Scientific Research Publishing

Contemporary Designs for Long-Term Care (LTC) Facilities

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Abstract

In addition to experiencing shortage in LTC workforce, some existing facilities are unable to provide quality service, since they were designed and built decades ago. Thus, the renovation of outdated LTC facilities is currently an unavoidable issue. In this paper, some contemporary practices are presented related to renovating old LTC facilities to improve the quality of service. The most important concept is the person-centered design. Some other elements include the importance of natural lighting for residents, proper practices of flooring and picking doors, some details in home-like design, new guidelines for resident rooms' design, and other miscellaneous issues. Furthermore, the latest Americans with Disabilities Act (ADA) compliance protocols are reviewed, and some crucial elements are discussed to ensure the renovations will make the facilities compliant with the current standards.

Keywords

Long-Term Care Facilities, LTC, ADA, Person-Centered Design, Aging in Place

1. Introduction

Research shows by 2050, 20 percent of the total U.S. population will be elderly (people who are 65 and above) [1]. The demand of LTC (long-term care) services and facilities will increase under such circumstances. However, a large number of LTC facilities were built decades ago. Some of them have problems with meeting the latest architectural concepts and elements, as well as being outdated in adapting to ADA codes. In this paper, some common practices are presented related to renovating old LTC facilities to improve the service quality.

Healthcare facilities around the U.S. are using Evidence-Based Design (EBD)

to create physical environments that best suit their patients' needs. Evidence-based design is defined as utilizing research to support design decisions used to create the most optimum results [2]. This involves using various strategies and mixing in best practices to design and build smarter buildings, not only for patients, but the staff as well [3]. Through research and case studies, best practices and guidelines have been developed for the design of various common facilities, from hospitals to schools.

Best practices for healthcare facilities commonly include the following qualities: resident-controlled features of the environment, such as temperature or lighting; natural lighting, visuals of nature, and/or access to the outdoors; modeling of a homelike environment; and noise reduction qualities in the facility [3]. These and other best practices can help decrease stress and speed recovery in some patients [3]. Making small changes in the physical environment of a facility can seem minor, but these changes can add up to create a significant impact within the facility. The environment where staff work, and residents live in can aid or hinder resident safety, the caliber of care, and the overall efficiency of the staff & facility [2]. Altogether, the implementation of evidence-based design in the design process has been shown to save time and money improve facility operations, and aid in avoiding risks for residents [3].

Besides, Person-Centered Design (PCD) is an emerging method that aims to make a more personalized experience in healthcare facilities. For LTC facilities, there are specific areas of importance to focus on: the physical, psychological, social, and spiritual [3]. By switching to a person-centered design facility, there is a greater focus on alleviating the stress from symptoms or side effects from treatment, especially with palliative care [2]. Each resident that receives treatment can experience different symptoms or side effects. Therefore, to make the facility feel less institutional, a person-centered design focus should be placed on providing personalized care. A calming environment can be created that is personalized for each resident, so they can actually enjoy their time in LTC facilities, not simply living in one. With this slight deviation from just providing treatments, there is less of an institutional feel to the facility and a more personable one.

The main objective with person-centered design is to create a homelike environment that residents will benefit from by exceeding code minimums in design, providing resident privacy, creating useful amenities, and providing welcoming areas for visitors and family [4]. The interior characteristics of the facility are equally as important for proving a more person-centered design for healthcare facilities.

Windows that provide bed-ridden residents to outdoor views, multi-purpose areas that encourage resident and staff interaction, or amenities that offer the chance for individual choices are all examples of ways to create a more person-centered facility [5]. These options go beyond providing treatment and help to enhance the experience of the residents and users of the facility. Person-centered design has also been shown to help provide higher-quality treat-

ment for those with dementia [6]. For dementia patients, a more holistic person-centered design approach where there is a focus on soothing instead of curing can be utilized [7]. Overall, the aim for person-centered design is to place the patients and their families first, prioritize the comfort of treatment and care, expand individual choices, and utilize hospitality concepts to enhance the residents' experiences.

The paper is organized as follows: Section 2 presents Interior Design & Aesthetics; Section 3 covers what an ideal resident room and bathroom should look like and what items should be included; Section 4 presents several items usually unmet by the aged LTC facilities; Section 5 presents computer design tools to visualize design concepts and elements before realizing them; Section 6 provides the summary and conclusions and offers some recommendations on renovation of outdated LTC facilities.

2. Interior Design & Aesthetics

2.1. Lighting

Often an overlooked quality in LTC facilities, lighting has become one of the most important design aspects for places that cater to older clientele. As people age, less light reaches the retina, which causes an increase in the dependence of elderly on their surrounding environment [8]. With increased sensory loss, those in LTC facilities require more exposure to enough lighting. Sufficient and adequate lighting can provide by using natural or artificial light, with maximizing natural light exposure being the more preferred method.

The Facility Guidelines Institute recommends that LTC facilities choose designs that incorporate natural light and provide space no further than 50 feet from any recreational or staff work area [9]. With natural or artificial lighting, the placement of the light source must avoid direct or reflection-type glare and be at a uniform level. The lighting levels can be, and should be variable, but different levels of lighting should not be utilized at one time within one space. A combo of both natural and artificial light can be used, provided that heavy reliance on one source over the other is not created.

Exposure to adequate lighting comes with a variety of benefits for those in adult living facilities: improved circadian rhythm, vitamin D synthesis, increased appetite, more contact with others, better physical and mental conditions, decreased risk of accidental falls, decreased sense of loneliness, and less anxiety [6] [8] [10].

During the daytime, the design of an LTC facility should focus on maximizing the amount of natural sunlight that the residents are exposed to (**Figure 1**). This includes the lighting in resident rooms, common areas, activity areas, and dining areas. If applicable, the residents' time in safe, outdoor spaces should be maximized as well. For natural lighting, a target level of 446 - 477 nanometers should be reached to lessen the dependence on natural lighting [8]. Introducing these high levels of light can help to reduce depression, dependence on pain medication,

Figure 1. The comparison between indoor environment without or with sufficient natural light. Source: Center of design [51].

and boost serotonin levels amongst the residents and staff [9]. To ensure the residents' safety and comfort, shades, blinds, and window treatments should be utilized to help reduce the glare provided by bright natural or artificial light [9].

As important as light is during the daytime, darkness during the night is equally as important. To promote proper sleep cycles and improved mood, night lighting should be utilized in resident rooms. Older and aging adults tend to sleep better in complete darkness [9]. Decreasing the amount of light exposure during the night, paired with ample exposure during the day helps to create a stable circadian rhythm. Introducing a regular twenty-four-hour light pattern to residents can lessen sleep disruption and fragment.

However, mobility during night can be hazardous. Therefore, amber or soft, red-colored lighting can be utilized to softly light important pathways at night. This includes the path to the residents' bathroom area and the exits. Colors to avoid using for nighttime illumination include white, blue, or green [9]. This warm-toned lighting is also recommended for common areas during the evening, as to induce relaxation for the residents [8].

To provide more natural lighting, simple renovations can be used such as transoms, clerestory windows, and skylights. With each addition of a window or source of natural light, precautions must be taken to avoid any type of glare in the facility, whether it is on floors, walls, or furniture. Incorporating these sources to increase the exposure to natural daytime lighting can help residents experience the natural daylight cycle, which in return helps to establish a good circadian rhythm.

LED lights are also recommended as they save money on cost, energy, and lifetime maintenance [11]. If LED lights are utilized, they can be programmed to mimic a natural daylight cycle schedule, or they can be specifically programmed for certain locations or specific resident needs. LED lights are also a great size to light important pathways at night. They can easily be placed under handrails, mirrors, beds, and near door handles [12]. With both lights, they come in a variety of shapes, sizes, and colors, so that any current light can be replaced by either a Kelvin changing or LED light [11].

2.2. Flooring

Flooring issues may present in some LTC facilities, such as mismatched, damaged, or uneven tiles. Sometimes the floor tile is too reflective since it's worn. This quality creates a harsh glare which is uncomfortable for residents but can also be dangerous especially for dementia patients.

When choosing flooring options for LTC facilities, there are certain qualities that are necessary for the flooring to have: easy to clean and disinfect, safe, durable, comfortable for residents, and appealing to the eye. For areas where the floor may retain water, it is essential that the flooring be non-skid and slip resistant [13]. It is also a good quality for the flooring to require little to no maintenance to be easy on the facility staff and cause fewer interruptions due to maintenance or replacement. Information about common and popular flooring options for LTC facilities are provided in Table 1 [14] [15].

2.3. Doors

Special attention must be paid to the types of doors chosen for LTC facilities. Doors are a small detail in the overall design of the facility but can make the biggest difference to providing the homelike environment where residents feel most comfortable.

Since the residents living in these facilities are of a more fragile nature, the doors cannot require too much force to open or operate. Opening and closing the door should be a smooth motion created by the least amount of effort. For this, doors can be made automatic. This means that with the touch of a button or by placing a trigger at handle-height, the door can open and close automatically with minimal effort from the residents [9]. These types of doors are also easy for both staff and visitors to utilize as well. Whether automatic or manual, all doors that require resident operation should be lightweight and swing-type or sliding doors are recommended for doorways to resident and common areas [9]. As per fire code regulations, manual or automatic sliding doors may still be used, but they cannot be placed where their use causes major egress issues [9].

A special note for doors is the type of door handles that are used. The typical standard is to use stainless steel handles due to their low maintenance. However, especially in areas of a colder climate, this material can have a large temperature difference from that of the ambient room temperature. This cold sensation can cause discomfort to some residents. An alternative to this is the use polyamide door handles [9].

Doors to bath and toilet areas that are for resident use should be sliding, folding, or hinge-type doors as these door types are easy to use for areas where fall risks are greater [9]. As for door materials, the use of wood in either the door or frame should be avoided. Wood is easy to chip causing safety issues and is not easy to maintain or clean, which can lead to bacterial issues. The use of wood for doors or door frames is also not as durable, and therefore less cost effective. An alternative to wood is to use vinyl coated metal frames. The vinyl coating can

Table 1. Flooring types and description [14] [15].

Floor Type	Description
Cork	Cork flooring can be waxed to prevent water damage and make the flooring stain resistant. When waxed, cork flooring is easy to clean and disinfect. The softness of the material can also help to cushion any falls that may occur. The downside to this flooring material is that it is not as durable as other recommended flooring options for LTC facilities.
Padded Vinyl	Padded vinyl flooring is easily disinfected and can resist stains as well. This flooring type is easy to clean and require minimal maintenance. This is also the universal type flooring and can be used for rooms, common areas, and bathrooms. The extra padding beneath the vinyl can provide warmth and help to cushion the floor, reducing the risk of injury for residents. Vinyl flooring comes in a variety of colors making it easy to help contrast the edge of the floor with the edge of the wall. This can help orient residents in smaller spaces, such as bathrooms and bedrooms.
Padded Linoleum	Padded linoleum shares many qualities with padded vinyl expect for this flooring type is natural. Any risks with fumes or chemicals are reduced. The downside to this flooring is that it is not as stain resistant as other flooring types.
Rubber	Rubber is claimed as the safest material to use for LTC facilities, as well as the easiest flooring type to maintain over time. Rubber is naturally water and stain resistant, which decreases the need for coatings or waxes. This flooring type is also helpful to reduce injury from fall as the impact from a fall gets dissipated throughout the flooring. A drawback from this flooring reported by users is that rubber emits a faint smell that can be unpleasant to some staff and residents.
Carpet	Carpet is usually discounted due to its low stain resistance. However, carpet can be replaced much easier than other flooring types and can provide a home-like feel through colors and patterns. Overall, carpet requires low maintenance and can come in a variety of textures, patterns, colors, and thicknesses. When used in dining areas, carpet can help to reduce the noise levels due to its acoustical properties of absorbing sound. This is a potential solution to help those with Alzheimer's and dementia to keep an appetite. It has been reported that loud dining space can reduce the appetite and overall food intake of patients with Alzheimer's Disease34. LTC facilities have also reported higher resident and staff satisfaction rates for carpeted rooms. A downside to using carpet is the chance for seam permeability, which is when the seam that holds two sheets of carpet together begins to unravel. Carpet is also a good option only if the concrete of the subflooring is properly sealed, which is an expensive process if not sealed.

come in a variety of colors and even textures to provide softer, more home-like feel to the door and frame.

For areas that staff would like to keep out of eye from residents, such as medicine, storage, or utility rooms, these doors can open both inwards and outwards for ease of access and can help to lessen the institutional feel. These types of door and door frames can help to reduce overstimulation, especially in long hallways or corridors with numerous doors.

2.4. Windows

Windows and window accessories are perhaps one of the most important details to the design of a long-term care facility since they can provide multiple benefits when utilized appropriately. As mentioned in the lighting section, special window types can be used to help provide excess natural light. Transoms, clerestories, and skylights are all simple ways to allow more natural light into a space. With skylights, care must be taken to avoid glare on the flooring, or any surfaces present in the room.

Larger windows allow for those in wheelchairs or in bed to still have access to views of the outdoors. The views that windows provide to the outdoors are just as important as the light they allow to enter indoors. Transoms and clerestories are covered in more detail below.

Shown in Figure 2, transoms are essentially smaller windows installed above another window. Their shapes are most commonly square, rectangular, or round. With transoms, the frame material and color, and the glass type and color can all be changed to help personalize a space. Vinyl coating can be used to match floors and frosted, or textured glass can be used to help provide more detail [16]. These design elements are typically chosen to help match the details of a space. Transoms can also be installed on both exterior and interior walls. If there are internal rooms that cannot have access to natural lighting, a transom

Figure 2. An example of how transoms increase the natural light to indoor space.

can help the space feel more open and allow artificial light to flow as well. Transoms can also open, allowing for ventilation and more air flow. Air flow is often considered a solution for those that shortness of breath [5], so a transom installed in specific areas can offer great benefits to residents in long-term care facilities.

With clerestory windows, ambient light instead of direct light can enter a space. This reduces the chance of glare, but also allows for a "flood" effect of the lighting meaning the space can get covered with light without the direct light source [17]. Clerestories are also located higher on the wall which clear up space allows for more use of wall space in an area. Clerestory windows can also open to allow ventilation as well, but it is less common than with transoms. Pictured below are large and thin clerestory windows. By changing the width and height of the clerestory, the amount of light allowed in can be altered (Figure 3).

2.5. Homelike Design Details

With today's LTC facilities there is a much greater focus on person-centered care. A large part of this new care design is to create a homelike environment where residents feel comfortable and less anxious. Creating a facility with less of an institutional feel is done through a variety of different factors. These changes can come from the facility layout down to the color schemes chosen. This section will mainly focus on the main interior aspects which help to create a more homelike design for LTC facilities. For a more encompassing list of guidelines and recommendations for flooring, walls, lighting, and other furnishings, the Facility Guidelines Institute has published a white paper: Resources for Selecting Architectural Details, Surfaces, and Furnishings for Health Care Facilities [9].

Choosing the proper colors for spaces in LTC facilities is one of the most overlooked design aspects [18]. It's imperative that the right colors be chosen to help not only make the space more homelike, but also help with wayfinding for the residents. Various colors and color schemes are believed to have various effects on the body and mind [19]. Therefore, some positive effects for younger people, may not be treated the same for those living in LTC facilities.

Figure 3. Clerestory windows in different styles and sizes both provide good natural-light illumination in daytime. Source: Architectural Digest [17].

Colors can help to define spaces by their uses and to help create optical illusions that can aide those in the low-vision community. For example, lighter colors can help to create the look of higher ceilings or wider rooms. Bright or saturated colors should be used instead of pastel colors when possible. Differences in pastel colors are hard to distinguish for aging eyes and distinct color schemes can help residents know where they are and assist them in wayfinding around the facility [19]. Providing a contrast between the edge of the wall and the beginning of the floor can help residents to maintain their balance if they have poor vision [18]. However, too stark of a contrast can cause eye strain for residents.

Therefore, choosing the best colors and color schemes for a facility is all about balance and purpose. For balance, use cool tones, but balance them out with the use of warm tones, whether in finishes or furnishings [20]. For purpose, always be cautious of what the space will be utilized for before picking a color. Avoid bright colors in resident rooms as the purpose of that space is to relax, not stimulate the residents [19]. When picking color schemes, using tones that can be found in the surrounding natural setting can help to make the design more comfortable. Any new color schemes should be based off the hues of any elements that will remain. If the floors and countertops are remaining the same tone, but the walls are being painted, consider choosing a paint tone that will keep the look cohesive once finished [19] [20]. Bright white walls should also be avoided as they add to the institutional feel and create easy surfaces for glares [19].

The furniture chosen for a facility can help create the right environment for the right spaces. The furniture should be comfortable and appealing to residents to not only spur use, but also help keep residents interested in a space. For example, comfortable and colorful dayroom furniture could help attract residents to the space and could facilitate more social resident interactions. For LTC facilities there is a focus on choosing durable, mobile, and comfortable furniture [21] [22] [23]. Furniture that will experience everyday use should have durable or reinforced joints to help with durability and maintenance [10].

Mobility in various pieces of furniture can help patients to move around easier, staff relocate patients easier, or allow for the furniture to be utilized for multiple purposes. Mobile furniture can also help to create a more active lifestyle for residents in LTC facilities [21]; allowing the furniture to move will allow residents to move as well. Having motorized furniture, such as recliners, can also help with mobility and add in choice for residents. The seating offered should have variety in not only type of seating, but in the positions that residents may sit as well.

Careful consideration should also be given for the materials of the furniture. Padded furniture with soft, smooth fabrics should be considered. If the material has a textured pattern, caution must be taken to ensure that the pattern is not rough on the sensitive skin of residents in LTC facilities [23]. The materials should also be able to remain relatively warm and quiet. Cold or noisy materials

may deter residents from utilizing the furniture or the space. Finally, consider having materials that are easy to clean and have a level of non-absorbent moisture control for accidents or spills [23].

Any furniture chosen needs to also be accessible to all residents, including those in wheelchairs or with walkers. There are often alternatives provided or manufacturers which specialize in creating furniture for nursing homes and other care facilities [23].

Note that the furniture is also rounded at the edges—this is an important safety feature when choosing furniture for LTC facilities. Avoid sharp edges or seams that may cause discomfort or present a safety hazard to residents.

Warm tones, light natural colors, and wood finishes are commonly chosen as these often can provide contrast from the flooring and wall to help define the furniture for residents [10]. The finishes should also be scratch resistant to not only keep the furniture looking new, but to aid in avoiding scratches from wheelchairs, walkers, and other mobility devices residents may use [22]. The furniture chosen may serve medical purposes, but the residents should not constantly be reminded of this purpose [23]. Choosing colors, patterns, finishes, and furniture type that help create a more homelike environment should always be considered.

2.6. Signage and Wayfinding

Signage and wayfinding are qualities that are helpful to all people connected to an LTC facility. This includes the nursing staff, residents, visitors, and administration. People need clear and concise indicators of where important locations are within a facility. For residents, it is also imperative that they know where they are and how to easily get from point A to point B. Elements that hinder wayfinding and proper orientation include: long corridors with numerous doorways, insufficient windows, use of elevators, floor patterns, agitative colors, and no reference points [10].

To alleviate signage issues, it is recommended to use large, easily readable signs at all major entrances [10]. This includes entrances to residential units, amenity areas, and entrance and exit points to the facility. These signs should be written at a middle school level and should be dark background with light writing to meet ADA standards [9]. Universal symbols in health care should be utilized on any signage when possible.

To assist with wayfinding within and around the facility, it is important to include unique landmarks and other cues for orientation [9] [24]. These landmarks can be artwork, a change in color, plants, or even directional signs. A landmark can help serve as a cue for orientation or a cue for a decision point. With the directional signs, these must be apparent and can be maps, overhead signs, wall-mounted placards, or even interactive maps that incorporate technology. Proving windows are certain points can also help to orient visitors and residents as to where they are inside the facility. These views to the outdoors can also help to provide mental stimulation to residents [24].

For residential areas or units, various ways to identify rooms should be used. Room numbers can help visitors, staff, security, or administration easily locate a room. However, residents may have a hard time remembering a room number. Therefore, something more personal or unique should be placed outside their room to help them identify this space. When there is a change in residential units, there should be a change in theme or color as well to alert residents and visitors [25].

3. Resident Rooms

The most intimate settings in LTC facilities are resident rooms and visiting areas. A special amount of consideration should be placed into how to design patients' rooms for safety, comfort, and efficiency. This section will cover what an ideal resident room and bathroom should look like and what items should be included.

3.1. Regulations & Requirements

The design of resident rooms should focus on creative calm and comfortable environments. The colors and patterns utilized in the room should be appropriate for the purpose of the space. Calming, light tones and wood finishes are typically used for resident rooms. For occupancy, some residents may prefer a single unit, while others might prefer to be housed with roommates. Therefore, it is recommended that a mix of both single and double-resident rooms be offered [26]. A maximum occupancy of two residents is recommended by multiple guidelines [9] [27] [28] [29].

In rooms with two occupants, side by side bed layouts are not recommended due to privacy standards [28]. The headboards of each bed should rest on opposite walls to provide for the best privacy. A ceiling-mounted privacy curtain should be used to ensure that all residents can have visual privacy in rooms of double occupancy [28] [29]. It is recommended that physically, each resident have approximately 80 square feet of space, including room for the bed, storage, and any seating space [13] [27]. Providing space for a desk, storage, and seating help to create a homelike feel and can encourage visitors to remain in the space for longer period of time [26].

As stated in the 1985 edition of the Life Safety Codes [30], it is required that there be access to at least one window in residents' rooms [13] [31]. The presence of a window in the bedroom can help to orient the resident to the natural day and night cycle, as well as provide stimulating views to the outdoors. The window and any furniture, including storage areas, must be accessible from a wheelchair or other mobility device [9]. In addition to natural light, the residents should be provided or allowed reading lights or night lights to help make their space more comfortable at varying levels of light [13]. At minimum, a resident room should include: a bed, side table or nightstand, side chair for visitors, lounge chair, window, storage area, dresser or closet, desk, and access to a toilet and sink [9] [13] [27] [29]. For residents that receive or eat meals in their rooms,

an over-the-bed table should be provided [13].

3.2. Bathroom

The bathrooms in LTC facilities are a commonly overlooked aspect when promoting resident independence and mobility [13]. All residents should have access to toilet facilities and bathing areas [27] [29]. Residents should have the independence to choose when to go to the bathroom. However, since the bathroom is the area with the greatest risk for injuries, falls, and infections, different residents may require different setups for toilet and bathing areas [29]. All toilet and bathing areas should have an emergency call option hardwired into the space in case of any accident, as well as grab bars or handrails where appropriate.

It is recommended by the Facility Guidelines Institute [9], that residents have access to a toilet without having to enter a general passageway. For facilities that provide in-room access to a toilet and hand-washing area, there are certain regulations and guidelines that must be followed to ensure the residents safety. As with any area, there needs to be plenty of space for to be compliant with ADA access, [25]. Additional space needs to be designed for two staff members to help a resident in case of a fall. A mirror shall be provided at every resident handwashing area [9], whether the sink is in a communal or private bathroom.

For safety, toilets of the appropriate height must be installed. This is typically 17 - 19 inches from the floor to the top of the toilet seat [29]. This height ensures that residents can easily maneuver their way onto and off the toilet while remaining comfortable. Male toilet areas should have both urinals and toilets if space allows. For toilets, quiet operation parts, such as flush valves, should be used as to not cause disturbance at night or agitation from the noise. With in-room bathrooms, no more than four residents should share one toilet [29]. This maximum scenario applies to connected rooms.

For communal bathrooms, all toilets must have stalls for privacy [29]. These communal bathrooms should be placed as centrally as possible for each residential unit so as not to place some residents at a disadvantage. It is recommended that residents be no more than 85 feet from access to bathroom, with less distance being preferred [13]. Adequate hand-washing stations must still be provided with accompanying mirrors. Most regulations regarding in-room bathrooms are still applicable for communal bathrooms.

Different guidelines exist for areas that will consist of showers or tubs for residents to bathe that are not in-room. Every residential area should have at least one tub or shower, but no one tub shall serve more than twenty people and no shower shall serve more than 10 to 15 people [13] [29]. This is to help with infection control as provided opportunity for simultaneous uses. Where there is more than one tub or shower, each shall be in an enclosed space to help ensure resident privacy while bathing [13] [29]. To allow for wheelchair access, shower stalls shall be at minimum four-square feet, without curbs [13] [29]. Area must also be included for a bathing attendant in some stalls, and space for resident to dry off and get dressed must be included as well (Figure 4).
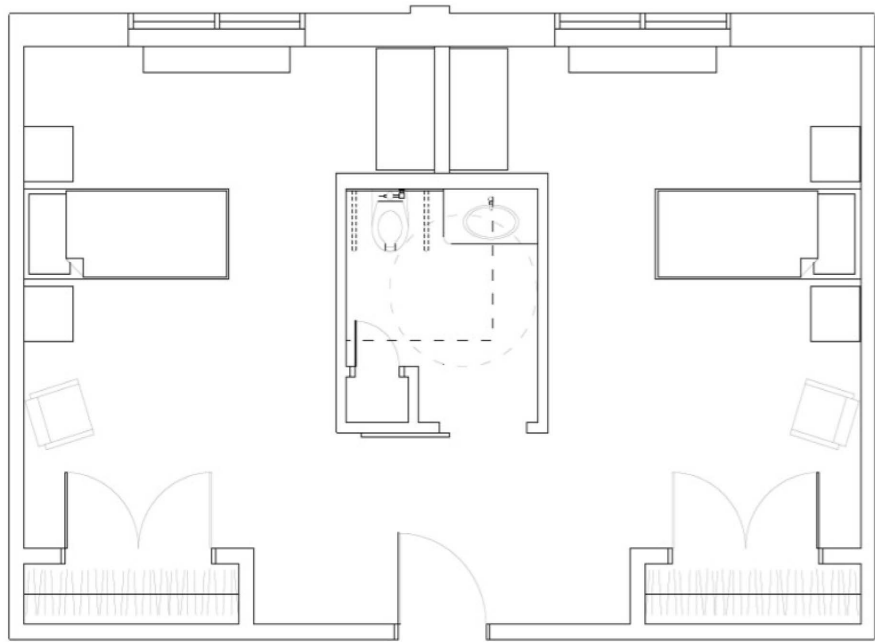
Figure 4. A simple double-resident room layout where there is a shared bathroom separating the two-bedroom spaces. Source: Facility Guidelines Institute [9].

3.3. Personal Storage

In each residential bedroom, space for storage should be provided. This can consist of a personal wardrobe or closet, or a shelf and drawer combo. The minimum width and depth of any provided storage space is 30 inches and 24 inches, respectively [9]. All furniture should be ADA accessible, and the closet rod is recommended to be adjustable to adhere to this accommodation [9]. Storage space inside in-room bathrooms or toilet areas should also be included. To aid in creating a comfortable, homelike space, areas for display of personal belongings, such as a windowsill, should also be incorporated into the design.

4. Other Issues

4.1. Healthy Living Environment

There are several items that are usually unmet by the aged LTC facilities. The first is noise control. Since the HVAC systems were mounted when the facilities were firstly built, the aging parts or unreasonable placement will cause annoying noise. That could cause anxiety and other negative effects on residents.

Furthermore, setting smoking areas too close to entrance of main living buildings can be a problem since they are supposed to be at least 25 feet from building entrances or operable windows [9].

4.2. Accessibility and Mobility

Since some LTC facilities were built decades before, the ADA compliance standards for different factors have been adjusted multiple times. For instance, the 2010 Standards provide, at section 403.3, that the cross slope of walking surfaces

should not be steeper than 1:48; but the 1991 Standards´ cross slope requirement was that it not exceed 1:50. Besides, in this paper a few factors are discussed [32]. More aspects' standards can be accessed on ADA compliance website [32].

Hallways should be wide enough for wheelchair users to pass each other, free of obstructions. Handrails are also required on both sides of the hall. The handrails should be mounted no closer than 1.5 inches off the wall [33]. Doorway widths should be a minimum of 32 inches in width and a maximum of 48 inches in width.

Moreover, since the LTC facilities may have raised foundation to encounter uneven geometric surface, ramps are crucial for entering and exiting the building for residents who need LTC services (Table 2). In ADA compliance 2010 standard, ramps' standards for existing site, buildings, and facilities shall be:

The standards for parking space in ADA compliance only provide the minimum number of required accessible parking spaces [34]-[39]. For LTC facilities, the need of accessible parking spaces may vary because of the residents' age, and health conditions. Each LTC home may increase the number of required accessible parking spaces based on its own situations. The standards of accessible parking space include: 1) access aisles serving car and van parking spaces shall be 60 inches (1525 mm) wide minimum; 2) Access aisles shall extend the full length of the parking spaces they serve [32]. Marking is also important. The facilities shall ensure the markings are clear and meet the local regulations. Other factors can be retrieved from ADA compliance website.

4.3. Dining Area

Creating the ideal dining space for residents is crucial to ensuring that they eat as much as they need to in order to stay healthy, get the stimulation their brains need from their surrounding environment, and improve their overall satisfaction. Therefore, person-centered dining is important to consider in creating communal dining areas. Person-centered dining can aid in the reduction of food waste, allows the residents more independence in their daily routine, decreases the need for supplement usage, uses fresher, better quality food, and calls for happier, healthier residents [40]. Residents should feel like they are more in control of what they consume daily; they should be given the ability to choose when and what they eat [40] [41]. Food is a form of comfort for all people, especially the residents. For them, it can remind them of memories, making them more inclined to eat [40].

Table 2. Maximum ramp slope and rise for existing sites, buildings, and facilities [32].

Slope 1	Maximum Rise
Steeper than 1:10 but not steeper than 1:8	3 inches (75 mm)
Steeper than 1:12 but not steeper than 1:10	6 inches (150 mm)
Slope steeper than 1:8 is prohibited.	

It's often found that residents leave up to 25% of their food uneaten at most meals. This leads to weight loss and increased fragility that should be avoided. Increasing appetites resolves this issue, as well as increases satisfaction and improves the moods of the residents, contributing to raising their overall quality of life during their residency at the home. One way to help with this is allowing the residents to choose what to eat, where to eat, and who to eat with as this makes them more likely to eat better. It also helps to make foods and desserts colorful and eye-catching coupled with changing the menu items at each quarter of the year, giving residents more options (at least 3) to pick and choose from [42]. It is also said that bright plate colors help stimulate appetites. Accommodating resident dining choices and taking a more hospitality-like approach in letting the residents have choices like they would if they were in a hotel/restaurant can lead to an upsurge in resident and family satisfaction [40].

In dining area, using round tables and rectangular tables have different pros and cons. For instance, it is said that switching from round to rectangular/square tables is more beneficial to residents to help with spatial recognition and knowing where their food is; using round tables can help with avoiding the residents get hurt by the shape edges or corners. The wall/divider from the serving area to the dining area creates a division between the two areas that would benefit from being taken away or shortened in height to create a more open feeling to the room.

4.4. Outdoor Areas

Courtyard and outdoor paths are recommended. There are numerous health benefits associated with allowing residents and patients outdoors: circadian rhythm alignment, boost in Vitamin D production, reduced depression and stress levels, and overall improved mood [9] [19]. Older adults tend to have a deeper appreciation for spending time outdoors [43]. Allowing access to outdoor spaces can promote a more active and healthier lifestyle for the residents, as well as alleviate feelings of being "trapped" indoors.

The most common spaces created for outdoor access are gardens and walking paths. Gardens can be offered at varying locations and can each carry different themes (*i.e.* healing garden, resident garden, flower garden). Indigenous plants and low-maintenance landscape designs are recommended. Any materials or plants used must also be non-toxic and provide smells that are not overwhelming. For planting easily accessible planting spaces, such as raised beds should be used.

Water features and other acoustic aspects can be added to gardens to provide positive noise distractions and increase the natural feel of the garden area. With the addition of water features, special considerations must be taken for safety and infection control. The water features must not be deep, cannot be pressurized, and must be maintained at a safe temperature.

Access to and frequent use of walking paths have been noted to offer the following benefits: improved sleep, reduced fall risk, reduction in the use of anti-

psychotics, and reduction in cortisol levels [9] [44] [45] [46] [47] [48]. In any outdoor area, access to shade is equally as important as access to the sunlight. Areas of respite should also be provided for residents to rest. On walking paths, these should be provided at set and equal intervals. For entrances and exits to these spaces, automatic opening doors are recommended. The large glass panes allow site of the space and the easy access of the door encourage visitation to the areas [9].

4.5. Physical Therapy Area, Medicine & Supplies Storage

The physical therapy area needs an open floor plan to provide ample space to perform various therapeutic activities [9]. It is recommended to create small alcoves within a physical therapy area to make the area appear wider. The need for storage is also important to better organize the physical therapy and activity equipment. The lighting and windows throughout the area can follow the concepts and elements introduced in previous sections.

A medicine storage room is recommended for each residential area [9], especially for emergency medicines and supplies. This helps ease the stress of staff and provide more efficient treatments to residents. Any medication storage room should be 50 square feet at minimum, unless a smaller storage area can still adequately meet the needs of the residents in the residential area [9]. Within each medicine storage room there should be space for the following: a sink, refrigerator for cold storage, double locked storage system, sharps containers, and enough counter space. Task specific lighting is recommended for this type of room.

4.6. Amenities and Other Areas

Besides meeting the basic demand of residents, a complete LTC facility usually has various amenities and other areas. Those areas give more options to residents on improving the quality of their life.

Craft room is one of the options. In craft room, residents can spend time on wood crafting, cooking, internet browsing, painting, and so many others. But basically, the common concepts for renovating a craft room were mentioned before. They include enhancing natural light exposure to make residents feel better, flooring with proper materials to avoiding glare and slippery, using warm color tones and home-like decors to reduce the institution-like feels, ensuring accessibility and others. Otherwise, since the tools for the activities mentioned above may cause injuries when they were not utilized or stored appropriately. The access to this area should be monitored. The storage area should also have sufficient illumination and good accessibility.

Usually, a library is a good place where residents spend their spare time at. In the library more appealing and comfortable furniture should be provided to create the cozy feel of a modern library. If residents are encouraged to remain here to read or relax, the furniture should be made of materials that stay warm

and are comfortable for long periods of time. The wall that creates an alcove should be eliminated for both security and functionality. With the wall removed, the area becomes more open, and a lounge area could possibly be provided. With a lounge area, the facility could utilize this area as a visitation space or place to hold book discussions. A section with audio books could be provided to modernize this area [49]. CD players or audiobook players could be provided along with headphones.

For long-term care facilities, it is recommended to have a welcoming and apparent reception area to help visitors feel more at ease [9]. This also serves as a main point of contact for visitors that may need assistance while at the facility. Near any main lobby or reception area there should be access to a public restroom that is not shared with residents [9]. The lobby or reception area itself should include an appropriately sized and comfortable waiting area. Both the waiting and reception areas are recommended using same or similar color tones and styles of furnishing.

4.7. Dementia & Alzheimer's Residents

Since the high share of population of elderly people are living with Alzheimer's and dementia in the U.S., throughout the renovation process, attention must be taken to provide care for all the various conditions that residents may have. Residents with dementia and Alzheimer's should be allotted special design details in their residential areas.

Apparent signage and easy wayfinding become imperative for residents with memory impairments [50] [51]. The layout and appearance of their facilities must be designed with impaired thinking skills in mind. Landmarks, prompts at decision areas, and other types of markers are essential to help create a familiar area for the residents. Essential paths, such as the way to the restroom at night, should be easily visible from bed and lit up [51]. Sensory stimulation is an important component of design for those with memory issues in LTC facilities [50]. This can be provided through art, music, nature, and technology. However, the stimulation provided should be helpful and calming, not a source of agitation or anxiety. Gardens and outdoor areas can provide positive stimulation that help residents with dementia and Alzheimer's feel less "trapped" indoors [52]. These areas should be designed with a circular path to reduce wandering.

The hallways can also be decorated with items that provide stimulation for residents with memory impairments. These items can include memory boxes outside their doors or murals with textural elements, as pictured below.

The Alzheimer's Association has published a comprehensive list of publications that aide in creating spaces for residents with Alzheimer's Disease for LTC facilities [53].

Some Residents with Alzheimer's and dementia may also have behavioral disorders. For facilities that have residents with behavioral disorders, there should be a focus on safety and calmness. All areas should be secure and safe from the

risk of self-harm. Spaces that provide greater risks, such as outdoor or dining areas, could possibly need greater security present [24]. Even the stairwells should be considered in design as they can also pose a safety risk [54]. Calming colors and dedicated quiet spaces should be utilized as to not agitate those with behavioral disorders. The furnishings for residents with certain traits, such as suicide risk or easy agitation, should be chosen carefully [24]. Single-resident rooms, maximum exposure to daylight, and the use of art for décor are all recommended.

5. Design Tools

In this paper, the most design concepts and elements can be modeled by using computer design tools. Using those tools can help architects and engineers to visualize design concepts and elements before realizing them. Following figures give examples.

Figure 5 shows that for dining area, large windows associated with correct amount of artificial light will make the canteen and dining area feel more welcoming. It was a view of a full 3D model developed by Building Information Modeling (BIM) software. Also, views of a 3D model of crafting room for an LTC facility are shown on Figure 6 and Figure 7.

BIM is an emerging technology that has been spreading rapidly in architecture, engineering, and construction fields for last decades [55]. It helps architects and engineers plan, design, construct, and manage infrastructures more efficiently. BIM can help users to model the infrastructures and furniture, to predict the placement of items. More than that, BIM can help with simulating how natural and artificial lights illuminate a room. Based on that, the architects and engineers can design effectively and efficiently.

Figure 5. Modeling a dining area with proper combination of natural and artificial light.

Figure 6. Using dividers in the craft room.

Figure 7. Cooking area in the craft room.

6. Conclusions

As the majority of Baby Boomers are going to reach 65 years old, the demand for LTC facilities and services has been steadily increasing. But as a matter of fact, besides shortage in LTC workforce, some existing LTC facilities are unable to provide qualified services since they were designed and built decades before. Thus, the renovation of outdated LTC facilities is an unavoidable issue.

In this paper, some essential and novel concepts for adapting to the current needs of LTC facilities and services by renovating LTC facilities are discussed. The major concept is the person-centered design. As well, some other elements include the importance of natural light to residents, proper practices of flooring and picking doors, some details in home-like design, new guidelines for resident

rooms' design, and some other miscellaneous issues. Other than those, the latest ADA compliance standards are reviewed some crucial standards are discussed in this paper, for ensuring the renovation will make the facilities comply with the standards.

In general, most LTC facilities in the U.S. need renovation to adapt to new concepts and comply with new standards. Upgrading aging facilities and outdated design concepts and practices, those LTC facilities will provide high quality services.

The factors mentioned in this paper are just some common issues and problems that old LTC facilities may encounter. To develop more detailed renovation and retrofitting plans, specified investigations are recommended.

Acknowledgements

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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