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## Conscientious Design: Design Proposals for Accomodating Multiple Sclerosis Patients

Kristina Lynn Carter  
*Utah State University*

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2011

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CONSCIENTIOUS DESIGN: DESIGN PROPOSALS FOR ACCOMODATING  
MULTIPLE SCLEROSIS PATIENTS

by

Kristina Lynn Carter

A Plan-B Project submitted in partial fulfillment  
of the requirements for the degree

of

MASTER OF SCIENCE

in

Human Environments

Approved:

---

Darrin S. Brooks, MFA  
Major Professor, Committee Chair

---

Steven R. Mansfield, MArch  
Major Professor, Committee Member

---

Keith Christensen,  
Committee Member

UTAH STATE UNIVERSITY  
Logan, Utah

2011

## ABSTRACT

### Conscientious Design: Design Proposals for Accommodating Multiple Sclerosis Patients

by  
Kristina Carter, Master of Science  
Utah State University, 2011

Major Professor: Darrin S. Brooks, MFA  
Program: Human Environments

This evidence-based research explains and provides interior design strategies for redesign and future design to meet the needs of MS patients. The project entails an analysis of MS patient needs, an assessment of interior design implementations in similar medical fields (with patients who have similar symptoms to those with MS), and the creation of information materials containing recommended design practices for distribution. The materials will include details on lay-outs, upholstery, space planning, suggested equipment, color schemes, and recommended practices to be applied to current or future facilities that treat MS patients. These materials provide previously unexplored and much needed research and applications for use in the field of interior design.

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ABSTRACT

The MS Healing Center: A facility for the research and  
treatment of those afflicted with Multiple Sclerosis

by

Kristina Lynn Carter, Master of Science

Utah State University, 2010

Major Professor: Darrin Brooks, ASID, IIDA, IDEC  
Program: Human Environments

Within the state of Utah there exists an exceedingly large number of people with



multiple sclerosis, a disease of the nervous system. There is no cure for multiple sclerosis. The individuals who have been diagnosed with this disease suffer from a variety of physical, mental and emotional symptoms. Because the disease is typically diagnosed at a young age and rarely results in death, it's sufferers will face decades of questions and problems.

At this time there are no facilities that cater to the research and treatment of multiple sclerosis patients. After diagnosis individuals are often left to their own devices to learn about the disease and find resources for treatment and support. The MS Healing Center will provide all of these amenities in one central location that is designed around the challenges of the disease.

(?pages)

## DEDICATION

To Steven Mansfield who guided me on my quest to find my talent and then myself in the field of interior design. I am a teacher because of you.

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(67 pages)

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## INTRODUCTION

For centuries multiple sclerosis (MS) went undiagnosed due to a lack of medical technology. MS can only be diagnosed by a spinal tap and a Magnetic Resonance Image (MRI), two things that could not be performed in centuries past (Diagnosing Multiple, n.d.). The National Multiple Sclerosis Society estimates that approximately 400,000 people in the United States have been diagnosed with MS and that 10,000 more are diagnosed each year (Kalb, 2008). What was once believed to be a rare and misunderstood disease is now becoming an epidemic. Specific information on MS in many countries is not available, making it impossible to gain world-wide statistics. However, we do know that 1/750 people in the United States have been diagnosed (Stachowiack, 2008). In Utah this number is remarkably higher at 1/300 (Brown, 2011). This high number of MS patients in Utah has drawn world-class neurological treatment to the state which has led to many out of state patients traveling to Utah for medical care.

However, Utah currently has no all-in-one centers available for the treatment of MS. This makes treating the variety of symptoms with multiple specialists complicated and arduous for both visiting and local patients. Because of the multiple service locations, this furthers the need for decision makers to understand the design needs of MS patients outlined in this thesis work. The perpetual increase of diagnosed patients has resulted in an rapid influx of neurologists, medications, and facilities. In order to keep up with the increasing demand, MS facilities are being retrofitted from existing medical facilities with no attention to specific MS related design challenges being addressed. This results in the problem of low physical accessibility and attention to psychological design details for

patients with MS even when Americans with Disabilities Act (ADA) codes have been met.

The primary goal of this evidence based research is to explain and provide interior design strategies for redesign and future design in MS facilities. The project will begin with a look at the disease itself and an analysis of MS symptoms that could be impacted or assisted by design. The categories these symptoms will cover are:

1. Accessibility: tremor and balance, and spasticity
2. Needs: numbness, and bladder and bowel Problems
3. Efficiency: weakness, and fatigue
4. Navigation: vertigo, and vision
5. Psychological welfare: cognitive problems, and depression

This section will answer the following research questions. The study will also include a review of current ADA codes, and suggested design practices for other illnesses or ailments with similar symptoms. An assessment of design field implementations in other MS treatment facilities and general healthcare services will be conducted to provide working evidence of design strategies. Finally suggested design strategies for future and existing MS facilities will be recommended.

1. How can space planning and building layouts assist MS patients?
2. In what ways can finishes and materials effect the physical and psychological well-being of an MS patient?
3. How should an infusion center be set up to meet the requirements, needs, and preferences of both medical staff and MS patients?
4. What kinds of furnishings should be used in an MS facility?
5. What kinds of equipment can aide with the treatment of MS patients?
6. What kinds of practices can be performed by the staff to assist MS patients?

To answer these questions the literature review will begin with a look at MS including: research on what the disease is, who is susceptible, and how many people have it will be addressed.

## LITERATURE REVIEW

The researcher will begin by investigating MS and its symptoms that could be impacted positively or negatively by design. Then an analysis of recommended design strategies for illnesses and ailments which share symptoms with MS will be conducted. Finally a look at what has been done in other healthcare facilities and the design recommendations from the field will be addressed.

### What is Multiple Sclerosis?

MS is considered to be an autoimmune disease where the immune system is attacking healthy tissue. Specifically the myelin sheathing of the central nervous system (see Figures 1 and 2). The central nervous system includes the spinal cord, brain and optic nerves (Polman, 2006).

Myelin is the tissue that surrounds or coats the nerves that run from the brain, down the spine, and then out to the limbs of the body (see Figure 3). When the myelin is attacked and broken down it creates a gap that the brain's messages can no longer cross (see Figure 2). These interruptions can create a variety of symptoms in the body including: loss of vision, double vision, stiffness, weakness, imbalance, numbness, pain, problems with bladder and bowel control, fatigue, sexual changes, speech and swallowing difficulties, emotional changes, and intellectual impairment (Kalb, 2008). Over time scar tissue will fill in the gap and the brain can resume sending messages normally. These scar tissue filled areas are called plaques or lesions and can be seen as white spots on an MRI.

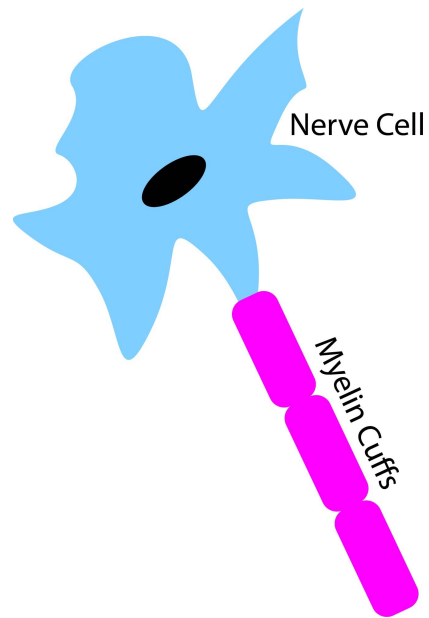


Figure 1 Myelin Sheath. A healthy nerve system with myelin cuffs protecting nerve cell fibers (Illustration: By Author).

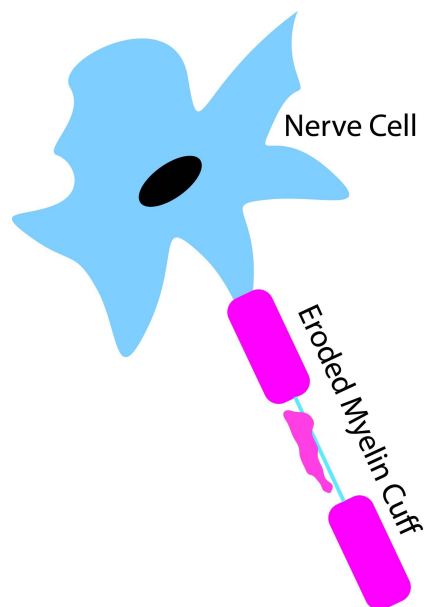


Figure 2 Damaged Nerve. A nerve showing the erosion of the myelin sheath due to multiple sclerosis (Illustration: By Author).

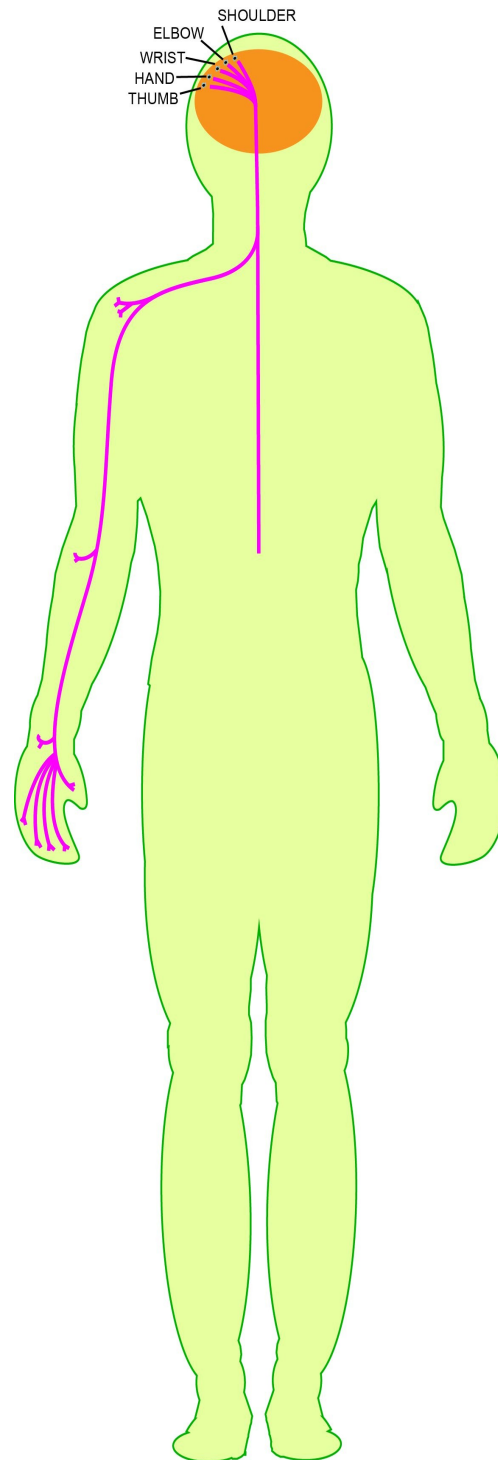


Figure 3 Nerve Fiber Pathways. The connections from the brain running through the spine out to different parts of the body (Illustration: By Author).

At this time MS is an incurable disease that affects both men and women in all age groups (Schapiro, 2003). Most however, are diagnosed during early adulthood. MS is a chronic disease whose symptoms range from very mild to severely disabling. At the diseases onset it is almost always in the relapse remittal phase which means that the disease symptoms come and go with periodic exacerbations sometimes called attacks. An exacerbation is characterized by a new or worsening symptom that lasts for more than 24 hours. An attack can be something as small as a tingling hand or as large as blindness or paralysis. Most attacks will resolve themselves but can be sped up with a *Solu-Medrol* (steroid medication) intravenous infusion (Exacerbations, n.d.). A typical attack will take about six weeks to dissipate.

### Who Has MS?

The cause of MS is still widely unknown and many theories have been explored. Predicting who will get MS can be a difficult situations because although some things are known while some things are not. Originally it believed that the disease could not be inherited. Many people with MS do not have a single family member in their history who have suffered from the disease. On the other hand there are some families who are plagued with the disease. In these families there are often more people with MS than without the disease. MS is not wholly genetic because there are many sets of identical twins made up of one healthy twin and one twin with MS (Stimpson, 2010).

Many people with MS report that their disease came about after a major medical infection or illness. In these cases it seems that the disease was triggered by these events.



“The current thinking is that the disease occurs in people who have a genetic predisposition to respond to some infectious trigger in the environment, and that this trigger sets in motion the autoimmune process” (Kalb, 2008, p. 11). This would indicate that both environment and heredity play a part in being susceptible to the disease.

Location also seems to have something to do with MS risk. People who live close to the equator are at a much lower risk than those who are farther away. MS occurs with a much greater frequency above 40 degrees latitude than it does closer to the equator (MS Society, 2010). This was thought to be because of a higher exposure to sunlight and thus higher levels of vitamin D which could act as a protective barrier. This is not always the case though. “One example of the complex interplay between geographic and other factors is seen among Inuits of the polar regions: Although they live in an area that is far from the equator, their risk of developing MS is virtually nil” (Kalb, 2008, p. 26). Caucasian people and those of northern European descent have the highest incidences of MS.

Where you live before hitting puberty is a bigger determinant than where you live for the majority of your life. People who moved near the equator after hitting puberty from a location such as the United States or Europe will still retain the risks associated with those countries where they grew up. The same is true for a child who was raised near the equator then moved after puberty to a higher risk country. That child will retain the lower risk associated with the near equator countries (National MS Society, n.d.).

How many people suffer from MS is a very difficult question to answer. That is because there is no system for tracking the disease and many people with MS do not

know it. This stems from the fact that the only way to diagnose MS is via a spinal tap, MRI or combination of the two. These procedures are costly, time consuming, and sometimes painful. Because diagnosis of the disease is relatively new the research and estimates for how many people have MS is in its infancy stage. At this time the National MS Society estimates that 400,000 people in the United States have been diagnosed with MS and that 10,000 more are diagnosed a year (Kalb, 2008). Others strongly disagree and believe this estimate to be extremely low.

We do not have information on Multiple Sclerosis in many countries which makes it very difficult to get world statistics. However, we do know that 1 /750 people in the United States have been diagnosed (Stachowiack, 2008). In Utah this number is remarkably higher at 1/300 (Brown, 2011). Figure 4 shows us a visual example of these statistics.

This may have to do with the fact that the majority of Utah's population live above the 40 degree latitude line which is the area identified as higher risk for Multiple Sclerosis (see Figure 5). Also according to the U.S. Census Bureau Utah's population is 92.7% caucasian, also contributing to a higher risk for MS.

### MS Symptoms that are Impacted by Design

In this section we will look at five categories that are impacted by design: accessibility, needs, efficiency, navigation, and psychological welfare. Each category will address the specific MS symptoms that might effect it.

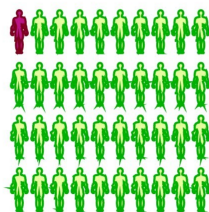
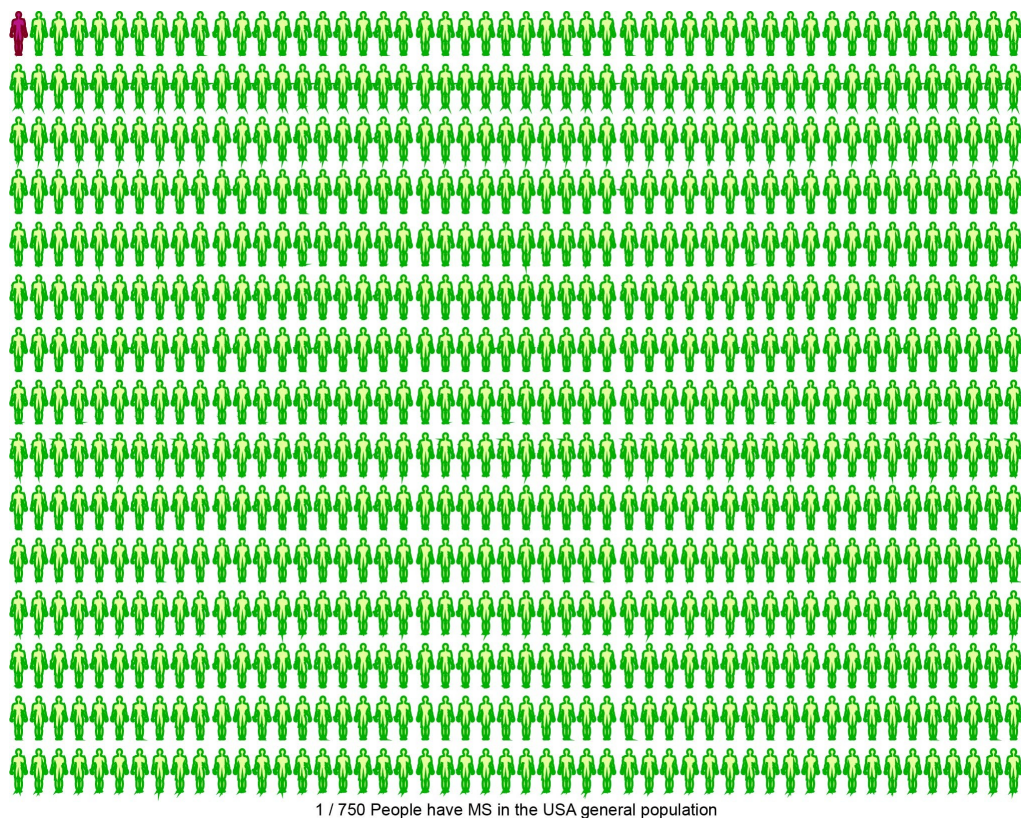


Figure 4 MS Population Comparisons. A comparison between different populations and their risk factor for multiple sclerosis (Illustration: By Author).

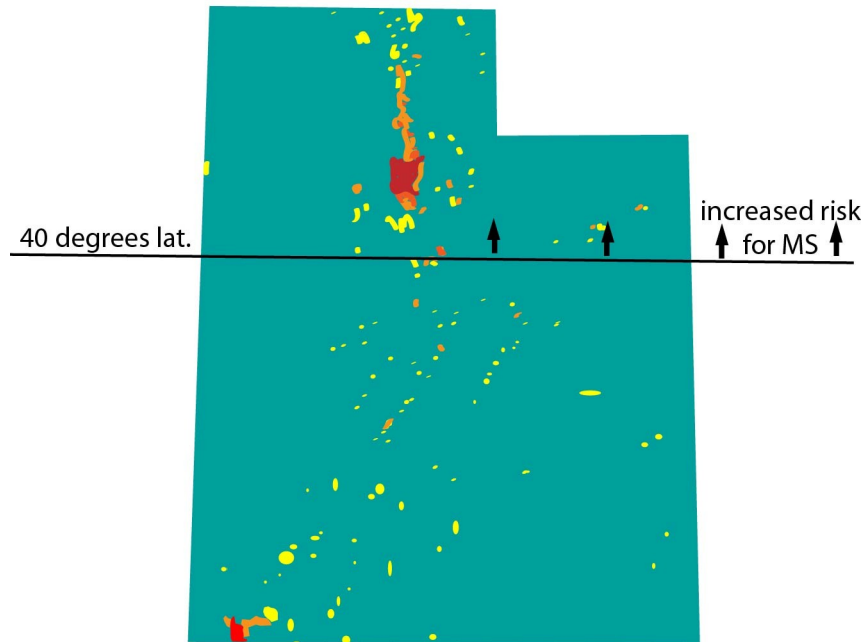


Figure 5 Utah's MS Risk Factor. The Majority of Utah's population reside above the 40 degree latitude line putting them at an increased risk (Illustration by Author).

### **Accessibility:**

#### *Mobility*

Many people admit to thinking of a wheelchair when they hear the words, 'Multiple Sclerosis' (The National MS Society, n.d.). Although many with MS will never need to use a wheelchair, there are many who will need a wheelchair or other walking aides at some point.

Almost all patients, during the course of MS, will require the use of a walking aide, such as a cane or walker. The majority of canes and walkers are collapsable. They

are designed to fit into a small spaces when not in use. But oddly enough space for the walking aides (even in collapsed form) are not generally provided in treatment centers.

This creates awkward situations for crowded medical waiting rooms. Folded and unfolded walkers take up space and can be obtrusive or embarrassing for all involved to navigate around.

### *Tremor and Balance*

Tremor can be an incredibly frustrating problem for many with MS. There is no cure for tremors and very few treatments are available and these are not very effective. Tremor symptoms occur in 75% of MS patients and are mostly evident in the upper limbs (Polman, 2008). This symptom interferes greatly with coordination, and may result in embarrassment for those experiencing tremors.

Tremors manifest in two ways. Gross tremors consist of wide back and forth movements while intention or action tremors occur when a person reaches for an object (The National MS Society, 2010). Tremors can manifest differently for different patients and treatment requires a good deal of patience and cooperation with a skilled medical team.

### *Spasticity*

Spasticity means “stiffness” of the muscles. It is a common problem faced by many with MS. Approximately 75-80 percent of people with MS will suffer with spasticity at some point. “This likely occurs as a result of demyelination of the nerves connected to ... muscles. This may lead to excessive firing of the nerves that control

muscles” (Holland, 2007, p. 3).

### **Needs:**

#### *Numbness*

Another symptom associated with MS is a numbing or tingling sensation sometimes described as pin and needles. It is caused by demyelination of the sensory nerves that tell the brain what it's feeling. This happens often in the hands and feet and can be a very distressing symptom.

Numbness and tingling sensations are not an indicator of disease progression and do not normally affect functionality of the muscles and joints. There are no treatments for this symptom. If the sensation interferes with functionality or causes emotional distress then drugs usually prescribed for other diseases can be helpful in reducing the sensation, but will not completely remove it. This symptom tends to come and go often and MS patients are generally counseled to ignore it as much as possible. Staying in one place can aggravate the condition.

#### *Bladder and Bowel Problems*

Some type of bladder dysfunction occurs in about 70% of people with MS (Polman, 2006). This symptom can be one of the most distressing and embarrassing problems for MS patients. It shows up in a variety of ways which require a variety of tests and treatments.

These types of problems can make using the bathroom more complicated, noisy and awkward. Using a public bathroom with open stalls can be difficult and

embarrassing.

## **Efficiency**

### *Weakness*

Muscle weakness is another severe problem for people with MS. Demyelination occurs on nerves connecting a muscle to the brain. It has nothing to do with the actual muscle or the muscles strength. Schapiro (2003) helps us understand with this example:

...when weakness is the result of poor transmission of electrical impulses, lifting weights may only fatigue the nerve and further increase muscle weakness. For people with MS, it is important to realize that exercises that involve lifting weights or repetitive movements of muscles to the point of fatigue do not increase strength, they increase weakness. It is somewhat akin to a light fixture that does not work because there is a problem with the fuse. Changing the bulb or flicking the switch will not fix the problem. In MS the problem is with the fuse, and attempting to correct the problem at the muscle or nerve level will only result in frustration (p. 43).

Although weakness can be temporarily aggravated by exercise the lack of it can also create weakness (Kalb, 2008). Deconditioning and muscle atrophy can be the result of avoiding exercise and activity. This weakness can add to overall symptoms and require extra treatment especially physical therapy. The line can be blurry at times, but a good indicator of when to stop is when one starts to feel numbness in a limb or ringing in their ears. This is a sign that the body is shutting down.

MS patients say that one of their biggest frustrations with weakness is when it effects their hands (Kalb, 2008). Hands are one of the most used body parts. It is hard to function without the ability to open a jar, turn a door knob or tie your own shoes.



Hand weakness can also lead to the frequent dropping of items. One MS patient talks of dropping her baby suddenly and dropping heavy objects as she pulls them off high shelves (Fraser, 2006). These things can be dangerous and emotionally taxing. Reportedly, dropping something makes individuals feel out of control of their situation. There are many new devices on the market now that can help with some of these problems. There are card holders for those who play cards and even devices that help you tie your shoes. Making eye contact with objects that you are picking up can help as can sensory impact such as rough surfaces. Taking precautions can prevent accidents like using lids on cups and driving with both hands on the steering wheel. Grasping items like doorknobs and faucet handles can be very difficult (Kalb, 2008).

### *Fatigue*

Polman, Thompson, Murray, Bowling, & Noweworthy (2006) state, “Fatigue, which may be defined as an overwhelming sense of tiredness, lack of energy, and feelings of exhaustion in excess of what might be expected for the associated level of activity, is thought to be the most common and perhaps the most disabling symptom of MS” (p. 70). Many with MS experience *Lassitude*, a kind of fatigue that strikes suddenly, thus demanding the immediate need for sleep and rest. Those with MS struggle to find a place, to rest and relax in crowded buildings or places with limited seating. They experience this same hardship while standing in lines at pharmacies, labs, and patient intake.



## **Navigation**

### *Vertigo*

Aggravation of the brain stem due to MS can produce the symptom of dizziness or lightheadedness. If severe spinning occurs it is called vertigo. Vertigo is a symptom of many diseases and illnesses. Vertigo is often accompanied with nausea and vomiting. Not much can be done for relieving vertigo through manipulating ones environment but often people who suffer from vertigo use canes and walkers which can impact how ones space is designed as discussed in the mobility section.

### *Vision*

Going permanently blind due to MS is possible though very rare. However, vision problems come in many other forms to those suffering from MS. In 2009, The National MS Society put out a brochure called: *Vision Problems: The Basic Facts*, in that brochure we find that often optic neuritis, or inflammation of the nerve, is one of the first noticeable symptoms that an undiagnosed MS patient will notice. This symptom can include blurred vision, dimming of colors, pain when the eye is moved, blind spots, and loss of contrast sensitivity. It is almost never permanent and most people regain their normal or close to normal vision within the month or within the year.

Nystagmus, another common MS symptom, is a condition where the eye jerks suddenly, sometimes called 'jiggly eyes'. This symptom can be vertical or horizontal and occur in either one eye or both eyes. It is more of a nuisance than a problem but medication can be helpful (Schapiro, 2003).

Double vision is categorized as Diplopia is often experienced by MS patients. It can affect one's balance and make tasks such as reading, watching television, and driving difficult. Often the eyes will adjust over time and compensate for the weak muscles causing this problem. Patching one eye can temporarily relieve the symptom during a task but is not recommended continuously because it does not allow for the eyes to adjust themselves (Schapiro, 2003).

## **Psychological Welfare**

### *Cognitive Problems*

Cognitive problems linked to MS are a more recent discovery. For years scientists and doctors did not recognize the mental symptoms that often occur along with the physical ones. Current research explains that the demyelination that occurs in the brain can occur in 'thinking' areas or areas that are commonly used for memory, recall, and problem solving.

Cognition can be divided into four main areas: receptive functions, learning and memory, thinking, and execution (LaRocca, 2006). Cognition is not the same thing as personality or emotions. For most people with MS personality changes are very rare. It is short term memory that affects most patients. One may be able to remember all of their childhood addresses but not remember the address of the house they just moved into. This falls under the category of recall. It can be very difficult for people with MS to recall the thoughts in their heads. This can also be said for recalling specific words. Often patients will say that they have a word on the tip of their tongue but just can not figure

out how to recall it. Keeping track of where one is in a building and figuring out navigation can become problematic for MS patients suffering from cognitive problems.

### *Depression*

There is a high number of MS patients suffering with depression. In fact, 25 percent of MS patients have suffered from the condition in the last year and 54 percent will suffer with it at some point during their lives (Fraser, 2006). Why MS patients suffer at such a high rate is still being speculated but three reasons that we know of are: (1) the physical effects happening in the brain from MS, (2) long term medications taken by MS patients that cause depression, and (3) the overwhelming amount of stress faced by those suffering with MS.

MS is actually a disease of the brain and because depression also occurs in the brain it is thought to correlate with the disease. The brains biochemistry can actually be changed by the disease which will influence emotions and behaviors. Demyelination, the result of one's immune system eroding the fatty lining around nerves, sometimes happens so severely in MS in parts of the brain, that ones thinking can be disturbed to the point of memory loss (Schapiro, 2003).

## METHODOLOGY

The primary goal of this evidence based research is to explain and provide interior design strategies for redesign and future design in MS facilities. The project began with an examination of the disease and an analysis of the associated symptoms that could be impacted or assisted by design covering accessibility, needs, efficiency, navigation, and psychological welfare. After a review of current ADA codes and suggested design practices for other illnesses and ailments with similar symptoms, an assessment of interior design field implementations in other MS treatment facilities and general healthcare services will be conducted. Finally suggested design strategies for future and existing MS facilities will be recommended using a collaboration of suggestions from the field of design as well as the field of medicine.

### Legal Requirements for MS Treatment Spaces

The United State Congress created the Americans with Disabilities Act Law (ADA) to create safe, barrier-free, accessible buildings and institutions for the millions of American people suffering from disabilities. The ADA Companion Guide written by M.A. Rhoads in 2010 provides the actual guidelines of the most updated version of the Act, which was last revised in 2004. Although the ADA successfully provides laws that require working spaces for those in a wheelchair, it does not cover architectural obstacles many individuals with MS might face. This means that ADA compliant spaces may not be conducive or accessible to individuals suffering from multiple sclerosis.

Laws exist to provide disabled persons with safe, functional environments but

these laws do not provide for all needs. This section provides the reader a look at some of the most common laws that should be applied to all spaces. The researcher is making design suggestions above what is required.

Section 703 of the ADA guidebook describes the guidelines for signs used in “way-finding.” Signs requirements include, pictograms, raised lettering, braille, approved text, and location of sign placement (Rhoads, 2010). The assumption being that a blind person could use the braille, a seeing person could read the sign, and a seeing person who spoke another language could derive the use based on the universal pictograms. However, this does not take into consideration people who are temporarily blind and do not know how to read braille; as is the case for many people with MS. A six week session of blindness is a typical MS exacerbation and will eventually clear and normal eyesight will return. Braille can take months or years to learn and thus it is safe to assume that most people suffering from this type of exacerbation will not will not be able to access braille, signs as a means of “way-finding.”

Per section 706 of the act Assistive Listening Systems, or audio devices such as headphones are required in venues where “an integral part of the space requires listening” (Rhoads, p. 310). This can provide great assistance to MS patients suffering from temporary blindness but does not provide help with way finding inside of a building.

Section 407.2.2.3 explains that elevators have to have to have audible signals for up and down but the use of one ding for up and two for down is allowable (Rhoads, 2010). It is highly probably that blind people have picked up on this sound system but someone with temporary blindness generally speaking would not know this system.

Another area of concern is the buttons inside the elevator are also not required to audibly announce the floor when pushed.

Seating requirements are provided for those who use wheelchairs and specific guidelines are given in section 800 (Rhoads, 2010). However, it is not required to provide seats with adjacent walker or cane parking. Although sufficient space may be available within the room the person using the cane or walker would have to travel back to their seat unaided after parking their walking aid. This challenge is impossible for some.

Most of the guidelines for egress and traffic involving wheelchairs are based on the assumption that there is one wheelchair in the hall or one wheelchair on the sidewalk and that all the others around that individual are walking normally, and not using assistive devices. This may be the case in most situations but in a facility that is geared toward MS there will typically be many wheelchairs in a given space. According to the ADA guidelines it is not required that two wheelchairs need to be able to pass each other in a hallway or in a bathroom. This creates major traffic jams and proves difficult for use in many medical facilities.

Section 604.8.2 states the parameters for ambulatory accessible toilet compartments. These compartments are ideal for someone who is using crutches a walker or a cane because they provide more space than a typical stall and have hand rails. The hand rails are parallel to the sides of the toilet and closer together than in a handicapped stall which makes them easier to use (Rhoads, 2010). The use of these types of stalls would greatly benefit MS users.

## Design Recommendations for Ailments and Illnesses that Share Symptoms with MS

The research for MS specific design recommendations is sparse at best. However, this type of research has been conducted for ailments and illnesses that share symptoms with MS patients. This section will review the design recommendations that have been provided for those ailments and illnesses including: fatigue, vision impairment, Parkinson's disease, depression, old age, and restless leg syndrome.

### **Fatigue**

Although chronic fatigue syndrome is an actual sickness who's symptoms cannot be reduced by rest or sleep. Many illnesses describe fatigue as a primary or secondary symptom. These illnesses include cancer, muscular dystrophy, multiple sclerosis, Parkinson's disease, and spinal muscular atrophy to name a few.

*Human Dimension & Interior Space*, written by Julius Panero, and Martin Zelnik was created to, "...develop an awareness on the part of the architect, interior designer, builder, manufacturer, and user of the importance of anthropometry as it relates to human fit and interior space" (Panero, 1989 p. 13). When designing a space that will be utilized by a disabled or wheelchair bound person or those with physical impairments or limitations it is exceptionally important that items of use such as patient outlets, chairs, exam tables, and bathroom fixtures are placed within a reasonable range of motion to lessen fatigue, foster independence, and promote best design practices (see Figure 6 and 7 for specific dimensions). The following Figures are illustrations drawn by the researcher using Panero's dimensions for disabled people.

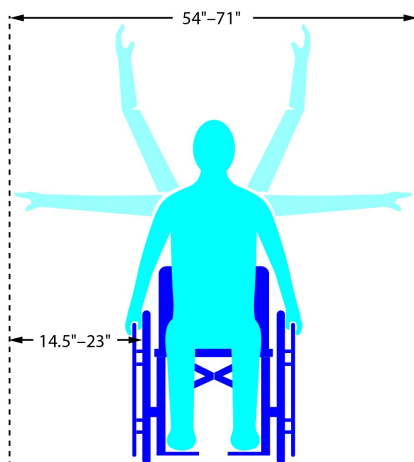


Figure 6 Wheelchair Dimensions Front View. Dimensions showing range of motion for a wheelchair bound patient. (Illustration: By Author)

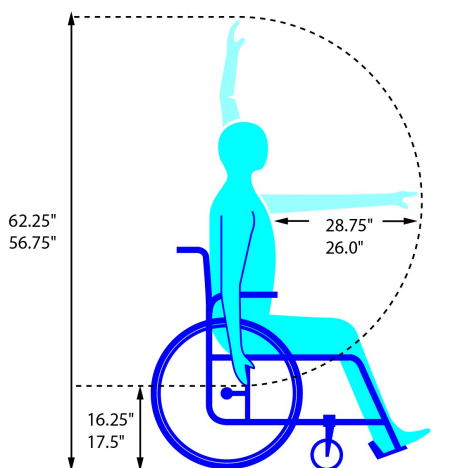


Figure 7 Wheelchair Dimensions Side View. Dimensions showing range of motion for a wheelchair bound patient. (Illustration: By Author)

In a typical working area where a table or desk is used the recommended height is 29-30 inches. This measurement is based off the distance between the bottom of one's thighs when sitting to the top of the surface being a minimum of 7.5". When a person is



sitting in an electric wheelchair they sit at a significantly higher height than an average chair. Therefore the the table or desk should be adjusted to the 7.5” rule over the 29-30” rule. (Panero, 1989).

Symptoms of fatigue can also be reduced in an environment by the use of ergonomic chairs that promote good posture, and foam mats where standing is required for a length of time. Flooring such as cork which has air pockets that act as natural shock absorbers can also reduce fatigue while walking.

“Cork's extraordinary properties derive from its distinctive cellular structure. A one inch cube of natural cork contains more than 200 million tiny air-filled pockets. Some 50% of cork is captive air, which results in excellent buoyancy, compressibility, elasticity, a high degree of imperviousness to both air and water penetration and low thermal conductivity.” (About Cork, n.d.)

More traditional flooring such as hardwood, and carpet can also reduce fatigue if the proper padding is used underneath. Floating hardwood that has a thick pad underneath will reduce injury during falls and cushion footsteps. Another option, rubber flooring, is ideal for surfaces that require resilience, shock and sound absorption and traction. The high level of reused materials makes it an environmentally friendly choice (rubber.com).

### **Vision Impairment**

The American Foundation for the Blind recommends a variety of design practices for accommodating vision impairment (Adapting Your, n.d.). Although the following summary was provided for use in a residential environment most of their recommendations apply to a commercial space as well.

### *Increase Lighting*

- Use stronger light bulbs or 3-way bulbs to provide non-glare lighting.
- Put lamps in places where you do close work. For example, put a gooseneck lamp in your reading-writing area. Many companies make lighter light bulbs which simulate natural day light which can be very helpful to someone with low vision.
- Put extra bright lighting over all stairways—the places where accidents are most likely to occur.
- Make sure the lighting level is consistent throughout the space so shadows and dangerous bright spots are eliminated. Install rheostats (a circuit current interrupter which allows for dimming and controlling lights).
- Be certain light switches are easily reached from doorways.

### *Eliminate Hazards*

- Use nonskid, nonglare wax to polish floors.
- Pick up items that you could trip over.
- Mop up spills as soon as they occur.
- replacing worn out carpeting and removing area rugs.
- Electrical cords should be away from walkways and nonskid products should be used when cleaning and polishing floors.

### *Create Color Contrasts*

- Put light colored objects against a dark background—a beige chair against a dark wood paneled wall, for example—and vice versa—a black switchplate on a white wall.
- Install doorknobs that contrast in color with the door for easy location.
- Avoid upholstery with patterns. Stripes, plaids, and checks can be visually confusing.
- Contrasting colors can be used on stairs, doors, light switches, and electrical outlets. Upholstery should use a variety of textures to provide tactile cues for differentiating items, such as a pillow from a chair.

### *Reduce Glare*

- Glare can be caused by sunlight or light from a lamp and can make it difficult for an individual with low vision to see when it hits shiny surfaces, such as a glass or highly polished table top, waxed floors, or the TV screen.
- Sunlight can fill the room with light without producing glare.
- Window coverings or blinds are one of the best window coverings because they can be altered during the course of the day to eliminate the glare.

- Avoid using wax on the floor; use a flat finish.
- To make the television easier to see, simply turn the screen away from the sun or a lamp so the light source is behind the screen.

The American Foundation for the Blind compiled useful ideas regarding designing for the blind. They recommend high contrast colors wherever possible and bright colored accessories. Items such as switch plates and doorknobs should be a darker color than the walls. Glare makes it harder to see items, so any shiny items should be avoided. Signs should be large, at eye level and on a matte surfaces. Stripes and checks can increase blurry vision so prints should be avoided on upholstery. A variety of textures is recommended for providing sensation cues (American Foundation, 2011).

#### PARKINSON'S DISEASE

Parkinson's disease is characterized by four major motor problems: shaking or tremor, bradykinesia (slowness of movement), rigidity of trunk and arms, and trouble with balance (Suzman, 2005). All four of these symptoms are shared with MS patients thus the design recommendations for Parkinson's disease are highly relevant for MS patients. The National Parkinson's Foundation has provided the following suggestions for making one's environment as functional and safe as possible for those suffering with Parkinson's disease. (Suzman, 2005).

- It is recommended that furniture be secure, sturdy, and does not swivel.
- In areas where people may want to read bright lighting is encouraged to reduce eye strain.
- Windows should feature adjustable blinds to regulate glare that could inhibit vision.
- There should be plenty of space between furnishings for easy navigation.\*
- All pathways should be free of clutter and drastic flooring changes to reduce falling risk.\*
- All cords should be hidden and out of the way of traffic patterns.\*
- Toilets should meet ADA height requirements.\*

- Grab bars should be provided in bathrooms AND areas where patients frequently get up and down.\*
- Keeping the water heater temperature low can prevent burns on numb hands.
- Flooring in bathrooms should be rigid and non-stick to prevent slipping.\*
- Floors should not be waxed or used any chemicals that may cause falling.
- Where possible a long handle in lieu of a knob is easier to operate. This includes faucets, doorknobs, and cabinetry.\*

*\*asterisks were placed by author to note that the suggestion is required by ADA code.*

WebMD, a medical website for the public, goes into more detail explaining that furnishings should be arranged around outlets so that lamps can be placed without the use of extension cords. They recommend that, “using chairs with straight backs, armrests, and firm seats, this will make it much easier for you to get up and sit down. Add firm cushions to existing pieces to add height and make it easier to move.” (Adapting Parkinson's Disease, n.d., p.1)

Stairways are an areas where there is a tremendous risk of falling. Avoiding stairs all together is the best option but when they can't be avoided great care should be taken to make them as safe as possible. The nosing on the stairs can be painted with a bright color for visual clarity and the stairs themselves should be made of non-skid flooring (Suzman, 2005). As required by ADA codes handrails on at least one side should be provided but two is the best scenario.

Falling is one of the greatest issues with Parkinson's disease and can cause serious injury. When selecting furnishings it is imperative that sharp edges are avoided. Countertops or other hard surfaces can be covered with a padding to cushion the blow if one does fall (Dealing with the Daily, n.d.).

Lighting is very important for Pakinson's patients who have visual problems.

Adding lamps can be helpful but the small knobs can be hard to operate. Using a touch sensitive lamp with three degrees of brightness is an ideal choice but when a switch is needed the rocker style is easier to flip than the standard switch. Negating switches altogether is also an option by installing motion activated switches (Schwarz, 2006).

When doorknobs become challenging, Schwarz recommends:

Replace regular doorknobs with lever handles or purchase a rubber lever that fits over any standard doorknob. Lever handles are easier to operate—just push down with your hand, arm, or elbow...Place U-shaped handles near doorways to help you navigate through the doorways more easily. If you tend to fall backward when opening a drawer, door, or cabinet, you may want to install U-shaped handles nearby to help keep your balance. (p. 16)

Although this is a requirement of the ADA guidelines it is often ignored within commercial spaces.

When it comes to designing for Parkinson's disease Ivan Suzman (2005) gives this advice:

First, arrange the furniture to allow plenty of space for comfortable standing, sitting and turning (for those who use wheelchairs, the standard is to allow at least five feet). If you use the stairs, add handrails to both sides of the staircase, and mark the first and last step with white, non-slip paint for easy recognition. Linoleum, vinyl and wood floors are safer if we either secure, or remove, loose rugs. If you are considering remodeling, Mary Ann Ryan, from Orion, Michigan, suggests staying away from carpet and instead opting for vinyl or tile floors. These surfaces will be easier to navigate when using Hoyer lifts, walkers, canes and wheelchairs and do not show as much wear. The downside of these materials, Mary Ann points out, is that they can be dangerous; vinyl can be slippery and tile is a hard surface if a person does fall. If you choose instead to lay down a carpet, make sure it is low-pile so that your feet do not get caught in it.

Suzman also recommends chairs with arms over side chairs because they can assist with

getting out of a chair. He also notes that pen and paper should be accessible for communication issues.

The risk of falling in the restroom for people with many medical issues can be greatly reduced by providing ADA height toilet seats, grab bars, and rubber mats to give purchase. (Safety at Home, 2011)

Tremor is also experienced by Parkinson's disease patients. There is significant research regarding securing a home environment for Parkinson's disease. This research informs and can, for the most part, also be applied to commercial design for MS patients.

Like MS patients, people with Parkinson's also have trouble with their eyesight and balance. Patrick McNamara, MD, suggests putting handrails in places that require frequent getting up and down such as waiting rooms and exam rooms. This could be considered the same need for MS infusion and treatment centers. Bright lighting to assist with vision impairment. When evaluating a space he suggests thinking of anything that, a shaking, off-balance, medicated, visually impaired and anxious person might find troublesome in their environment. (McNamara, 2011)

## **Depression**

When it comes to design and depression, color can be our greatest tool. Color can actually effect depression. Blues have been determined to feel depressing while hot colors, like red, have actually been proven to increase blood pressure and stimulate the nervous system which is undesired in MS patients. These buildings color schemes effects are described by Prentiss (2009):

Certain hues have been defined by their usage over the years, and have become widely known to evoke certain feelings or emotions. There is also a physical science to color. Often these emotions that are tied to color are not purely defined through sociological refinement, but rather are visceral reactions created in the brain that slow down or speed up the nervous system.

Color is more than just what we see with our eyes but something that can actually have an effect on our bodies and minds. “Color is, first, a sensory event. The beginning of every color experience is a physiological response to a stimulus of light” (Holtzschue, 2006, p.2). This means that the colors we come in contact with in our environment have positive or negative effects on individuals.

The power of color is significant and can be used as a tool to create the desired effect on people. Colors have been chosen to stimulate or to calm; and can therefore be used to arouse a non-visual sense, instill unconscious motivation, alter behavior, or induce mood (Holtzschue, 2006).

A field recognized expert in color theory, Frank H. Mahrke, is quoted in *Understanding Color* (Holtzchue, 2006) as describing six different levels of response to color. Figure 8 is a visual representation of his levels of response.

At the base level of his theory, we as human beings are constantly being stimulated by color. Our reaction to this stimulus is an unlearned behavior. Collective unconscious means that the association with color is cross cultural like blood and red or sky and blue. Moving up the pyramid, we see learned responses. These are influenced by the places we live and the things we see, they are not universal, they are environmental. Such as white being the color of purity in western civilization but the color of mourning in India. (Holtzschue, 2006)

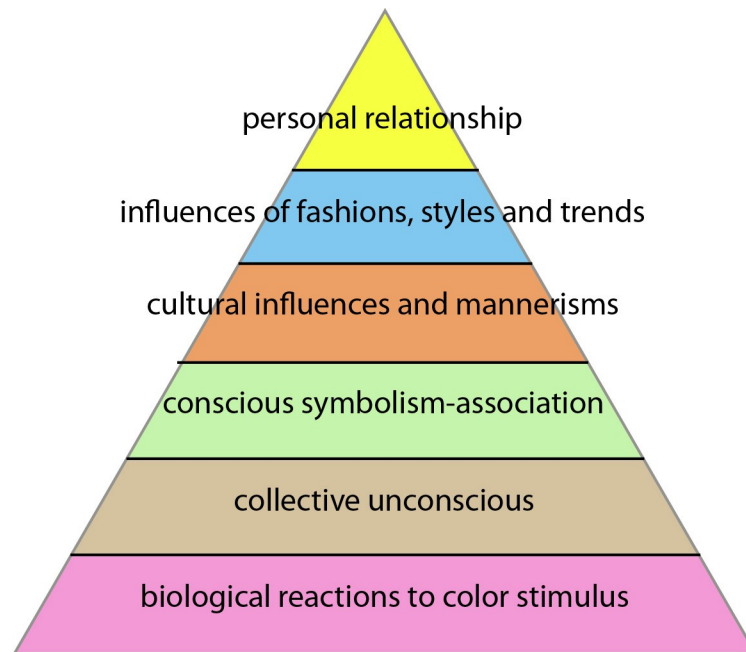


Figure 8 Color Theory Pyramid: Mahnk's theory on the six levels of response to color. (Illustration: by Author)

Studies have been done extensively to figure out just how much color can influence one's actions and emotions. These tests range from people's personal preferences to scientific studies of light. Currently studies are being conducted to investigate the environmental impact of color on different types of illnesses. Findings are still in the newborn stage. (Pile, 1997). The basic color wheel is broken into two families: warm colors and cool colors. John Pile (1997, p. 137) explains the use of different color families and their effects:

Warm colors. These are generally associated with the impact that is suggested by the use of the word warm with other meanings. We speak of a warmth greeting, and warm friendship, or a warm atmosphere. In color terms, the hues on the warm side of the color circle (red, orange, and yellow) and their related tints and shades



are generally understood as comfortable, cozy, homelike, and pleasant. There is an association with physical warmth and the resultant sense of contentment. Experiments have shown that interiors with primarily warm color schemes will prove comfortable to occupants with actual air temperatures lower than required to achieve similar comfort in identical spaces using cooler colors.

Cool colors. These colors fall on the green-blue-violet side of the color circle. They are, not surprisingly, associated with calm, relaxation, and more contemplative experience. Cool colors tend to lower the sense of actual air-temperature and so are often preferred in situations where excessive heat (climatic or artificial) can be anticipated. At an extreme, cool colors may become depressive and negative in psychological impact.

These color families become very important when dealing with a high stress environment where patients commonly suffer from depression and heat sensitivity. In fact, The National MS Society reports that many MS patients' symptoms increase dramatically when a patient feels overheated. Using cool colors could reduce the overall perceived temperature to be cool (Pile, 1997).

The following is an important summary of color effects described in *Color in Interior Design* by John Pile, an interior designer, architect and professor at Pratt University. These explanations of the effects of particular colors correlate with needs expressed by MS patients and will be explained further in the project details.

Red is the color of fire and blood, giving the feeling of excitement, heat, intensity, and force. Associated with danger and warnings, it loses its intensity when mixed with white, which produces pink.

Orange shares some of the same characteristics with red and yellow, giving it a sense of excitement but reduced when compared with red; it also evokes cheerfulness from its yellow side.

Yellow is less aggressive than other warm colors and generally seen as happy. Yellow feels open and expansive, the color of sunlight. Represents cheer, activity and mild stimulation. It is warm but not overbearing.

Green is the warmest of the cool colors. The yellow makes it cheerful and the blue makes it calm. Green has a sense of stability. It has the tendency to be seen as the ideal color offering some virtues of all other colors. Because of this it is sometimes overused and thus can become drab. Green is associated with grass, trees and vegetation so is thought to be a natural color. It is calming and restful. It is also associated with health and well-being. It also links to dignity and solidity.

Blue is the coolest color. It has no content of any of the warm hues. It is associated with calm but can also border on depressing. Blue encourages thought, contemplation, and meditation and so it is the color of intellectual activity. It can actually lower body temperature, pulse rate, and blood pressure and thus stands as a full opposite to red. Blue represents openness and spaciousness because of it's associated with ocean and sky.

Violet is thought of as problematic as it combines the two most contrasting colors. Some feel it is to be avoided because it disturbs people. It is also viewed as the color of subtlety, sensitivity, and artistic. Lighter tints are thought of as light, playful, and magical while darker shades are viewed as dignified, mystical, and threatening.

Brown is considered warm due to it's parent hues. It is associated with dirt and soil and can be seen as drab. It also relates to wood which gives it a feel of honesty and simplicity. It lacks energy but gives comfort.

White is often viewed as a non-color but is actually the combination of all colors. It is viewed as a color of purity, cleanliness, and boredom. It is also viewed as a color of modernism. It is a symbol of sanitation.

Black is the true non-color because it reflects no light or color. It evokes feeling of depression, power, edge, emptiness, authority, formality and death. It feels heavy and forbidding. It feels dramatic and makes a powerful statement when mixed with white.

Gray does not have any strong color associations. It can range from light to dark and warm to cool. It tends to take on the feelings of the color that it most closely resembles.

Using the color theorists Pile, Holtzschue, and Mahnke explanations of color interior designer can mold existing and future spaces to better meet the emotional and physical needs of MS patients. Similar to many design projects, the use of color in a space can be laid out in an obvious path by first thinking of the mood one wants to create in a space. Once this is established the colors can be chosen based on the feelings they produce to create an optimally colored space. However, often times in medical facilities the needs of the patients are not addressed through the use of color.

### **Old Age**

As a person ages their body slowly begins to break down. This leads to a variety of ailments including but not limited to memory loss, vision impairment, mobility issues, weakness, poor balance, fatigue, and stiffness. All of these ailments are also symptoms of MS. By looking at design adaptations for the elderly we can derive working design strategies for MS patients.

Senior Resource, an online resource for housing options for the elderly, provides an overall look at where potential problems may lie. Table one is a summarized list of these recommendations that could apply to MS in a treatment center as well as the elderly.

<b>Difficulty</b>	<b>Possible Remedy</b>
Balance & Coordination	Counter edges are rounded
	Grab bars near toilets*
	Stairway handrails on both sides*
Limited Vision	Edge of Counters is a different color than the top
	Edge of each step is a color that stands out
	Increased wattage of light bulbs
	Stairs are well lit
Poor Hand and Arm Strength	Steps are a different color than the surrounding area
	Doors have lever handles*
	Rocker light switches
Trouble Walking	Sinks with lever faucet handles.*
	Floors are smooth and slip-resistant*
	Knee space under sinks, can sit while washing.*
Uses a wheelchair	No area rugs*
	Stairs have slip resistant surface*
	Clutter and electric cords are out of pathways*
	Doors and hallways are wide enough for a wheelchair*
	Electrical outlets are 27" above the floor
	Floors are smooth; carpet has a low pile and a firm pad.*

*\*Asterisks added by author to note recommendation is a current ADA code.*

Senior Resource (Home Assessment, n.d.) tells us that over one million Americans over the age of 40 are blind and that 2.4 million are visually impaired. This makes better lighting critical in environments hosting seniors. Contrast colors between floors and walls, color borders around the perimeter of the floor and counters, matt-finish paint, non-glare artwork, and additional task lighting are all recommended for vision impairment.

In a report given by *Science News* we see some similar recommendations made for the elderly. They also advocate lever doorknobs, and dense tightly woven carpet but in addition to these recommendations they also suggest using loophole drawer pulls, french doors, and threshold free travel paths (Cornell, 1998).

In addition to these recommendations there is also helpful equipment that should be considered. In an existing facility not much can be done about tall thresholds but there is an easy fix, rubber ramps. Rubber ramps can be ordered online and cut to fit individual door needs. They can smooth the transition from room to room when a person is in a wheelchair (Adapting Your...Elderly Parent, 2011).

Getting in and out of seats can also become a struggle for an elderly person. Asking for assistance takes away independence and puts a physical strain on both the patient and the care giver. Recliners are available with push buttons to raise and lower a person on and off a chair from a sitting or standing position (Adapting Your...Elderly Parent, 2011).

Although MS patients rarely encounter cognitive problems up to the point of dementia some will be faced with memory loss. "Alzheimer's disease is a slow

progressive disease, starting with mild memory disturbances and ending with severe destruction of certain brain areas” (Creating an Alzheimer's, n.d.). Some suggestions given for Alzheimer's patients could possibly be beneficial for an MS patient. Keeping the layout of a space constant and avoiding rearranging furniture will help Alzheimer patients keep their bearings (Creating an Alzheimer's, n.d.).

### **Restless Leg Syndrome**

A newer disease, restless leg syndrome, is described by the Mayo Clinic (2009) as:

a condition in which your legs feel extremely uncomfortable while you're sitting or lying down. It makes you feel like getting up and moving around. When you do so, the unpleasant feeling of restless legs syndrome temporarily goes away. Restless legs syndrome can begin at any age and generally worsens as you get older. Women are more likely than men to develop this condition. (p. 1)

It's symptoms are often described as limbs that feel: Crawly, Tingling, Cramping, Creeping, Pulling, Painful, Electric, Tense, Uncomfortable, Itchy Tugging, Gnawing, Aching, or burning. (Mayo clinic.) These symptoms are often experienced by MS patients as well and like Ms RLS worsens and lessens over periods of time. The urge to move should not be ignored and sometimes standing can be helpful. Although these are not direct design suggestions the design of a space should be set up to accommodate people who might wish to move or stand during their time in a facility (Mayo Clinic Staff, 2009).

### **Current Interior Design Field Practices in Healthcare**

The breadth of research on direct implementations found in the illness section in a

commercial setting is incredibly narrow. Information on ADA and general welfare has been addressed, but the kind of specificity that could benefit an MS clinic is not available yet, which furthers the need of this paper. This section include a review regarding design guidelines produced by the healthcare interior design industry as well as current implementations of these guidelines.

### **Planetree**

Planetree is a world renowned leader in medical healthcare design. They believe strongly in the patient receiving the very best medical care but also the best human care. One of their core beliefs is that physical environments can enhance healing, health and wellbeing (Planetree Vision, n.d.).

Carr (2010) writes about the Whole Building Design Group, a program of the National Institute of Building Sciences. In this article he tells us about the evolution of medical design to encompass the patients physical and emotional needs:

In the past, communicable diseases were the major health problem, and sanitation or cleanliness was the main characteristic of a healing or therapeutic environment. Cleanliness remains extremely important, but there is increasing recognition of the value of a pleasant, easily-understood, and non-threatening environment for patient recovery. For example, the Planetree Hospital philosophy of "demystifying medicine" emphasizes such a physical environment as part of its approach. Good design in the health care setting starts by recognizing the basic functional needs, but does not end there—it must also meet the emotional needs of those who use such facilities at times of uncertainty, dependency, and stress.

### **LittleFISH Think Tank**

Sibley Fleming wrote an article on an interview with Tara Rae Heal the principal at LittleFISH think tank an interior design firm focusing on healthcare (2009). In that

interview Tara explain the facets of healing with interior design. She discovered a study by Roger Ulrich (1986) that explained:

...the beneficial effect of visual stimulation on the recuperation rate of patients in hospitals. Ulrich reported that patients provided with vibrant surroundings in the form of paintings, flowers, or merely a pleasant outside view, recovered roughly three-quarters of a day faster, and needed fewer painkillers than those living in dull drab surroundings.

This information was crucial in backing up the importance of design and healthcare. Hill has designed many spaces using this information. She likes to draw on nature for the visual stimuli. There are five tenets of design that she employs for healthcare design they are:

The first tenet is *access or connection to nature*. It can be plants indoors or an aquarium. But, research shows that figurative forms of nature can be just as healing as the genuine article. Figurative forms serve as a conduit for the psyche to experience nature without a literal connection. A figurative form could be anything from artwork that evokes nature to furnishings with wood surfaces. Some facilities apply the first tenet by piping in music that has a very natural sound to it.

Another tenet is *positive distractions*. Anything that takes a patient and/or their family's mind off the serious medical issues they may be dealing with promotes healing. It could be the way the floor pattern is designed or a lighting display or even a sculpture. For children, positive distractions must be interactive to be effective. They respond quite well to audio-visual special-feature walls consisting of an enormous screen with buttons they can punch to make things happen.

Patients also respond to *a greater sense of control in their environment*, such as having multiple seating options with say one grouping around a TV screen and another in a quiet setting so that a patient can read. Also, a more intuitive space can be designed so that when a patient walks in the front door he knows where to go and what to do. This empowers the patient and minimizes the need for onerous signage since the architectural elements naturally guide him to key destination places.



*Social support spaces* are more relevant to clinics and hospitals and include consultation rooms. Instead of formal libraries and impersonal waiting rooms, where families have historically received bad news, there are now information centers. Here, family members can leave the patient for a bit, go to the info center, surf the internet, and find comfort and empowerment in conducting their own research to corroborate what the medical practitioners are telling them to do.

And the last healing tenet, which is actually incorporated into some of the others, is *to reduce or eliminate environmental stressors*. Patients feel less stress in a space that has good acoustics, reduced signage and a less institutional feel. For example, noise reduction and the elimination of overhead paging serve to neutralize an otherwise irritating environmental stressor. (Fleming, 2009, P. 1)

Studies have shown that following these five tenets have made patients calmer and more cooperative. Designs that follow the five tenets have also shown to decrease anxiety in family members and make staff more effective with less turnover. Using the five tenets does not have to cost any more than traditional design strategies (Fleming, 2009).

### **MS and Sunlight**

A recent study was conducted on Multiple Sclerosis and sunlight. It has now actually been proven that MS patients symptoms actually decline when exposed to greater amounts of sunlight. Scientists have found that disease symptoms are reduced as exposure to sunlight increases – large windows, skylights, and readily accessible outdoor areas seem like important features in environments used by people with multiple sclerosis (Mayne, n.d.).

## Existing Healthcare Facilities

### **John Muir Medical Center**

The newly expanded John Muir Medical Center has employed the same strategy on light. Every new room has an outdoor view that maximizes natural light as well as lighting and acoustical treatments to create a more healing environment. The use of local artwork also brings indoors the feelings evoked by the outdoors (Ratcliff, 2011).

### **Muhammad Ali Parkinson's Disease Center**

*Medical Construction & Design Magazine* recently published an article on the Muhammad Ali Parkinson's Disease Center in Phoenix, Arizona. This center is part of the St. Joseph's Hospital. Matthew Bode, president of Trinity, the design firm on the project, was quoted as saying: “We have been privileged to coordinate a team effort to design a facility that is a model for the rest of the country by providing a unique approach to integrated Parkinson's care with a focus on the latest in technological advances.” (p. 9). One of the key points of their design is the inclusion of spaces a Parkinson's disease patient might use in addition to the standard medical care typically included in a facility. Some of these newly included spaces are a multi-purpose room for recreation and education, a store that sells Parkinson's adaptive items, a dedicated area for speech, occupational, and physical therapists and a resource library (Muhammad Ali, 2010). The all-in-one focused center provides a more unified treatment experience as well as providing the patient with more outside resources and less travel time.

## **The International Multiple Sclerosis Management Practice**

The International Multiple Sclerosis Management Practice or IMSMP is a fairly new building located in Manhattan, NYC, NY. The focus of the design was to create a liveable feeling space that didn't follow the generally accepted maze like floor plan of healthcare buildings. The first goal of the center was to open communication between the doctors and staff of the facility with the researchers and scientists. Yoshihara McKee Architects, placed the lab in plain view of the patients and staff to give them an ever present reminder of hope (International Multiple, n.d.). The second goal of the project was to focus on the feel of the space. Bright colors and wood floors were used to enhance the feeling of comfort and stray from the standard sterile white. Large well lit columns are featured throughout the space giving the open floor plan focus. (International Multiple n.d.). The third goal of the project was the lighting. Glass clerestories windows were placed in the perimeter rooms, maximizing and distributing light into the interior corridors, and the main corridors end in areas with windows to the exterior. This provides a sense of the exterior and an orientation point. A series of glass screens and the punctuation of the round columns create an interesting sequence in the long corridors (International Multiple, n.d.). Beyond the feeling good lighting produces we also know the importance of lighting for vision impairment from the illness section of the paper.

The IMSMP also utilizes gait paths in its design. A gait path is a dedicated area for walking tests that consists of a predetermined length of flooring separated by color or permanent floor markings with ADA compliant handrails that can be adjusted for height and mirrors which give feedback to the patient. During a routine exam of an MS patient

an assessment of the patients gait, or walking pattern is performed. Detailed notes are taken about balance, timing, and coordination to be compared with previous and future gait tests. These studies can tell doctors about the progress or deterioration of a patient. Performing the test in the same area for the same length of floor creates more accurate patient data. The IMSMP's gait paths are 4' x 15' and include rails, and mirrors.

(International Multiple, n.d.) Other facilities have also included gait paths in their spaces like the Melen Center in Cleveland. (Departments, n.d.)

The IMSMP also features an infusion center. Their infusion center has 18 stations and provides many extras for the patients. Some of these include: large, inviting treatment chairs, blankets, a flat-screen television, and coffee and snack bar. Massage and reflexology services are available to patients during their treatments. A private infusion room is also an option. (imsmp.org)

### **Intermountain Medical Center**

One of these facilities is Intermountain Medical Center (IMC) in Murray, Utah. Upon researchers tour of the facility it was found that this facility, includes large single occupant bathrooms that easily allow for IV poles and wheelchairs. Each infusion station has its own flat screen TV mounted on the ceiling, and each patient is given their own set of headphones that stays at the center for future use. These stations also have a chair for a loved one and a privacy curtain that can be pulled around it. Meals, snacks, and beverages are provided. Patients have the option of a hospital bed or a reclining infusion chair for their treatment. Patients can also choose to be in a dark room or a room with six foot tall windows that go wall to wall. The centers design revolves around cool relaxing

colors.

### Design Strategies for Multiple Sclerosis

In this section the researcher will combine and apply all of the recommendations found in the previous sections, starting with a strategies checklist that applies to all areas of the building. A look at individual areas of the facility will follow.

## Finishes

### *Flooring & Finishes*

Recommendation:	For further information see section(s):
Flooring should be smooth and slip-resistant (Home Assessment, n.d.)	Old Age / Parkinson's Disease
Flooring changes should maintain the same elevation (Safety at Home, 2011)	Tremor & Balance
Flooring should be a contrasting color to it's surroundings (Adapting Your, n.d.)	Vision Impairment / Old Age
Avoid flooring that requires glossy wax (Adapting Your, n.d.)	Vision Impairment
Select an anti-fatigue flooring such as cork, rubber or floating hard wood (About Cork, n.d.) (Rubber.com)	Fatigue
Carpeting should have a low profile and a firm pad (Home Assessment, n.d.)	Old Age
Paint should have a matte finish (Home Assessment, n.d.)	Old Age
The perimeter of flooring should have a contrasting color band (Home Assessment, n.d.).	Old Age

### *Furnishings*

Recommendation:	For further information see section(s):
Layer light and dark colors for ideal vision clarity	Vision Impairment

(Adapting Your, n.d.) see figure 13 & 14.	
Avoid upholstery with patterns such as stripes, plaids, and checks (Adapting Your, n.d.) see figure 15.	Vision Impairment
Use a variety of textures (Adapting Your, n.d.) see figure 16.	Vision Impairment
Patient use tables and desks should be adjustable to 7.5" above chair seat (Panero, 1989).	Fatigue
Use ergonomic chairs which promote good posture (Panero, 1989)	Fatigue
Chairs should have firm cushions, straight backs, and armrests (Adapting...Parkinson's Disease n.d.)	Parkinson's Disease
Cool colors with warm accents should be used on furnishings (Pile, 1997).	Depression
Furnishings should be void or sharp edges to reduce injury during a fall (Home Assessment, n.d.).	Old Age
Countertops should have a band of contrasting color around the edges for visual clarity (Home Assessment, n.d.).	Old Age
A variety of furnishings should be provided for varied body position (Mayo Clinic Staff, 2009)	Restless Leg Syndrome

Vision problems can make identifying furniture difficult. To aide with this, use contrasting colors in layers so that no two same colors are adjacent to each other. Walls should contrast with what's placed in front of them and items on the walls should contrast with the wall color. Upholstery should use a variety of textures to provide tactile cues to differentiating, such as a pillow from a chair. Textile selection should avoid stripes, checks, and small patterns as these increase visual blurriness (see Figures 10 and 11).



Figure 9 Furniture Textiles: Solid hued fabrics of contrasting colors with varying textures are recommended for MS patients (on right) while chairs with patterns, stripes, or checks (on left) are to be avoided (Illustration: By Author).

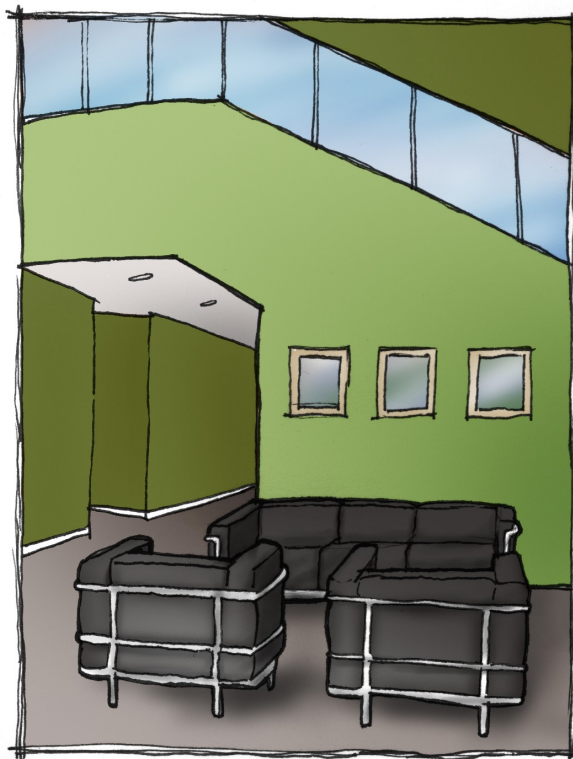


Figure 10 Color Scheme Contrast: Contrasting colored furnishings and walls are recommended for MS patients due to vision problems (Illustration: By Author).

*Fixtures & Equipment*

Recommendation:	For further information see section(s):
Use strong light bulbs or 3-way bulbs to provide non-glare lighting (Adapting Your, n.d.)	Vision Impairment
Provide lamps in areas used for reading and close work (Adapting Your, n.d.)	Vision Impairment / Old Age
Doorknobs, electrical outlets, and switches should contrast in color with the door and walls (Adapting Your, n.d.)	Vision Impairment
Place TV to avoid glare (Adapting Your, n.d.)	Vision Impairment
Sign should be large and placed at eye-level on a matte surface (Adapting Your, n.d.)	Vision Impairment
Items of patient use such should be within natural range of motion (Panero, 1989) see figure-?	Fatigue
Faucets and Doorknobs should use levers as opposed to knobs (Parkinsons.org).	Parkinson's Disease / Old Age
Adjustable blinds should be placed on windows to reduce glare (Parkinsons.org).	Parkinson's Disease
Light switches should be rocker-style (Schwarz, 2006)	Parkinson's Disease / Old Age
Patient use drawer pulls should be loop style opposed to knobs (Schwarz, 2006).	Parkinson's Disease
Pen and Paper should be available for communication issues (Suzman, 2005)	Parkinson's Disease
Grab bars should be provided in areas where patients frequently get up and down (McNamara, 2011)	Parkinson's Disease
All equipment should have rounded edges to reduce injury during a fall (Home Assessment, n.d.)	Old Age
Patient use electrical outlets should be 27" above finished floor (Home Assessment, n.d.).	Old Age

In areas where a patient is required to get up and down, commonly handrails can provide support. They can be used in areas such as the waiting room, exam rooms, or the



infusion center to make standing easier when tremor, balance, or strength are not up to par. These challenges can be increased if furniture moves or swivels. All furnishings should be sturdy and stable. If an area such as the infusion center has chairs that rock or swivel for comfort purposes they should have a locking option for ease of getting up.

When planning a seating area an identified place for walker or cane storage should be provided (see Figure 21). This allows patients to store their own walker and retrieve it without asking for assistance. It also keeps traffic patterns flowing smoothly.

### **Color Scheme**

It is recommended by John Pile (1997) that the overall color scheme of the building use cool colors to bring the perceived temperature down. Cool colors are more relaxing and have been proven to lower body temperature while warm colors are more exciting and heighten body temperature. For example a green color scheme, which is cool, relaxing and promotes well-being could be paired with orange accents which are warm and cozy. These color suggestions are based on the color psychology detailed in the depression section of the paper. Heat sensitivity commonly occurs in MS patients. Feeling overheated makes their symptoms worse (The National MS Society, 2011) that is why warm colors are not recommended for an overall color scheme. Using cool colors can lower the perceived temperature of the room and make patients physically feel cooler.

Although steps should be avoided, in places where they are required a strip of brightly colored tape can provide assistance in visually identifying steps (see Old Age, Vision Impairment and Parkinson's Disease section for more information). Figure 11 shows an example of this.

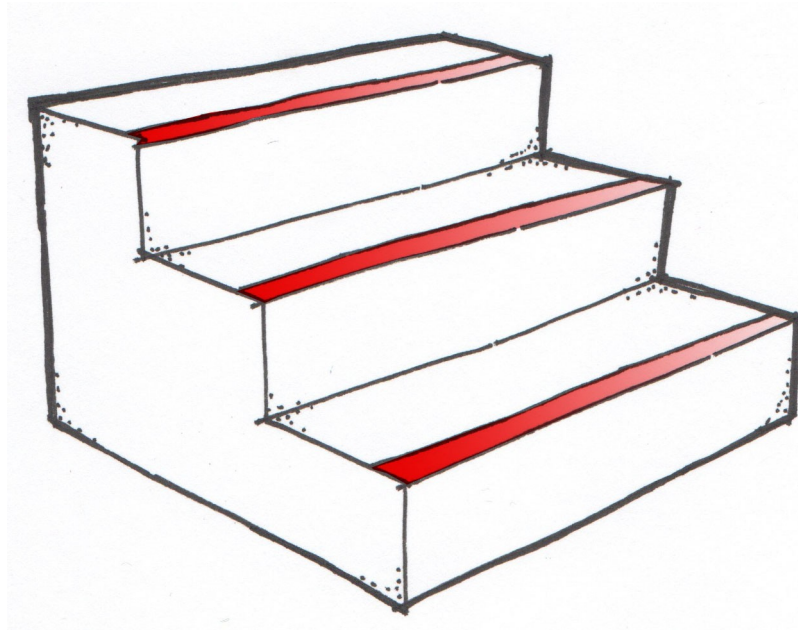


Figure 11 Stair Nose Striping. Brightly colored tape applied to nose edge of steps for visual clarity (Illustration: By Author).

### Building Layout

When planning a building layout for MS, careful consideration should be given to the proximity of the rooms. Restroom facilities should be relatively easy to access from any space occupied by patients - especially in the infusion center. Check-in areas should be near entrances to ensure that traveling distances are minimized. Gait, or walking, paths should be located adjacent to exam rooms for patient convenience and reduced exam time.

If additional MS care such as physical therapy, counseling, or urogynecology is not offered at a given facility, an existing space could be dedicated for visiting physicians. This area could be open for invited specialists in related fields to offer care to

patients who use the facility on a daily, weekly, or monthly basis. Also consider adding in resource areas, or a shop that provides MS specific items similar to what was done in the Muhammad Ali Center (Muhammad Ali, 2010). This would greatly reduce the amount of time patients spend driving around the state for varied treatments. Figure 12 shows the correlation between these spaces.

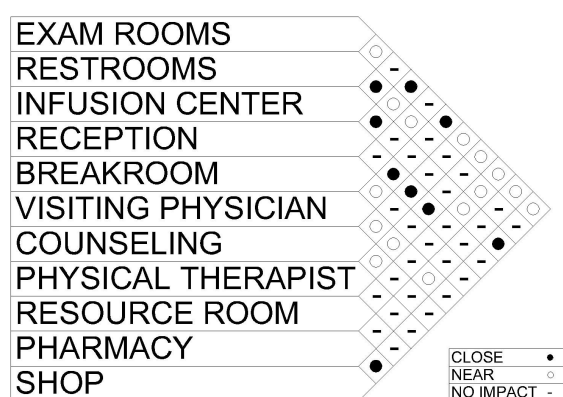


Figure 12 Adjacency Matrix. The relationship between different spaces in an MS facility (Illustration: By Author).

## Hallways

In the hallway a gait path can be laid which is a distinguished pathway on a floor measuring 4'-0" by 15'-0". The hallway should have an adjustable handrail for patient gait (walking) analysis, which is a standard test, given during MS exams. The hallway can have a pattern laid into the floor in a new facility or painted on the floor in an existing facility (see Figure 13). Providing a gait pathway insures accurate observation notes and comparisons for physicians. It also provides a safe and convenient area for patients to walk. A mirror should be placed facing the gait path to provide visual feedback

for the patient. One gait pathway can serve all facility exam rooms within a center (Departments, n.d.).

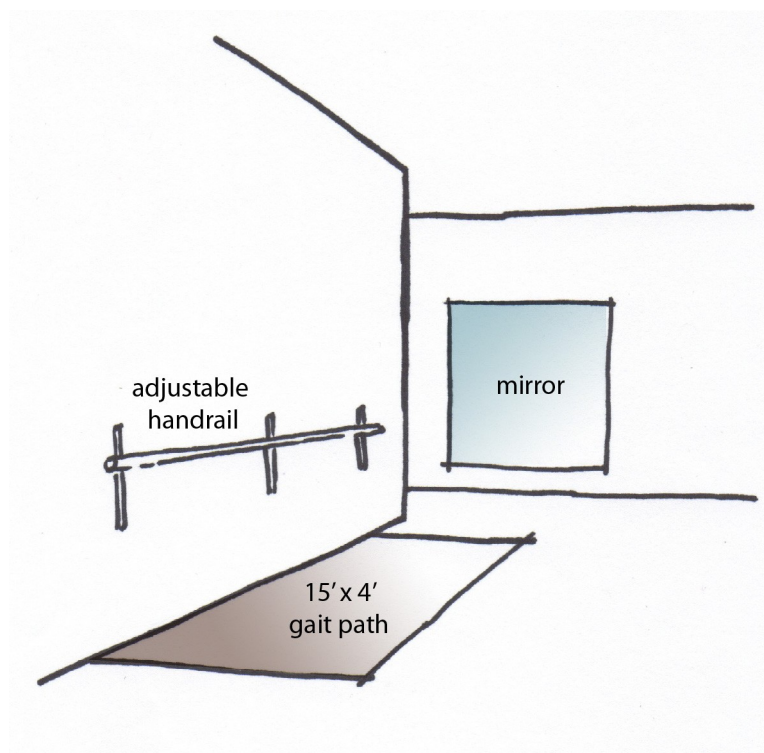


Figure 13 Gait Pathway. Appropriate proportions and positions for items in a gait path (Illustration: By Author).

Traveling any distance can be a challenge for a patient with MS. Attention should be paid to making hallways as short as possible. Current law requires that hallways are wide enough for one person in a wheelchair to travel safely and to turn around in that hallway. This law is based on the assumption that only one person in a wheelchair will be in the hallway at any one time. In an MS facility there are many patients who are using some form of a walking aid so a hallway that can accommodate two passing wheelchairs would be ideal. Seven feet or greater would allow for this.

Eyesight problems are common in patients with MS and picking out doors in a hallway that are the same or similar color as the walls can be challenging. As discussed in the vision section of the literature review it is recommended that doors and levers be a contrasting color to adjacent colors (see Flooring & Finishes section for more information). In a new facility these color choices can be determined during planning. If an existing facility already violates this rule a vinyl door surround can be added or the door frame can be painted to accommodate this design recommendation (see Figure 14).

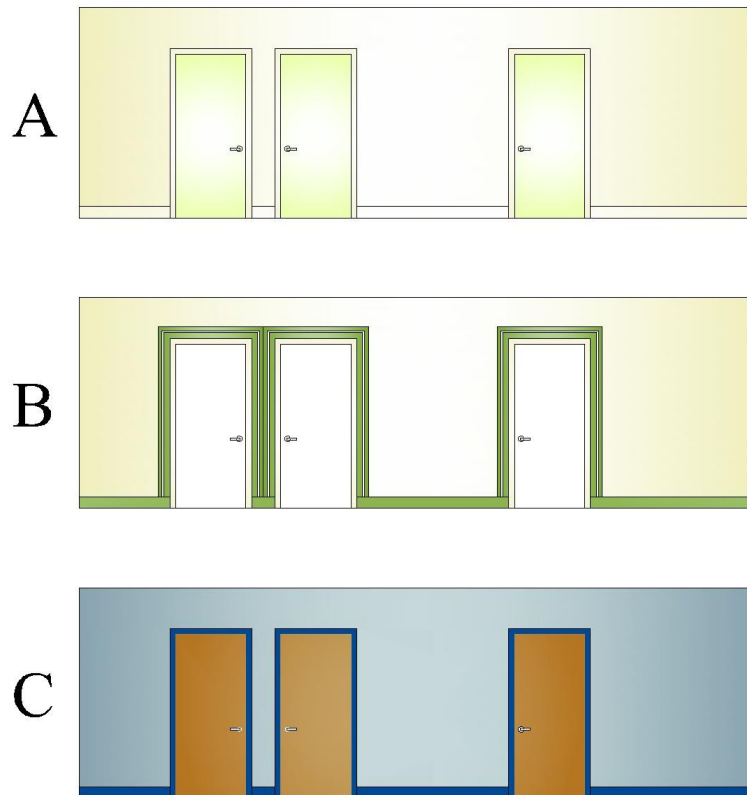


Figure 14 Hallway Doors and Walls. A - an example of similar door, wall, and door frame colors which is not recommended. B - An example of adding a vinyl door surround to visually separate doors when walls are a similar color. C - An example of walls and doors painted contrasting colors for visual clarity (Illustration: By Author).

## **Restrooms**

Bladder and bowel problems are common in MS patients which can require the use of self-catheterization. Infection can be barred against by use of good sanitation practices. A hand sanitizer pump placed next to the toilet can aide in this process. Also a self-closing shelf next to the toilet can be useful for laying out supplies (see Figures 15 and 20). Obviously privacy is of utmost importance so providing single occupancy bathrooms or closed compartment stalls is recommended.

Restrooms near the infusion center should be spacious enough to accommodate IV poles and extra people if assistance is needed (see Figures 15 and 20). A call button located next to the toilet can be used to call a nurse for assistance. Handrails should be placed in all handicapped stalls according to ADA codes but should also be placed in standard stalls running parallel to the toilet to assist with standing for those who are using walkers or canes (see Figure 15). These types of stalls are called ambulatory stalls which are not required by ADA codes (Rhoads, 2010).

Restrooms are often wet and create falling hazards. It is imperative that ADA codes be followed by providing non-skid flooring. Imbedded rubber matting can also be used to give purchase to bathroom floors (see Flooring and Finishes section for more information).

## **Infusion Center**

The infusion center is probably the most important part of a facility. It is an area where patients will spend an immense amount of time. The space needs to be functional and safe but also comfortable and relaxing. The area should be designed in the

recommended color scheme of green with orange accents as talked about earlier in the paper. The temperature should be kept a couple of degrees cooler than average due to MS heat sensitivity. Blankets should also be provided for those who wish to be a little warmer or for comfort.

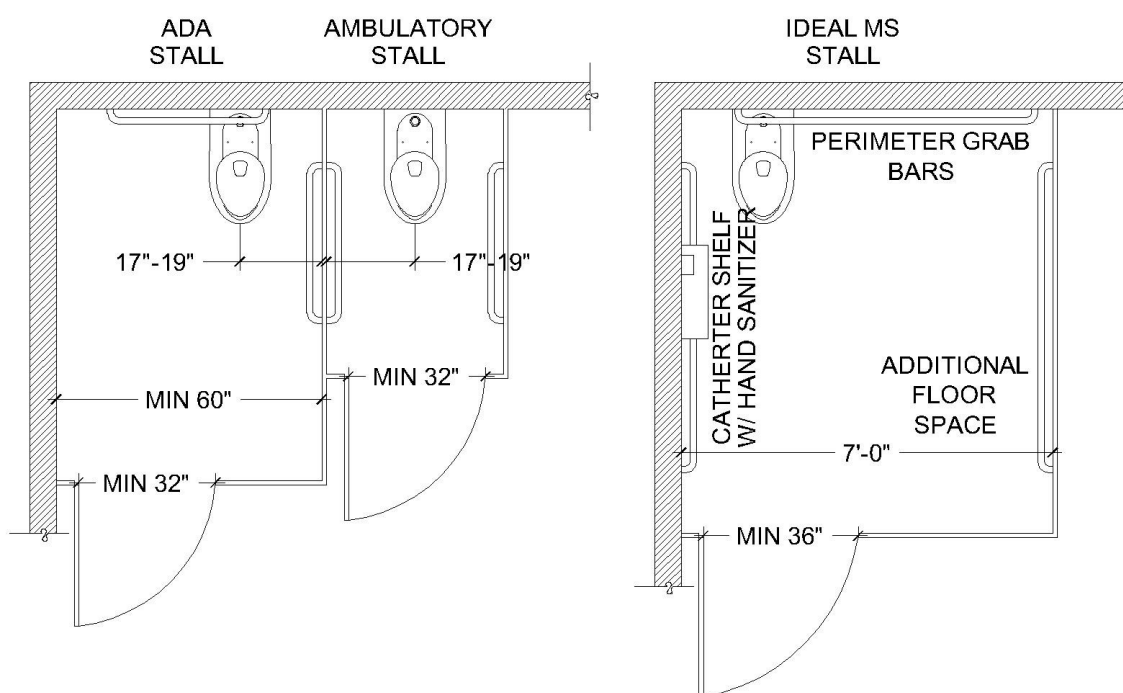


Figure 15 Restroom Stall Layouts. Dimensioned floor plans for a typical ADA ambulatory and handicap bathroom stall (left). Floor plan of an ideal stall for an MS patient (right) (Illustration: By Author).

Each infusion station should be equipped with two outlets, one for patient use and one for the IV infusion machine. Every station should have a chair, or bed for patient use (see Tremor and Balance section). An infusion chair that reclines all the way down, has

the option of a pull out foot rest, and can rock or swivel but has a locking mechanism is an ideal choice (see Parkinson's Disease section). A privacy curtain that pulls around the station and a call button or intercom system should be provided. Some stations should have a visitor chair provided. A fold out desk at each station can provide a surface for writing, eating, etc the desk should adjust to fit inside the range of motion provided by Panero (1989). A television with a headphone jack and a permanently mounted reading lamp could also be provided.

The space plan of the infusion should consider patient activity during infusions. Many patients may feel ill or tired during their infusion and prefer to sleep reclined or sit quietly. An area that is dimly lit, and is deemed a 'quiet space' with no guests or cell phone use allowed can accommodate these patients. Other patients actually feel better and more awake during their infusion. They may prefer to bring a guest, conduct business phone calls, or work on their lap top during this time. An 'activity' area can be provided for these patients. This area should have plenty of bright lighting and windows if possible.

All stations should be located near a bathroom and within close proximity to the nurses station. Solu-Mederol patients should be placed closest to the bathrooms because of the drugs side effect of frequent urination. Unisex bathrooms are recommended in the infusion center.

Fleming (2009) recommends reducing and eliminating stressors. This could be addressed by providing a convenience area to be stocked with items to make a patients infusion stay more comfortable. Included items could be:



- inexpensive headphones for each patient that are kept at the center and reused each month
- blankets
- heat packs and cool packs for plumping veins or easing vein burn from catheters
- books
- games
- CD's
- over the counter drugs such as *Tylenol*®, or *Excedrin*® for aches and pains
- beverages for dry mouth
- hard candy or chocolate to relieve the battery taste *Solu-Medrol* causes
- complimentary snacks or snacks available for purchase
- portable DVD players

### Infusion Center Prototype

The following section demonstrates one way to create an infusion center that follows the recommendations and strategies found within this thesis (see figures 16 and 17). The prototype is freestanding which allows for it to be built in a new facility or built into an existing MS facility.

A - Patient Service Area: This area feature a sink, refrigerator, and microwave for patient use during their stay at the infusion center. Cabinetry can be stocked with snacks, books, puzzles, games, headphones, DVD's, and blankets.

B – Sun Side (See figure C): This section of the infusion center features open stations with a view of the floor to ceiling windows. Planter boxes bring an element of nature to the space. Each station is equipped with a visitor chair, a reclining infusion chair with a foldaway desk, a patient use outlet at 27” high (see Old Age section for more info) within the range of motion provided by Panero (1989). Giving the space a name, a recommendation from LittleFISH Think Tank (n.d.) makes it feel more comfortable and less sterile. The name “Sun Side” was chosen, for a open bright area and the relation to

daytime. The motif pattern laid in wood or cork (see fatigue section for more info) in the flooring provides interest while maintaining a zero elevation change.

C – Moon Side (see Figure 19): For patients who would prefer to rest or sleep during their infusion a quiet area is provided. Tucked away from the windows and check-in area and featuring wrap-around curtains these infusion stations provide an ideal area for sleeping and resting. The layout is reminiscent of a crescent moon and lends itself to sleeping or resting. Each station features a TV, a privacy curtain, and a reclining infusion chair with a foldaway desk. The chair is positioned so that one can recline completely inside of the station.

D - Nurses Station: The nurses station is centrally located within the space. Five foot high acrylic wall panel allow nurses to keep an eye on patient activity while maintaining a sense of privacy.

E - Vein Port Station: This area services patients upon arrival. Benches are provided for the patient to sit while a nurse inserts a plastic port into their arm in preparation for the infusion. Providing this area is convenient for nurses and negates the needs for nurses to travel around all of the station while carrying the port supplies. It also makes the infusion stations a little more private.

F – Restrooms (see Figure 20): Unisex restrooms are provided within close proximity to all infusion stations. The majority of MS patients are women so having unisex bathrooms creates greater accessibility. In addition to following ADA guidelines the bathrooms feature a fold up shelf to hold catheter supplies and extra floor space for walking aides, IV poles, and nursing assistance.

G – Figure 21: Waiting Area. The waiting area is located adjacent to the entrance. This minimizes walking distances. The chairs in the waiting room follow the guidelines specified in the furnishings section, it is stiff, solid colored, and had arms. Walker / Cane storage is provided within arms reach of chairs.

H – Figure 22: Window Area: This area features a walking path and benches for patient who may want to walk or change positions during their infusion (see restless leg syndrome section for more information).

Furniture, flooring, and stairs can all be accommodated to assist people in both the MS and Parkinson's disease communities. People who suffer from these diseases and with balance and tremor issues do not always have the capacity to navigate around obstacles that typical people might expect. These obstacles can cause serious falls that can lead to greater medical risks. Proper design consideration may minimize these risks.

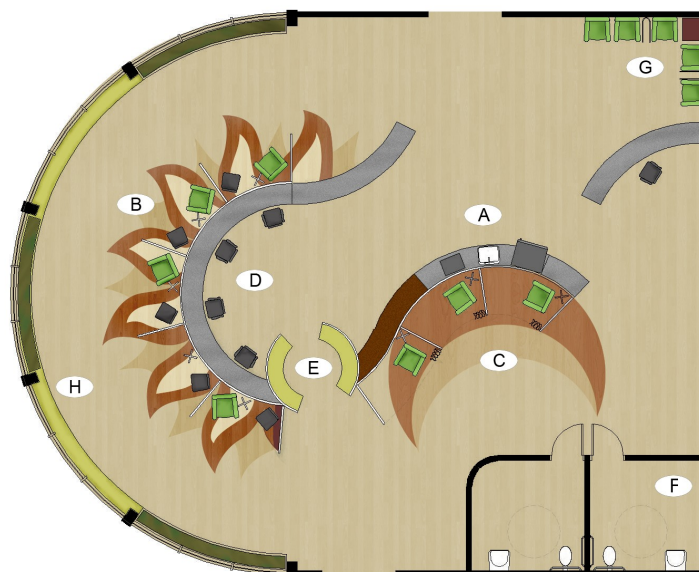


Figure 16 Infusion Center Floor Plan. An overhead view of the infusion center prototype (Illustration: By Author).

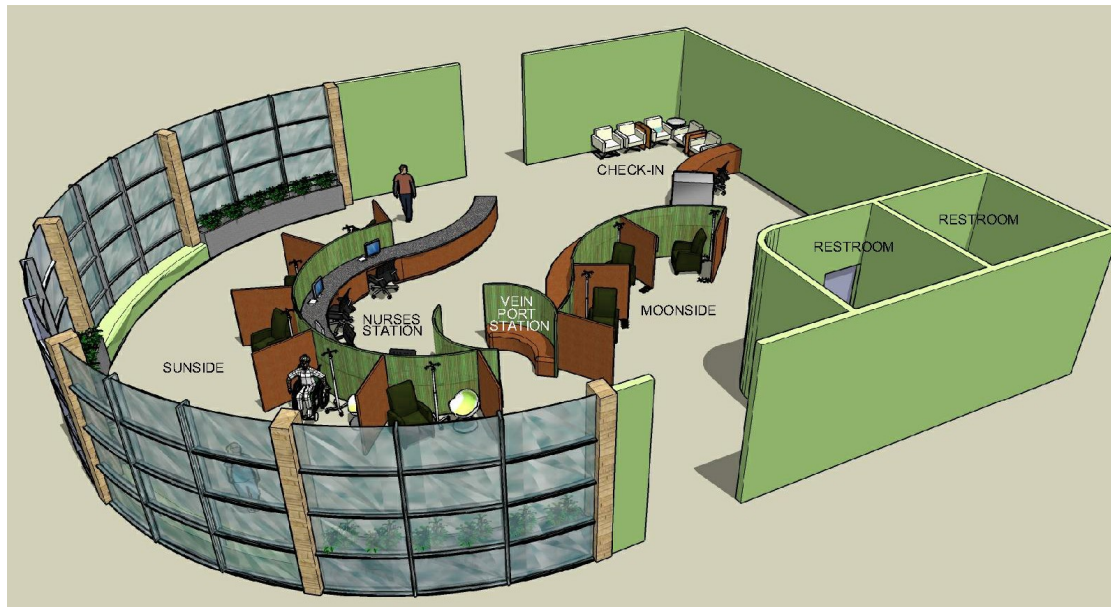


Figure 17 Infusion Center Perspective. A 3D view of the Infusion Center Prototype (Illustration: By Author).

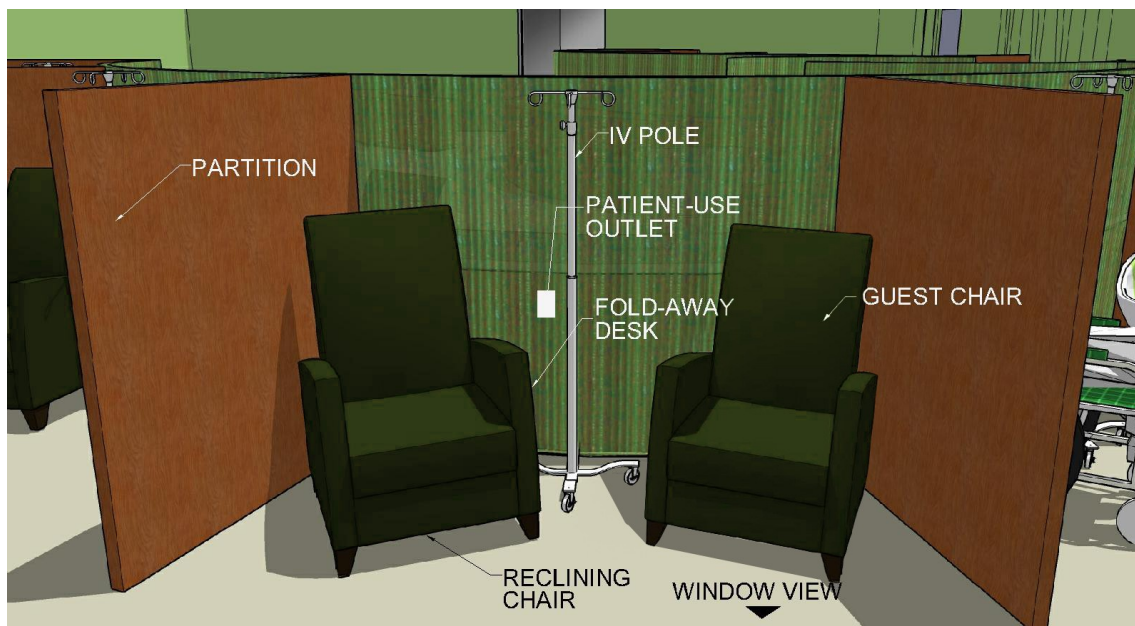


Figure 18 Sun Side Infusion Station. A perspective of an infusion station on the Sun Side of the infusion center (Illustration: By Author).

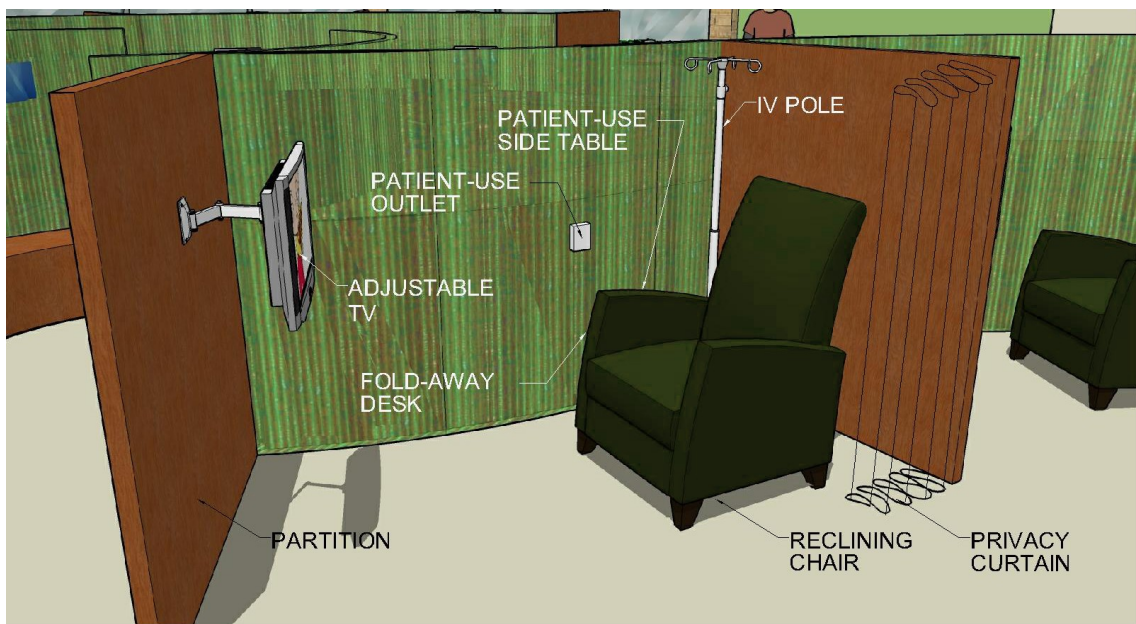


Figure 19 Moon Side Infusion Station. A perspective of an infusion station on the Moon Side of the infusion center (Illustration: By Author).

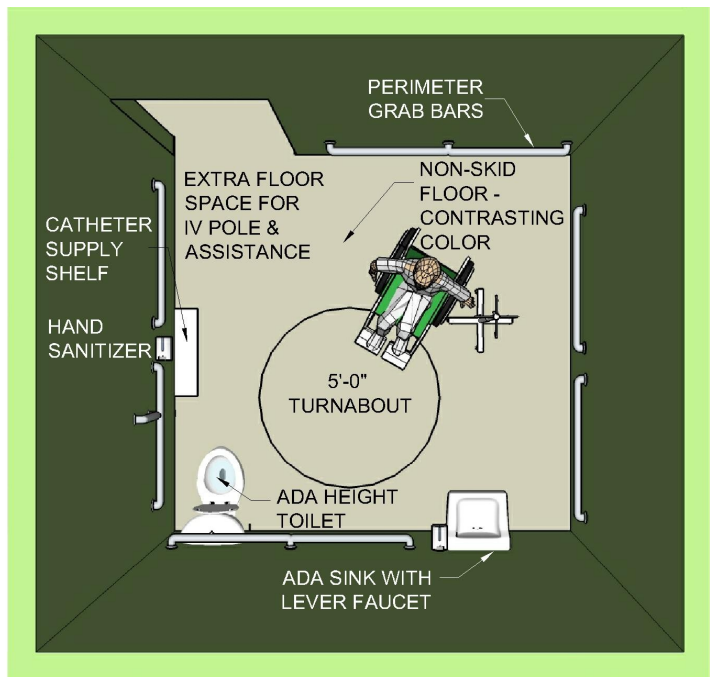


Figure 20 Infusion Station Restroom. A perspective of a unisex restroom in the infusion center (Illustration: By Author).



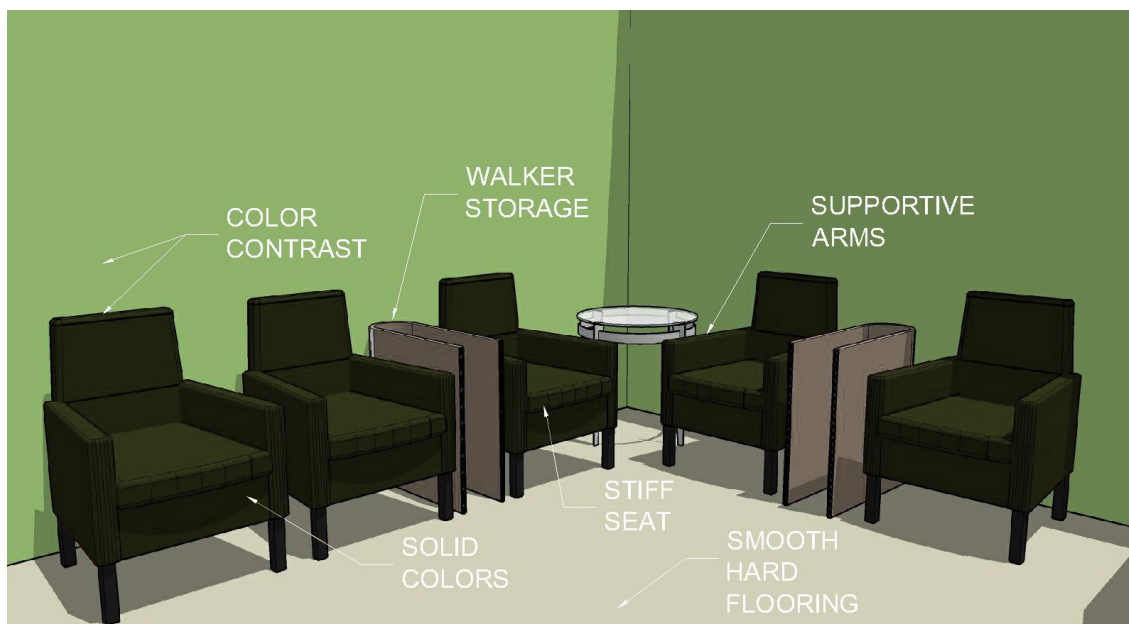


Figure 21 Waiting Area. A perspective of the waiting area in the infusion center (Illustration: By Author).

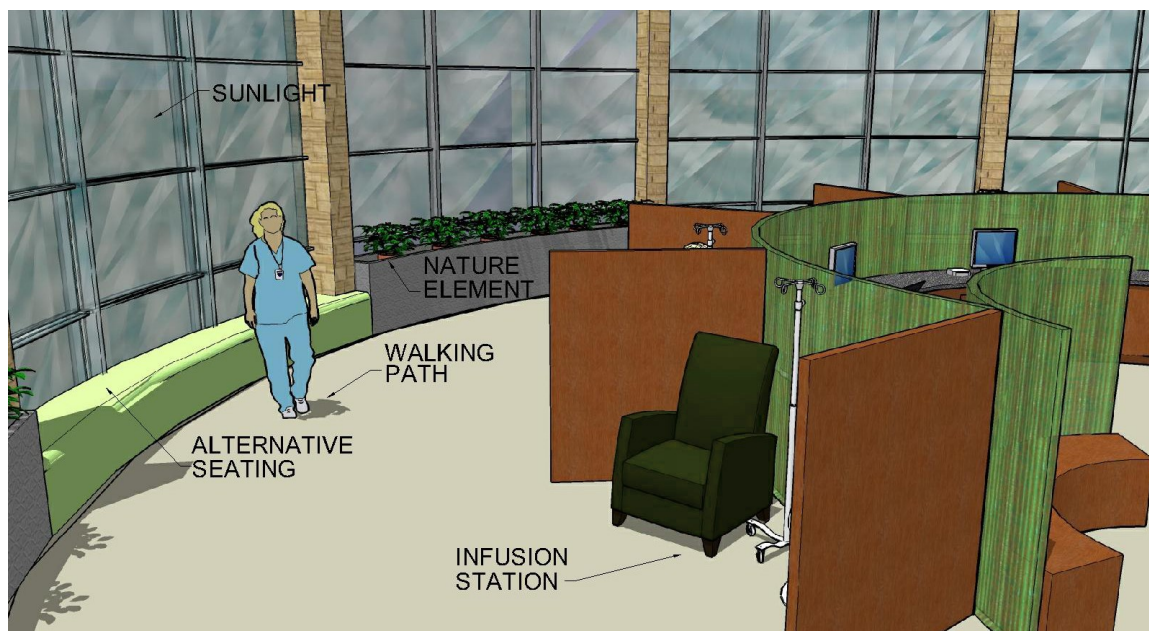


Figure 22 Window Area. A perspective of the window area on the Sun Side of the infusion center (Illustration: By Author)

## LIMITATIONS AND SCOPE

This study is to provide interior design guidelines and strategies for implementation of MS treatment facilities. The scope of this project is narrow. Potential weaknesses of the study could be due to the lack of medical facilities dedicated to the treatment of MS. There are a limited number of centers. Furthermore, there is little research in the area of interior design and MS facilities. Were this research to be taken further, it could include international studies of MS centers. Questions for future research could also include feedback from current MS patients using world-class treatment centers to determine if needs are being met in state-of-the-art facilities.

## CONCLUSION

The mental and physical treatments of thousands of patients could be benefited by simply creating awareness of MS patients' needs and desires coupled with interior design strategies and abilities. By answering these research questions this thesis addresses, both the design community and the medical community will be able to understand the specific needs and preferences of MS patients. The design field can use these strategies for working with medical practitioners to create convenient efficient spaces for the treatments of MS.

This evidence-based research explains and provides interior design strategies for redesign and future design that meet the needs of MS patients. The project entails an analysis of MS patient symptoms, recommendations for similar symptoms in other medical areas, a review of what has already been done and the creation of design strategies culminating all that was learned to be applied to MS treatment centers future or existing.



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