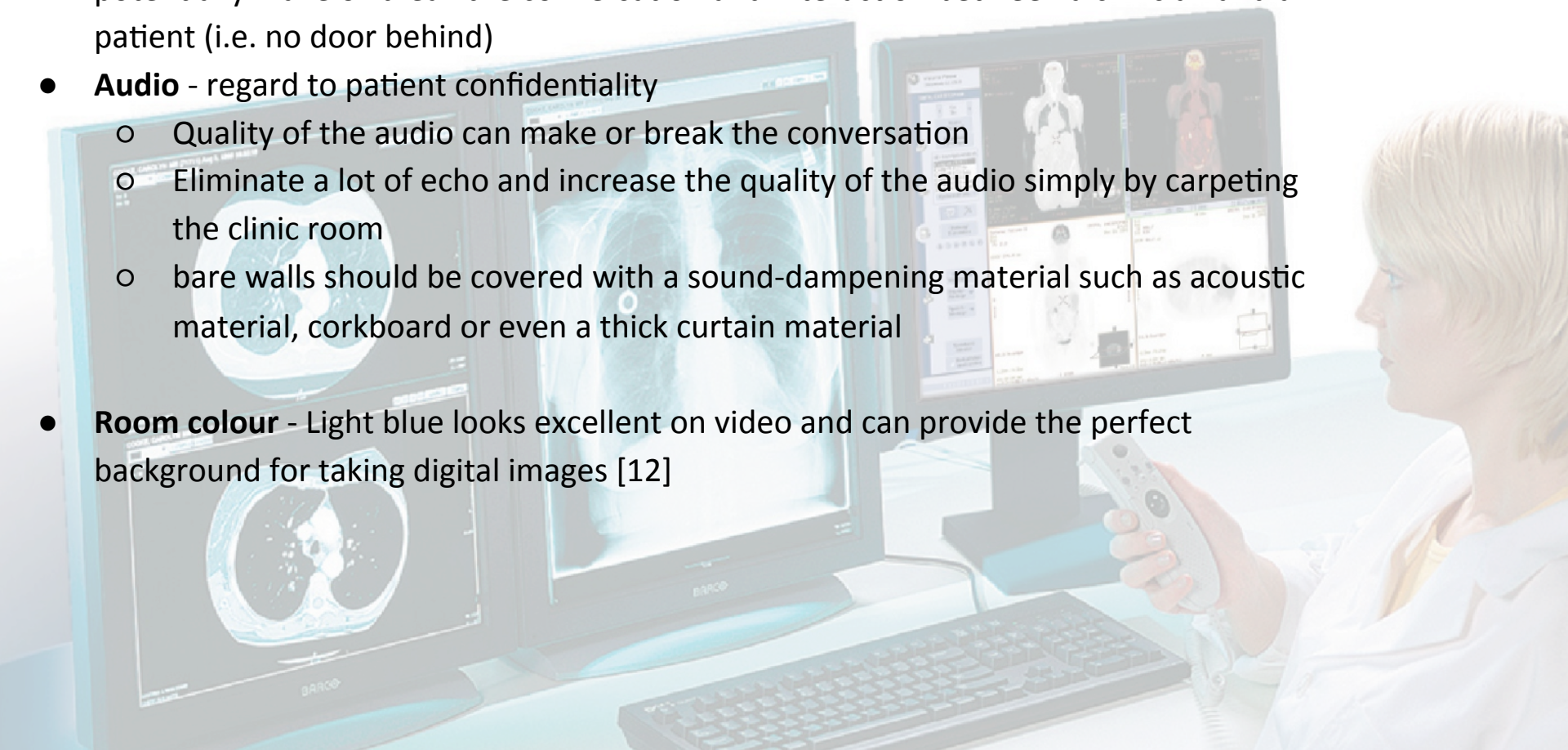



staff training

## LEGAL REQUIREMENTS FOR TELEMEDICINE

- **Required Georgia License**
- **In-Person Examination required prior to encounter unless:**
  - The telemedical exam with tele-technology is equal or superior to an in-person exam
  - Provider is conducting care at the request of a physician, PA, or APRN
- Medical history must be visible
- Annual in personal follow up exam
- Standard of care should be equal to or better than a standard examination[1]

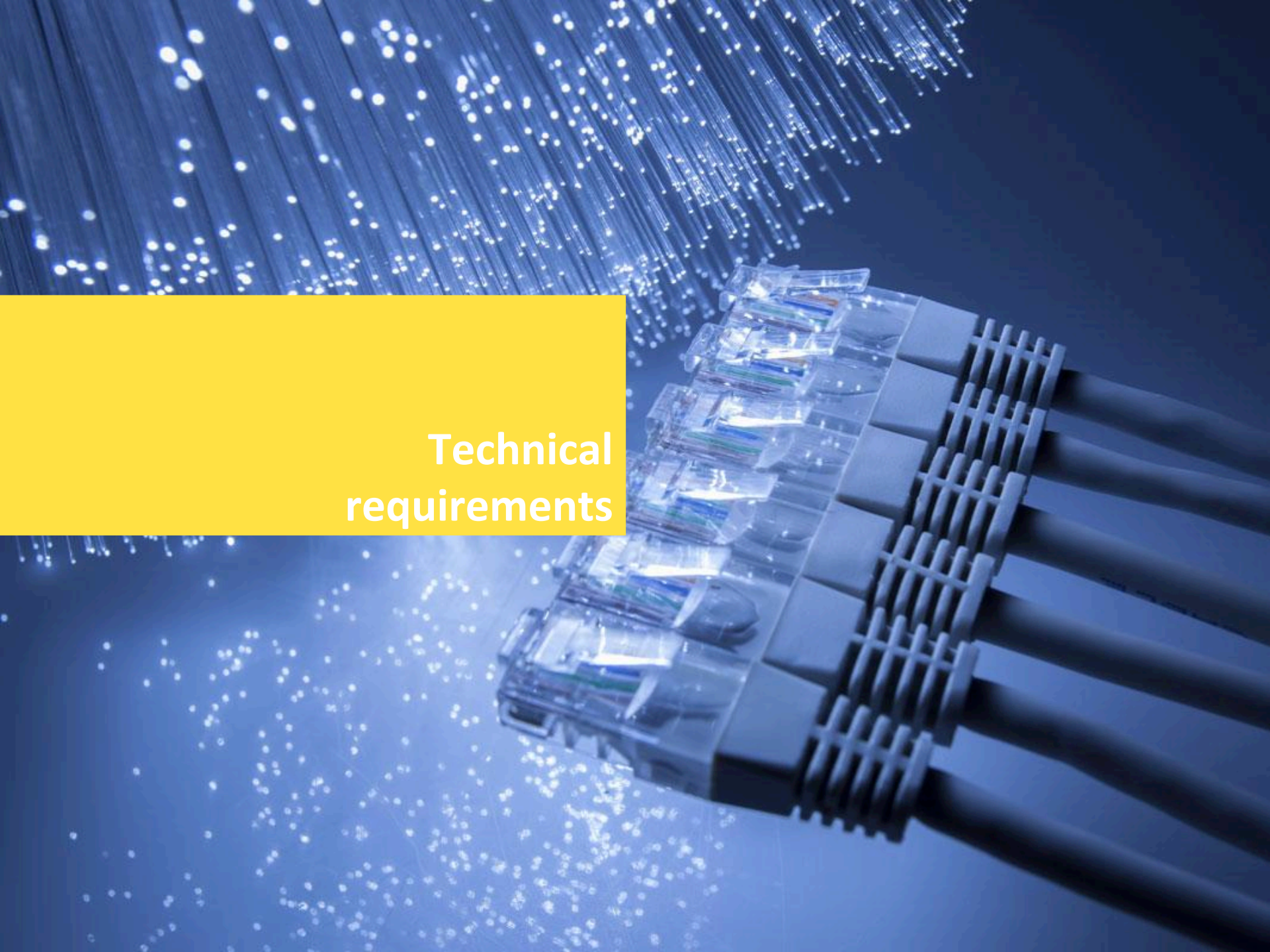
http://www.healthcarelawtoday.com/2014/08/20/georgia-composite-medical-board-issues-new-telemedicine-rules/

## STAFF TRAINING [9, 10]

- Training users to make the best use of equipment
- Specific privacy and security protocols of the "digital" working environment
- Teleradiology and telemedicine should be considered as an integral part of residency training

## COMMUNICATION:

- Effective two-way communication between the referring physician/nurse and the interpreting teleradiologist
- Language barriers in multicultural communities


Technical
requirements

## TECHNICAL REQUIREMENTS [9]

- Provide robust solutions reliably protecting patient data and offering sufficient network bandwidth to work efficiently:[7]
  - images without loss in quality during transmission or display solutions : Virtual private network (VPN), Data push technology, etc.
- Workflow support and availability of relevant medical information
- Hughes Network Systems - North America's largest satellite broadband provider has linked up with Wal-Mart to sell satellite high-speed Internet access in rural and suburban areas across North America [20]

| | **X Ray** | | **CT** | | **MR** | | **Mammogram** | |
|---|---|---|---|---|---|---|---|---|
| Size of Exam | 30 MB | | 300 MB | | 90 MB | | 150 MB | |
| Compression Ratio | 25:1 | | 7:1 | | 6:1 | | 10:1 | |
| Size of Compressed Image | 1.2 MB | | 42 MB | | 15 MB | | 15 MB | |
| **Transmission Time (seconds)** | Uncompr. | Compress. | Uncompr. | Compress. | Uncompr. | Compress. | Uncompr. | Compress. |
| DSL | 720 | 28 | 7200 | 980 | 6480 | 350 | 3600 | 350 |
| Cable Modem | 480 | 19 | 4800 | 665 | 4320 | 238 | 2400 | 238 |
| T1 | 320 | 13 | 3200 | 455 | 2880 | 163 | 1600 | 163 |
| 10 MB Ethernet | 50 | 2 | 500 | 90 | 450 | 25 | 250 | 25 |
| SONET (OC-3) | 36 | 0.1 | 360 | 3.5 | 324 | 1.3 | 180 | 1.3 |

## OPERATIONAL MODELS FOR RADIOLOGY PARTNERSHIPS [2]

- Operational Excellence (low cost provider)
  - Limit size and compensation of radiologists
  - Minimize professional labor costs by hiring at highest level
  - Invest in logistics
  - 24/7/365 diagnostic imaging services with as many partnerships as possible
  - **DIFFICULT TO ESTABLISH CUSTOMER INTIMACY POSITION OR MAINTAIN IT**
- Product Leader position
- Customer intimacy position
  - Children's main current position
  - Deep understanding of customers needs.
  - Full solution encompassing diagnosis and treatment
  - Economy of knowledge

## CHILDREN' S MARKET POSITION

- Pediatric Specialty care and knowledge
- Clinical use of tests in children
  - CT scans[3]
  - High Value of Care
  - Clinical Decision making history
  - Informatics on when to use
  - Child Abuse[4]

## POSITRON EMISSION TOMOGRAPHY PET EXAMPLE [13-15]

- Used in Oncology, cardiology, and neuropsychiatry.
- High Cost ~ $1885 per procedure on average
- High fixed costs, increasing scans obtained can decrease costs.
- Critical factor for profitability is throughput
- 21 Scanners currently in Georgia
- Focussed in and around Atlanta, Savannah, Macon, and Fayetteville, Augusta, Athens, Albany
- Area of need between the Albany, Savanna, Augusta triangle
- With capacity of ~2,000 PET per year the existence of more than 10 PET scanners is unjustifiable for Belgium, a country 1 million inhabitants larger than Georgia[6]