Over Bed Table Service System Design Aging design practice through research in a nursing home

Yu Liu
Over Bed Table
Service System Design

Aging design practice
through research in a nursing home

By YU LIU
Master of Fine Arts in Industrial Design
School of Design
College of Image Arts and Sciences
Rochester Institute of Technology
May 2014
Thesis Committee Approval

Chief advisor approval
Prof. Stan Rickel

Associate advisor approval
Prof. Alex Lobos

Associate advisor approval
Mr. Gabe Hallancia

Administrative Chair approval
Prof. Peter Byrne
Dedicated to
my mother and father for their continual support and endless encouragement
Abstract

As citizens we all comprehend that an aging population is one of the biggest trends of our society in the 21st century and as designers, we should understand the significance of assistive products for geriatric use and provide in-depth research on how to optimize the social service system utilizing them.

My project started with a general open-topic survey, in order to record authentic daily inconveniences from seniors and select the direction that is most characteristic and has the most potential to be fully developed. The Overbed Table System Design not only redesigns an existing product, but reconsiders the complete service system in a wider working environment circle. I determined that design research was the priority implement to lead my proposal and cooperated with the local nursing home community from the beginning to the end.

The design process included topic background research, user and prevailing product research, problem definition, ideation, design advancement and specification. I arrange the information above in the first five chapters and discuss what I've learned from this significant project in the final chapter.

I hope my thesis design can be a practical example to elucidate how a product designer cares about the senior community and can originate new products or improve an existing product, which can help designers tackle other issues and make seniors' lives a little bit easier.
# Table of Contents

**Abstract**
Table of Contents  
List of Tables  
List of Figures

**Chapter 1 Introduction** .............................................................. 01
  1.1 Background Research ............................................................. 01  
  1.2 Design for Aging ................................................................. 03  
  1.3 Definitions of Terms? ............................................................. 06

**Chapter 2 Research** ................................................................. 07
  2.1 Research Methodology ............................................................. 07  
  2.2 Literature Review ................................................................. 08  
  2.3 Intended Target Group ............................................................. 
  2.4 Field Study ................................................................. 09  
      2.4.1 Design Point Analysis Update 1.0 ........................................... 12  
  2.5 Design Objective ................................................................. 13  
  2.6 Market Research ................................................................. 14  
      2.6.1 Product General Report ................................................... 14  
      2.6.2 Selected Benchmarks ....................................................... 16  
      2.6.3 Confirm Market Position ................................................... 18

**Chapter 3 Proposal** ................................................................. 20
  3.1 Design Thinking 1.0 .............................................................. 20  
  3.2 Simulation ................................................................. 20  
  3.3 Early Concepts ................................................................. 22  
      3.3.1 The Ideation ................................................................. 22  
      3.3.2 Modify on the Basis ....................................................... 23

**Chapter 4 Development** ............................................................. 24
  4.1 Design Thinking 2.0 .............................................................. 24  
  4.2 Ergonomic Study ................................................................. 24  
      4.2.1 Info Graphics ................................................................. 24  
      4.2.2 Using Scenario Analysis ................................................... 25  
      4.2.3 Usage Percentage ........................................................... 26  
      4.2.4 General Equipment Data .................................................. 26  
  4.3 First Trial ................................................................. 28  
      4.3.1 Purpose ................................................................. 28
List of Tables

Table 1. Population aged 0-4, 0-14 and aged 60 or over, 1950-2050 ............. 01
Table 2. The US senior population growing map 1900-2050 ..................... 02
Table 3. Ten directions and evaluation .................................................. 05
List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Health and healthcare in New York State</td>
<td>03</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Innovative products design for the elderly</td>
<td>04</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Definition of Terms?</td>
<td>06</td>
</tr>
<tr>
<td>Figure 4</td>
<td>S.E.T. Factors</td>
<td>07</td>
</tr>
<tr>
<td>Figure 5</td>
<td>The phrase of the USAP design model</td>
<td>08</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Nursing home and hospital</td>
<td>09</td>
</tr>
<tr>
<td>Figure 7</td>
<td>Personal item for home use</td>
<td>10</td>
</tr>
<tr>
<td>Figure 8</td>
<td>Hospitality use</td>
<td>10</td>
</tr>
<tr>
<td>Figure 9</td>
<td>Activity &amp; Training Center - Hurlbut Nursing Home, Henrietta, NY</td>
<td>10</td>
</tr>
<tr>
<td>Figure 10</td>
<td>Mrs. Betty</td>
<td>11</td>
</tr>
<tr>
<td>Figure 11</td>
<td>Mr. Wang</td>
<td>11</td>
</tr>
<tr>
<td>Figure 12</td>
<td>Shelly – Caregiver</td>
<td>11</td>
</tr>
<tr>
<td>Figure 13</td>
<td>Value Opportunity Analysis</td>
<td>13</td>
</tr>
<tr>
<td>Figure 14</td>
<td>General Product Report</td>
<td>14</td>
</tr>
<tr>
<td>Figure 15</td>
<td>Changeable height</td>
<td>15</td>
</tr>
<tr>
<td>Figure 16</td>
<td>Tilt surface</td>
<td>15</td>
</tr>
<tr>
<td>Figure 17</td>
<td>Storage space</td>
<td>15</td>
</tr>
<tr>
<td>Figure 18</td>
<td>Multi-layer</td>
<td>15</td>
</tr>
<tr>
<td>Figure 19</td>
<td>Hidden handle</td>
<td>15</td>
</tr>
<tr>
<td>Figure 20</td>
<td>Metal base frame</td>
<td>16</td>
</tr>
<tr>
<td>Figure 21</td>
<td>Hill-Rom's Overbed Table Design</td>
<td>16</td>
</tr>
<tr>
<td>Figure 22</td>
<td>Michael Graves’ Overbed Table Design</td>
<td>17</td>
</tr>
<tr>
<td>Figure 23</td>
<td>&quot;iForm&quot; designed by Geoff Hollington</td>
<td>17</td>
</tr>
<tr>
<td>Figure 24</td>
<td>Carex’s Overbed Table Design</td>
<td>18</td>
</tr>
<tr>
<td>Figure 25</td>
<td>Product – oriented</td>
<td>19</td>
</tr>
<tr>
<td>Figure 26</td>
<td>Customer – oriented</td>
<td>19</td>
</tr>
<tr>
<td>Figure 27</td>
<td>Design Thinking 1.0</td>
<td>20</td>
</tr>
<tr>
<td>Figure 28</td>
<td>Used Overbed Table</td>
<td>21</td>
</tr>
<tr>
<td>Figure 29</td>
<td>Marked with yellow notes</td>
<td>21</td>
</tr>
<tr>
<td>Figure 30</td>
<td>Notes of questions and suggestions</td>
<td>21</td>
</tr>
<tr>
<td>Figure 31</td>
<td>Ideation Map</td>
<td>22</td>
</tr>
<tr>
<td>Figure 32</td>
<td>Modify the basis</td>
<td>23</td>
</tr>
<tr>
<td>Figure 33</td>
<td>Design Thinking 2.0</td>
<td>24</td>
</tr>
<tr>
<td>Figure 34</td>
<td><em>The Measure of Man and Woman</em></td>
<td>25</td>
</tr>
<tr>
<td>Figure 35</td>
<td>Using scenario analysis</td>
<td>25</td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>36</td>
<td>Regular Overbed Table</td>
<td>26</td>
</tr>
<tr>
<td>37</td>
<td>Low-height Overbed Table</td>
<td>26</td>
</tr>
<tr>
<td>38</td>
<td>Layout of patient's room</td>
<td>27</td>
</tr>
<tr>
<td>39</td>
<td>Dimension of other objects</td>
<td>27</td>
</tr>
<tr>
<td>40</td>
<td>Model Dimension</td>
<td>28</td>
</tr>
<tr>
<td>41</td>
<td>Model testing in Hurlbut Nursing Home</td>
<td>29</td>
</tr>
<tr>
<td>42</td>
<td>Detail Refinement 01 – Surface</td>
<td>31</td>
</tr>
<tr>
<td>43</td>
<td>Detail Refinement 02 – Surface</td>
<td>32</td>
</tr>
<tr>
<td>44</td>
<td>Detail Refinement 01 – Column</td>
<td>33</td>
</tr>
<tr>
<td>45</td>
<td>Detail Refinement 02 – Column</td>
<td>34</td>
</tr>
<tr>
<td>46</td>
<td>Detail Refinement 01 – Base</td>
<td>35</td>
</tr>
<tr>
<td>47</td>
<td>Detail Refinement 02 – Base</td>
<td>36</td>
</tr>
<tr>
<td>48</td>
<td>Final Concept 01</td>
<td>37</td>
</tr>
<tr>
<td>49</td>
<td>Final Concept 02</td>
<td>37</td>
</tr>
<tr>
<td>50</td>
<td>Mood Board</td>
<td>39</td>
</tr>
<tr>
<td>51</td>
<td>Form Reference</td>
<td>40</td>
</tr>
<tr>
<td>52</td>
<td>Product Rendering</td>
<td>41</td>
</tr>
<tr>
<td>53</td>
<td>Exploded View</td>
<td>42</td>
</tr>
<tr>
<td>54</td>
<td>Assembly &amp; Delivery 01</td>
<td>43</td>
</tr>
<tr>
<td>55</td>
<td>Assembly &amp; Delivery 02</td>
<td>43</td>
</tr>
<tr>
<td>56</td>
<td>Materials</td>
<td>43</td>
</tr>
<tr>
<td>57</td>
<td>Model 1.0</td>
<td>44</td>
</tr>
<tr>
<td>58</td>
<td>Model 2.0</td>
<td>45</td>
</tr>
<tr>
<td>59</td>
<td>Model 3.0 making process</td>
<td>46</td>
</tr>
<tr>
<td>60</td>
<td>Model 3.0</td>
<td>46</td>
</tr>
<tr>
<td>61</td>
<td>Official picture for show</td>
<td>47</td>
</tr>
<tr>
<td>62</td>
<td>LED light, Book holder, Cup holder</td>
<td>47</td>
</tr>
<tr>
<td>63</td>
<td>User testing</td>
<td>48</td>
</tr>
<tr>
<td>64</td>
<td>Design evaluation</td>
<td>49</td>
</tr>
<tr>
<td>65</td>
<td>Using Scenario</td>
<td>50</td>
</tr>
<tr>
<td>66</td>
<td>Painting</td>
<td>50</td>
</tr>
<tr>
<td>67</td>
<td>Thesis Design Exhibition</td>
<td>51</td>
</tr>
<tr>
<td>68</td>
<td>Presenting idea to Hurlbut Nursing Home</td>
<td>52</td>
</tr>
<tr>
<td>69</td>
<td>Repurpose a bed</td>
<td>52</td>
</tr>
<tr>
<td>70</td>
<td>Universal Design</td>
<td>52</td>
</tr>
</tbody>
</table>
Chapter 1 Introduction

1.1 Background Research

The world needs to take urgent action to cope with the impact of a rapidly aging population, according to a new report, which forecasts that the number of individuals older than 60 will surpass one billion within a decade.

In order to identify the situation better, I have listed several fundamental resources below.

Population Aging

“Population ageing is a phenomenon that occurs when the median age of a country or region rises due to rising life expectancy and/or declining birth rates. There has been, initially in the more economically developed countries but also more recently in LEDCs (less economically developed countries), an increase in life expectancy which triggers ageing population.” - Wikipedia

“A country's aging rate (65 years old population accounts for the population ratio) between 7% ~ 14% called aging countries. If the aging rate of more than 14% is called aged countries” - WTO

The Definition of Elderly

“The elderly is the people at the age of 65 or more developed countries, in
developing countries, the age is 60 or more. (according to life expectancy to decide) - The United Nations

Three Stages of Old Age
“Young old” is the senior who is between 60 to 75 years old.
“Old old” is the senior who is between 75 to 90 years old.
“Very old” is the senior who is above 90 years old.

America’s Situation
In the early 1940s, the United States entered an aging population society. Currently, the aging population 65 years or older accounts for 17.4% of the total population, and this proportion will reach more than 30% in the near future.

Table 2 The US senior population growing map 1900-2050
About Nursing Home Service in the US
People desire independence, but based on health and service requirements or other reasons, 40% of the elderly are still living in socialized organizations such as nursing homes.

![Figure 1: Health and healthcare in New York State](image)

About Nursing Home Service in Rochester, NY
According to my recent research, there are at least 35 nursing home communities in Monroe County and 28 of them are in the City of Rochester.

1.2 Design for Aging

As the increasing aging of the world population has globally created a phenomenon that affects every community’s life style, design for aging is not just a slogan but a real opportunity for both designers and industries to bring ideas to the seniors’ market. These products aim to strengthen those living independently and the quality of life for the aged and connect them to dynamic social networks.
Even though there are already plentiful aging products on the market, the majority of them are designed for home and hospital use, which means there are not plentiful products designed for life in a nursing home community. Meanwhile, there is a growing number of nursing homes being established owing to the demands of the fast growing senior population. Hence, I chose to focus on exploring these difficulties and examining products in a nursing home context. After listening to patients’ complaints, I listed ten conceivable directions to develop relevant products. Then, I met with therapists and caretakers who train and serve these patients’ daily activities to see if any direction matches their experiences. The topics with descriptions can be observed in Figure 3 below.
Also, I listed all the typical geriatric diseases that bring inconvenience to a senior’s daily life.

Musculoskeletal: Arthritis
Hormonal: Diabetes, high blood cholesterol
Neurologic: Dementia, Parkinson’s disease, strokes
Visual: Macular degeneration, cataracts
Cardiovascular disease: Heart attack
Skin and Hair: Hair loss, dry skin
Cancers: Prostate, lung, breast, etc.
Urinary: Urinary incontinence
Oral and dental: Loss of teeth

Consequently, I chose to devote more time to researching and thinking about the Overbed Table, a product with an obscure definition but that can be recognized in hospitals, nursing homes and even offices. An Overbed Table is a long-term use product in nursing homes, assigned to specific patients. Users interact with it every day in situations like muscle weakness, vision impairment and amnesia. Accordingly, both staff and patients expressed their desires for me to make it better, enhancing comfort level and emotional respects. Therapists recommended that I take a look at the patients who are using an Overbed Table, and Hurlbut Nursing Home was willing to provide product resources for me to measure and modify.

1.3 Definition of Terms

Definition
“A narrow rectangular table designed especially for hospital patients that spans the bed and is typically fitted with casters and a crank for adjusting the height and tilting the top.” - Merriam Webster

Based on the brief explanation above, I extracted three keywords—span, mobility, and adjustment—which represent the form and function of this term. The Overbed Table can be either segmented into the indoor furniture category or a kind of medical auxiliary equipment. The benefit of designing an Overbed Table for nursing home use is apparent; it’s not merely a piece of simple but elegant furniture in a house, but also could serve as professional multifunctional hospital equipment through upgrading.
Chapter 2 Research

2.1 Research Methodology

Before designing anything, I determined a research strategy. I utilized three ways to gain information. The primary and the easiest way to understand a product’s overall status including brand category, price point, manufacturing and users’ comments is through online research. In addition, I went to the library to get anthropometry books. Through this approach, I was able to access universal human body measurements. The third and most effective method I used was face-to-face conversations with people following my survey questions. When I talked to nursing home staff, I attempted to make my points clear and keep the entire communication efficient. When I chatted with nursing home patients, I devoted more time to observing their behaviors than asking questions.

From research to design is not a linear execution process. My research stage lasted more than six months and certainly overlapped with my design process. Since I constantly gathered information and refined useful data, I established
several principles to help guide my design direction. For instance, I defined the Product Opportunity Gap (Design Objective) and based on that, I conducted a Value Opportunity Analysis of the Overbed Table. Next, I used Value Opportunity Analysis to assess benchmarks and map out the product market position.

2.2 Literature Review

_Elder People and Design_
This is a brief program description to clarify the new research courses at the Department of Design Sciences, Lund Institute of Technology, Sweden. In this text, I found seven focusing perspectives that were extraordinary references for theorizing my design principles:
1. Change as little as possible
2. Design that maintains rhythm and balance
3. Design for your own doing and learning
4. Design for communication
5. Design for telecommunication
6. Design for planning
7. Design for memory functions

_ Universal Product Design involving Elderly Users: a participatory design model_
This is a scholarly article written by industrial design faculty at the University of New South Wales, Sydney. It states that in order to provide a safe and fitting environment for aging people, a participatory design model is proposed. The model includes brainstorming, scenario building, unstructured interviews, sketching and videotaping. Basically, it provided me a practical example of how to structure the Overbed Table design. There are mainly five phases of the design model that are needed in order to transform a concept into a design description so that the artifact is capable of producing the determined functions.
Transgenerational Design Matters
This is a commercial site but also a useful reading resource for the term “trangenerational design,” which is similar to aging design. To me, trangenerational design is surely universal design. It’s not only designed for aging, but designed for the old as well. The Overbed Table is a kind of product that should have gone transgenerational design thinking. The website listed five essential merits: usability, legibility, accessibility, adaptability and compatibility. I will evaluate my concepts and test models depending on these guidelines.

Designing the Nursing Home of the Future
This is an online article by Anthony Cirillo. The author speaks about the situation of nursing homes in the US and how to turn them from hospital-like to home-like. I agree with his point that the facilities and assistive equipment in nursing homes should be designed more akin to friendly household furniture than cold medical devices. The other point I found of value in this text is that the assistive products patients use in nursing homes should be universal. Besides, the seniors, their therapists, housekeepers, caretakers or family members are likely to operate the product.

2.3 Intended Target Group

In terms of my comprehension of the Overbed Table and design trends in transforming aging products from hospital-like to home-like, I organized my intended target users into three groups.

First of all, most needs come from nursing homes and hospitals.

Figure 6 Nursing home or hospital
Subsequently, the Overbed Table could be used as a personal item for a family member. The younger generation can purchase it and use it for entertainment devices on the bed at night and individuals who work at home may also use it as a mobile work station.

Eventually, it can be designed as a room accessory for hospitality use.

2.4 Field Study

After I confirmed my thesis topic, I went to the Hurlbut Nursing Home to learn more about the Overbed Table. According to people’s feedback, I made three distinct personas of users. The purpose is to demonstrate several facts about when people live with this product and get a better understanding of user scenarios from feasible facets.
Persona 1
Name: Mrs. Betty
Age: 72
Things on table surface:
Magazine, mirror, water bottle, remote control

Mrs. Betty is a long-term resident here.
She is visually impaired due to glaucoma and thus needs more light. She is not in a position to sit up straight and she sits in a wheelchair for hours. It is arduous for her to lift her feet up over the base of the Overbed Table.

Unmet needs: insufficient light, undesirable base frame design, no surface arrangement.

Persona 2
Name: Mr. Wang
Age: 75
Things on table surface:
Book, magazine, water bottle, remote control, DVD player

Mr. Wang can do various things. He likes the idea of placing a plastic bag on the side of the Overbed Table and discarding garbage in it. He is unable to move his feet and he sits in a wheelchair when he gets off his bed. He is fond of reading. The thing Mr. Wang complains is that the table surface is too high for him to put his arms on.

Unmet needs: garbage disposal, top surface is too high, arm gets too tired for holding books or magazines.

Persona 3
Name: Shelly
Age: 28
Job: Deliver daily meals, clean patients’ rooms, collect record sheets
She is a caregiver and exceedingly industrious during the daytime. She claims that the objects on the surface are too easily tipped over. Additionally, she believes the base of the Overbed Table should be wider. She said many users feel that it is difficult to get close as their wheelchairs are wider than the space allowed by the base frame.

Unmet needs: objects are easy to drop, the dimension doesn't accommodate wheelchairs.

2.4.1 Design Point Analysis Update 1.0

**Table Top:**
1. The user can knock over objects on the surface table easily.
2. How to make it easier for user to read books or magazines without having to hold them too long?
3. The room light is not enough for quite a few activities. The room light needs to be turned off when one roommate tends to sleep.
4. The width of the table surface should consider both sides of the user’s bed.
5. The user's habits and hobbies may affect the table layout. How to ensure objects are discovered easily?
6. How to make moving the entire table more convenient?

**Column:**
1. How to let the user perceive it is adjustable and operate it by himself?
2. What’s the appropriate height range for most universal situations?

**Base:**
1. Figure out the best shape for the base that allows a wheelchair to move around easily.
2. What’s the right width of bars that can match a standard chair and sofa?
2.5 Design Objective (POG)

Once I knew exactly what nursing home users needed from my field study, my design objective became clear. The goal was to design an Overbed Table-based product service system for the nursing home environment and home use. It should provide users more independent user experience and user-friendly interactions, improving their quality of life. My design starts with nursing home aging design in mind, but the final output should be a universal product for anyone to utilize.

Taking into account the design objective. I drafted a VOA of the characteristics would look for in this product. As you can view in figure 13, I grouped needs and concerns into seven branches. The most important requirements are independence, safety, nice shape, universality, high quality, fully basic functions and ease of cleaning.

VALUE OPPORTUNITY ANALYSIS

<table>
<thead>
<tr>
<th>EMOTION</th>
<th>Pravate</th>
<th>Independence</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERGONOMICS</td>
<td>Comfort</td>
<td>Safety</td>
<td>Ease of use</td>
</tr>
<tr>
<td>AESTHETICS</td>
<td>Color</td>
<td>Tactile</td>
<td>Shape</td>
</tr>
<tr>
<td>IDENTITY</td>
<td>Personality</td>
<td>Universality</td>
<td>Sense of place</td>
</tr>
<tr>
<td>QUALITY&amp;COST</td>
<td>Cost</td>
<td>Quality</td>
<td>Durability</td>
</tr>
<tr>
<td>FUNCTION</td>
<td>Basics</td>
<td>Extension</td>
<td>Customization</td>
</tr>
<tr>
<td>OTHERS</td>
<td>Ease of maintain</td>
<td>Ease of clean</td>
<td></td>
</tr>
</tbody>
</table>
# 2.6 Market Research

## 2.6.1 Product General Report

<table>
<thead>
<tr>
<th>OBT</th>
<th>Dimension</th>
<th>Height Range</th>
<th>Price Point</th>
<th>Material</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overall 30x15x28 in 22 pounds</td>
<td>28 - 45 in</td>
<td>153 USD</td>
<td>Surface Walnut, Wood grain Structure Chrome-plated steel</td>
<td>Table top can be raised or lowered. Table top is locked when adjustment handle is released. 4 swivel casters all for easy maneuverability.</td>
</tr>
<tr>
<td></td>
<td>Table 30x15 in</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall 24x16x21 in 18 pounds</td>
<td>21 - 32 in</td>
<td>99 USD</td>
<td>Surface Plastic with anti-scratch finish Structure Polished aluminum</td>
<td>Surface comes with shock absorbing lining. It can be both adjust height and tilted. Anti-slip raised ledge. 4 lockable castors fit onto base frame.</td>
</tr>
<tr>
<td></td>
<td>Table 24x16 in</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall 30x15x30 in 28 pounds</td>
<td>30 - 45 in</td>
<td>220 USD</td>
<td>Surface Wood grain Structure chrome-plated welded tubular steel</td>
<td>Adaptable tilt-top using tilt-release lever Upward and downward touch allow height adjustment 4 swivel casters for easy movement</td>
</tr>
<tr>
<td></td>
<td>Table 30x15 in</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall 32x18x29 in 27 pounds</td>
<td>29 - 45 in</td>
<td>285 USD</td>
<td>Structure Opal powder coated aluminum base and column</td>
<td>Split top Dual cup holders Dual ergonomic handles Pneumatic lift mechanism C style base design Column can be changed on left or right</td>
</tr>
<tr>
<td></td>
<td>Table 32x18 in 26x17 in</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall 33x20x28 in 22 pounds</td>
<td>28 - 42 in</td>
<td>183 USD</td>
<td>Surface ABS plastic Column and base are covered by PP Plastic</td>
<td>Easily adjusts for different heights Bumped surface edge design Cup holder and small square space for little stuff Wide C style footrest</td>
</tr>
<tr>
<td></td>
<td>Table 33x20 in</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 14 General Product Report

After analyzing a series of similar existing products, I summarized the six most shared features that serve the majority of customer needs:
Pneumatic gas cylinder, hydraulic lifting cylinder, gear-lifting mechanism

The entire surface or 1/3 surface space

Storage box, place for hanging items

Two-layer (one drawer), three-layer (two drawers)

Located at the left/right side of the table surface

Figure 15 Changeable height

Figure 16 Tilt surface

Figure 17 Storage space

Figure 18 Multi-layer

Figure 19 Hidden handle
“T” shape welded frame, “C” style frame, regular height base (4 inch), low height base (3 inch)

2.6.2 Selected Benchmarks

My next step was to discard the conventional benchmarks and take a deeper look at the products represent commercial success: By using the VOA table, I compared the successful ones in the equipment market with my design objectives. The purpose behind that was to figure out which product has gratified most of the needs in a nursing home circumstance and what else can be approved.

**Benchmark 01**
Hill-Rom’s new Overbed Table Design

![Figure 21 Hill-Rom's Overbed Table Design](image)
**Benchmark 02**
Michael Graves’ Overbed Table Design, in collaboration with Stryker

![Figure 22 Michael Graves' Overbed Table Design](image)

**Benchmark 03**
“iForm” – designed by Geoff Hollington

![Figure 23 "iForm" designed by Geoff Hollington](image)
Benchmark 04
Carex’s Overbed Table Design

By comparison, benchmark 04 matches the best. Nevertheless, there is still much room for improvement akin to safety issues, function extension and the ability to customize.

2.6.3 Confirm Market Position

On the basis of all the research information above, I determined that my design should be quite simple to use and provide levels of functions. The price point for this product is in the middle of the price range (150-200 USD, approximately). It should be definitely capable of fitting diverse domestic or office environments in addition to nursing homes.
Figure 25 Product-oriented

Figure 26 Customer-oriented
Chapter 3 Proposal

3.1 Design Thinking 1.0

The diagram above indicates the relationship between the Overbed Table and senior users. I realized that the product doesn’t work along with the user. Instead, it’s a slice of the personal service system. It links with other equipment in the room and interacts with other roles around the user.

3.2 Simulation

In the early design stage, I analyzed a used Overbed Table donated by Hurlbut Nursing Home and put notes all over it. These notes consisted of facts, inquiries and suggestions.
SURFACE
The width of surface should provide enough space for both hands.
How to make it easier for patients to hold reading materials for a while.
The smoothy surface is easy for patients to know objects down unconsciously.
The illumination around table surface is not sufficient for user to do certain activities.
Seniors have their own habits and it has been reflected from the layout of daily objects.
What’s the most convenient way for patients to push and pull table to the direction they want.

COLUMN
How they could adjust surface height by themselves independently.
What’s the most reasonable height range for the most situations.
What’s the right distance from the base frame to the floor.

BASE
Figure out the right width to fit for most wheelchairs and couches.
Determine the appropriate position of the connecting part.

Figure 28 Notes of questions and suggestions
3.3 Early Concepts

3.3.1 The Ideation

The Idea Map

In the right hand section, I listed all the concerns, behaviors and possible activities according to user needs. In the left part, I started to consider a number of technical approaches to meet these requirements.
3.3.2 Modify On the Basis

This step had a tremendous impact on my next full-size model. I transformed ideas from brainstorming into small mock ups and tested them quickly. While setting mock ups on the Overbed Table, promising ideas already have the appropriate sense of size.

Figure 30 Modify the basis
Chapter 4 Development

4.1 Design Thinking 2.0

I modified certain features of the original product and presented my ideas in the mid-term presentation. It was time to jump into the next level, which was doing further detailed research and comes with specific practical design solutions. My whole design process needed to be logical and convincive. Following the principle of Human-Centered Design, I also needed to pay attention to users’ emotional factors. An ordinary Overbed Table can be separated into three parts – top surface, column (supporting) and base frame. But all components need to be incorporated into one to make the product fully serviceable.

4.2 Ergonomic Study

4.2.1 Info Graphics

From the book *The Measure of Man and Woman: Human Factors in Design* by Author, I found four aspects of measurement data I need:

- Wheelchair dimension
- Regular desktop height
- Arm moving range while sitting
- Platform height for standing position
4.2.2 Using Scenario Analysis

During my field study, I concluded that there are basically three types of user scenarios that directly influence product height adjustments:

- Therapist – teaching and interacting – stand
- Senior User – playing and sit
- Senior user – eating, reading, watching TV – recline

Figure 32 The Measure of Man and Woman

Figure 33 Using scenario analyses
4.2.3 Usage Percentage

Generally speaking, there are two types of Overbed Table on the market: the regular version and the low-height version.

Ninety percent of Overbed Tables belong to the regular type. The regular version serves the user of average height, seated in a standard wheelchair. In addition, users are more likely to choose the standard bed-height setting.

Barely 10% of people use the low-height version. It’s designed particularly for users with a short body height who are seated in a low-seat wheelchair.

4.2.4 General Equipment Data

In order to make sure the Overbed Table I designed provides a comfortable size for patients and allows them to rotate and move around their rooms, I recorded the layout of the room and measured the space between beds and other furniture. Simultaneously, for making maximal compatibility, I collected
dimension data from other equipment and furniture that share the same space with an Overbed Table.

Data 01 - Layout of patient’s room

![Figure 36 Layout of patient's room](image1)

Data 02 – Dimensions of other objects

![Figure 37 Dimension of other objects](image2)

**Food Tray**
Dimension: 17.25x14.5 in

**Electric Lifting Bed**
Dimension: 80x42 in
Bed height: 18-19 in
Height range: 7.25-26 in
Standard Wheelchair
Maximal lap height: 27 in
Armrest height of wheelchair: 28-29 in
Seat height of wheelchair: 19 in
Footrest height to the floor: 3.25 in

Armchair
Seat height: 20-21 in
Seat height (low version): 18-19 in

Regular Chair
Armrest height: 26 in
Seat height: 18 in

4.3 First Trial
4.3.1 Purpose

By making a full-size foam core model, I was able to test its accessibility and compatibility more easily. Since I am not the top user, I decided to put the model into a real environment and acquire feedback from a nursing home community.

Figure 38 Model Dimension
4.3.2 Design Point Analysis Update 2.0

**Table Top:**
1. “Fun Area 1” a small part can be customized (creativity, function).
2. Should it be designed with a specified height or need I/should I come up with a simple way to convert heights?
3. Does it need a stacking function? This means it could be effortless to put together so that several pieces would form a larger surface.
4. Not all objects need to be preconized. Maybe a core part can act as the “key,” which belongs to the user.
5. For housekeepers, any groove on the table surface is probably difficult to clean.
6. Seek an intuitive way to help users organize objects on the table so that they can notice them easily.
7. “Edge Handle” is a conductive direction. Consider the area that can be applied to this feature.

**Column:**
1. “Fun Area 2”
2. Should consider all the processes manufactured by using plastic material.
3. If it’s made of plastic, is it likely to be assembled by two main plastic parts?

**Base:**
1. Broadening the base is an advantageous idea, so I need to figure out the right dimension.
2. What’s the reasonable distance between two columns that can fit the majority of wheelchairs and standard chairs?
4.4 Detail Refinement

The feedback from my first trial was unquestionably positive, and many of my questions or ideas were confirmed and discussed. However, I still missed a few design points. For instance, some caretakers suggested designing a tiny interlayer under the top surface for storing patient’s recording sheets. In the detail refinement stage, I made several blue foam mock ups to explore ideas, and tried to balance form and function. In the meantime, I decided to use wood material for a final display model, and I made small-scale wood models with the structure I used in the full-size one.
Table Top

STAGE 01

STAGE 02

Figure 40 Detail Refinement01 - Surface
Figure 43 Detail Refinement01 - Surface
Column

STAGE 01

STAGE 02

Figure 44 Detail Refinement01 - Column
Figure 45 Detail Refinement02 - Column
Base

STAGE 01

STAGE 02

Figure 46 Detail Refinement01 - Base
Figure 47 Detail Refinement02 - Base
4.5 Final Concept

The table top provides a 10% larger space for patients to use so that they won’t find it difficult to place both arms on it from either the left side or the right.
side. There are two thin drawers on both sides. In this way, the patient can safely store sharp or fragile objects such as pencils, pens or mirrors. This design solution comes from the demands for personal safety and concerns about geriatric symptoms like amnesia. Caretakers can also deposit patient’s recording sheets in the drawer to retain privacy. On the top surface, there are two delicate bumpers on both sides for preventing objects from falling off. Around the top surface, the idea of an "edge handle" is maintained, surrounding the table top in order to let the user drag and rotate the table conveniently.

**Column**
The table surface is raised and lowered by a pneumatic mechanism installed in a column, similar to the lower segment of a task chair. The table top height adjustment range is from 26–42 inches. A vertical adjustment range of 16 inches offers adequate table height. The column can provide both left and right side versions, and the same feature goes with the base. Knobs on the side of the column have triple functions. It can be a telephone wire arrangement, a handle to control the moving direction, or a hook for hanging a garbage bag. In this way, patients won’t worry that a trashcan is too far away to use.

**Base**
The distance between the C style base frame is 26 inches, wide enough for matching most wheelchairs and armchairs. The distance from the floor to the base surface is about 3.25 inches, which makes patients feel easier putting their feet on it and it won’t interfere with the wheelchair’s footrest when it’s pushed forward.

**Overall**
My final Overbed Table design is a service system made with a basic plastic-based Overbed Table and a series of accessories. The main body is assembled using three plastic parts. The dimension is 35 (L) x15 (W) x26 (H). Instead of designing an exhaustive product by continuing to add features to it, I picked the correct accessories to boost the user’s experience. After clamping on an LED reading light, cup holder and book holder, seniors can enjoy reading in bed at night for a long time. Again, the quintessential objective is to
provide a simple, user-friendly service system to enhance people's independent living.
Chapter 5 Specification

5.1 Clarifying Plastic Model

5.1.1 Mood Board

Mood Board is about discovering the right expression from nature to guide design aesthetical tendency, which will be reflected in product color, tactility and shape. In this case, the keywords I defined are bright, smooth, fluid and peaceful.

Figure 50 Mood Board
5.1.2 Form Reference

Form Reference is another way to direct the language of form. It is more concrete and rational compared to mood board, which is abstractive. In that the Overbed Table I described is between medical assistive equipment and household furniture, I selected a series of close-ups of products to indicate this soft, humanized form language I look for. The keywords are neat, round edges, and an integration of form and detail.

Figure 51 Form Reference
5.1.3 Product Rendering

The white plastic model elucidates how the mobile table looks. All the colored parts are adjustable. The front side of the lifting bar is a branding area and a name tag is located on the right corner of the table top. The table top also has two linear embossments, the purpose of which is to fix the food tray during meal time. Moreover, the table top uses an egg-crate structure to reinforce its cantilevered shape. The base is actually assembled with a C-shaped steel sheet covered with plastic. Clusters of bosses and ribs connect vertical metal rods in the column with the base steel part. All plastic surfaces are glossy except the table top.
5.1.4 Color, Material, Finish

**Color**
For the standard product, the color theme is white for the main body and the moveable parts have color options. The white surface provides much possibility for users to customize with their own patterns and textures.

**Material & Finish**
The plastic is High Density Polyethylene. The table top is made using Reaction Injection Molding with a semi-gloss surface finish. The upper column part is made with Structural Foam Molding and the lower column part is made using Rotational Molding. The same molding technique can be used to create the base frame cover.
5.1.5 Assembly & Delivery

The buyer will receive partially assembled pieces and will need to assemble them before use. For delivery, similarly shaped components will be stacked before shipping.

5.2 Making of Display Model

5.2.1 Material & Color

Materials:
Customized steel plate
Square Steel Tube & Rod
Task Chair Gas Spring (Pneumatic lifter)
Baltic Birch Plywood
Wood scrap, screws, nuts and flat washes
Color – Pure White

5.2.2 Making Process

Model 1.0
The purpose of this rough model was to work out the correct size as built during the research process. In the meantime, I tested the supporting structure, which prevents the table top from rotating and tilting.

What I learned is that the structure combining PVC pipe with customized wood cylinder is not strong and steady enough to sustain the weight from the table top. A pneumatic mechanism has more capacity to decrease space and shake. Moreover, the thickness of the table top is too thin to validate the drawer idea.

Figure 57 Model 1.0
Model 2.0
The second full-scale model was to prove that the table top could be fully supported by two groups of metal tubes and rods. Secondly, it was intended to confirm the appropriate basic dimension and height adjustment range.

What I’ve learned from this intermediate model is that the column is capable of balancing its superstructure. But it needs considerable lubricating oil to make sure the table top can be raised and lowered with minimal hand power. I still need to examine details of my assorted design including customized joints and part tolerance.
Model 3.0

As a final model, the goal is to execute ideas about this project while making sure all functions can still work after assembly. The most challenging part is to optimize the connection of the table top and column so that the cantilevered surface doesn’t sag. After putting all the parts together, I spent a considerable amount of time polishing. For the final model, I am aware that it is impractical to make the column extend perfectly due to deviation. But as an appearance model, it meets the purpose.

Figure 59 Model 3.0 making process

Figure 60 Model 3.0
Figure 61 Official picture for show

Figure 62 LED light, Book holder, Cup holder
5.3 User Testing

5.3.1 Design Point Analysis Update 3.0

The final prototype has been tested by four users and the therapist team asked questions in accordance with their user experiences.

Here, I want to share the feedback from patients and nursing home staff. They were impressed by my design and believe that it is better than the Overbed Table they are using, but there are invariably enhancements that can be made.
**Table Top:**
1. The table surface needs to be strengthened for home or office use for the reason that a user may put a PC, personal printer or camera on the table.
2. For nursing home and hospital situations, the product, especially the surfaces, may be processed with MicroBan finish, which protects the table surface from the damaging impacts of bacteria, mold, and mildew.

**Column:**
1. The side part should be thinner so that the user feels that it is more convenient to throw garbage into the bag hung on the side part.
2. The adjustment range should also consider the activity center scenario that therapists use it as a teaching platform while they stand behind it.

**Base:**
1. The locking function of the base should be considered. In a particular case, the user may move the Overbed Table as a walker for a short distance. As a result, the user may easily fall down as the product moves forward simultaneously and can’t provide enough friction.

In general, the service system I proposed trailed my design objective. The product has an identical but peaceful look. It should be lighter than the wood and metal version since it is made of plastic. Safety continues to be the biggest issue because of the cantilever shape and non-breakable swivel casters. The entire design process has been a beneficial practice for me and it motivates me to continue doing research about aging design.
Chapter 6 Conclusion

6.1 Design Consequence

Through this thesis project, I put the theory of Value Proposition I learned from entrepreneurial class into practice. Here is the Value Proposition of my design - for the nursing homes that desire to obtain the proper kind of Overbed Table for senior users or the people who wish to choose one for their bedroom. It provides not only all the elementary functions, but fits into your environment as well. It is an innovative and user-centered product at a price in the mid-range of Oberbed Table brands on the market.
Through this thesis design, I not only exercised my design thinking, but also exercised my problem solving capability especially hand crafting and modeling skills. In addition to generating and visualizing a concept, I learned how to make it happen physically with mock-ups and operational prototypes.

The meaning of this thesis design exhibition is to indicate a designer’s story and inspire individuals from various fields. I hope more people can realize the significance of aging design in our society by viewing my work and comprehend that medical equipment is just one of numerous possible design directions.
Thanks to Hurlbut Nursing Home for helping me gather intuitional information and contributing valuable perspectives from the beginning to the end. I discovered many design opportunities there and hopefully, my imperfect solution can strengthen patient confidence and I hope to do more for the nursing home community in the future.

6.2 Some Thoughts

- Design helps to repurpose a bed as a working/entertaining/sleeping space.

- Universal Design helps to address problems for aging, but it has benefits for all as well.
References


[2] “Patterson Medical 2011 Long Term Care Catalog”


Appendices

For Users – Version 1.0

Hello! I am Jason, Industrial Design graduate from RIT. I am currently conducting user research for aging design thesis. Your answers will bring me a big help, thanks a lot!

1. Please tell me the problems in the aspects below
   - House cleaning:
   - Taking bath & Using toilet:
   - Cooking & Eating:
   - Dressing:
   - Sitting & Walking:
   - Taking medicine:
   - Outdoor safety:
   - Recreation & Fitness:
   - Watching & Hearing & Communicating:

2. Based on what you mentioned above, is there any product can solve your problems?
   - Item 1:
     - What’s the function:
     - Any advise to make it use better?
   - Item 2:
     - What’s the function:
     - Any advise to make it use better?
Hello!

I am Jason, Industrial Design graduate from RIT. I am currently conducting user research for aging design thesis. Your answers will bring me a big help, thanks a lot!

Item 3:

What's the function:

Any advise to make it use better?

Item 4:

What's the function:

Any advise to make it use better?

3. Do you know anything about these symptoms below:

- Arthritis
- Dementia
- Tremor
- Balance & Falling
- Stroke
- Hearing, Vision & Memory Problem

4. Your age: ____________ The number of home member: ____________

5. Do you live in your own house or share your house with other family members?

Reason:

6. Describe the product you use most, does it designed for senior group?

Name:

How do you feel about it:
Hello!

I am Jason, Industrial Design graduate from RIT. I am currently conducting user research for aging design thesis. Your answers will bring me a big help, thanks a lot!

7. Please mark the following behaviors which are not easy to accomplish in your life.

   Standing bath
   Open the outdoor at night
   Operate TV remote for a while
   Stand up from your seat
   Find the quality guarantee date on your food package
   Find the someone’s phone number
   Take off your shoes/socks/pants
   Walk outside for a half hour
   Carry food from market
   Take pills at a regular time

   The thing you always try to use, but it’s hard to learn how to use: ____________

   Please tell me why: _______________________________________________________

   Is there anything I didn’t mention about but it keeps bothering you?
Hi!

This is the sheet I prepared for interviewing with both senior patient and staff. I try to as many details as I can about the current OBT.

To the senior user: “Let’s talk something about OBT.”

1. Do you like the Overbed Table? Could you be happy without it?
2. How long do you usually stay on bed everyday and how about the table?
3. What do you usually do with it? Does it help you to accomplish these things well?
4. What kind of function of feature do want to add to your table?
5. What objects you like to put on the table instead of other places?
6. Do you notice any other people also need to use it besides you, why?
7. Tell the point you like most about it and the thing you complain most about it.
8. Do you use wheelchair? Do you still use the table as an OCT as well?
9. Do you still use it when you are off the bed?
10. What things you need to do besides sleeping on your bed? And how many things need to use on the OBT?
11. Do you want to use it if you are at home?
12. Will the table becomes an obstacle when you get off the bed?
13. While you sleep, does the table panel still stay over your body?
14. Do you ever feel the table limit your movement?
15. Did you be hurt by your OBT before?
16. What’s the most important object in your room?
17. Can you describe your daily activities?
18. What do you think about OBT’s dimension? Is it big enough, or you wish it has an additional surface?
19. Is there any other accessories or assist devices related or attached to OBT?
Hi!

This is the sheet I prepared for interviewing with both senior patient and staff. I try to as many details as I can about the current OBT.

To the senior user: “Is this true or not?”

1. You right hand/arm can’t gain enough space to do things if the table is on your left.
2. You want to adjust the height by yourself, but you can’t sice the control bar is on the edge.
3. You objects can be knocked down easily.
4. It’s hard to read books on bed, the table doesn’t help to hold your books, and the light isn’t strong enough.
5. There is no other case such as bed table or shelf allow you to store your stuff.
6. The table is not steady enough, it’s always moved by other people when they touch it unintentionally.
7. When you want to move it, the wheel is stopped by telephone wire.
8. It never changes since you come here.
9. Is it very heavy for you to move?
Hi!

This is the sheet I prepared for interviewing with both senior patient and staff. I try to as many details as I can about the current OBT.

To the Nursing Home Staff: “Let’s talk about OBT in your working place?”

1. Is there any similar product like the OBT?

2. Is it hard to clean? What’s the hardest part?

3. How important do you think the table is to the patient?

4. How important the table is to your activity?

5. What do you think about its weight, height and size?

6. What kind of aspects influenced you to choose this type finally? How many choices you faced before you made the decision?

7. Is there any other tools or accessories you like to attach with the table?
Hi, Gabee and Brenda, before I come to Hutbutf Nursing Home, I have some questions and I write them below. If you are not sure about some of them, that's ok, we can figure out next week.

01. In order to know how high the bottom frame will be for the patient sits on wheelchair, I need to know the height between feet panel and ground.

02. Based on your working experiences and observation, could you tell me the most suitable height range of OBT (Over Bed Table) for senior patients? Because last time, one of the therapists pointed out that the OBT are either too high or low for senior to use.

03. I also want to know the basic dimension of OBT, does the size (Length/Width) of surface is the same as the bottom frame or the surface is a little bit smaller that frame?

04. Remember we talked about the limitation of OBT when the patient's bed is located besides right wall? Now I want to know how big the problem is. Could you help me to count how many beds face this problem?

05. When I was talking with a male patient, he complained the wheels are often stopped by telephone wire. He tries to put the wire below his bed, but the problem happens again when assistant moves OBT. Do you have any suggestions? Is there any other wire stuff around OBT also? By the way, is OBT's four wheels all swivel wheels?

06. Now, one of my idea is dividing the surface into two parts, the big part is fixed and small part is changeable based on different requirements. What do you think? Based on several typical symptoms, are their desktop layout different?

07. I think one of the challenge to me is how to get the hydraulic plunger elevator part, do you have any suggestion?