Research and Design of multifunctional nursing bed for Elderly People

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Abstract. The growth of elderly population has promoted the increasing needs of the geriatric nursing industry. However, geriatric nursing products are quite rare. The functions of current nursing bed in the market are quite simple and lack of completeness, which leads to few detailed design for elder people’s life. This paper focus on building design philosophy of the nursing bed for elderly people and attempting to design multifunctional nursing beds that could solve elderly people's living problems by following old people's behaviour.

Keywords: multifunctional nursing bed, elderly people, barrier free design.

1. Introduction
Since 2000, the results of the fifth census show that the number of elderly people over 60 years old in China has reached 130 million, accounting for 10.2% of the total population. [1] China has officially become the country of aging population. The aging population has become one of the important components of the population base of our country. The one-child policy makes China at present a "421" family model. In the meanwhile, most children don’t have enough time to take care of their parents as a result of the increasing fierce competition. Like young people, elderly people do not surrender to their age. When they grow old, they’d like to take care of themselves even when they feel not quite well.

The research of geriatric products in China is booming. However, those beds are initially designed to solve certain groups of people’s certain problems, which are too idealized. The design of those beds only concerns about practical problems like how nurses take care of elderly people. However, the study about the state of how to use nursing beds when elderly people take care of themselves should be enhanced.

2. Division of elderly people
When people grow old, their physical function decreases, making them easy to be ill. Therefore, according to the degree of physiological function decrease, the decrease of self-care ability and the degree of their need for help, old people can be classified into three category: the self-care elderly, the device-aided elderly, and the nursing-cared elderly. The self-care elderly refers to people who can basically take care of their own life and don’t need to depend on others. The device-aided elderly refers to people who can take care of themselves, but they have physical diseases, need to be taken care of and depend on crutches, armrest, wheelchairs and elevating facilities to move around.

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nursing-aided elderly are people who cannot live by themselves, have serious diseases or cannot move around, and completely depend on others. [2]

The nursing bed will focus on the study of the device-aided elderly and the nursing-aided elderly by analyzing their habits and way of living to design functions that satisfy elderly people’s basic needs.

3.  Analysis of elderly people’s illness condition
People’s physical function decreases as they grow old. The analysis of elderly people’s illness condition are showed in Table 1.

Table 1. Changes and specific manifestations of physiological characteristics of elderly people.

| Changes of physiological character | Specific manifestations                                      |
|-----------------------------------|-------------------------------------------------------------|
| Impairment of perceptual function | Slow audition, decreased hearing                            |
|                                   | Blurred sight, low color identification                     |
|                                   | Dull sense of touch, decreased perceptivity                 |
|                                   | Degeneration of smell and insensitivity to smell            |
|                                   | Diminished taste perception and poor appetite               |
| Neurasthenia                      | Decline in memory, slow reaction, trance                    |
| Degeneration of motor system      | Muscle weakness, slow movement and decline of resistance    |
| Mental defense disorder           | anxiety, melancholy, irritability, self-doubt              |

Orderly’s disease, no matter what it is, even psychological disease, will eventually make them become slow in action, which makes it difficult for them to walk, thus they will end up bedridden. Whether elderly people can walk or not, the nursing bed is very important for their lives. A suitable nursing bed can release their mental burden and slow down deterioration of disease.

4.  Type of nursing bed
The nursing bed is mainly used for the treatment and recovery of the patients. In order to satisfy different people’s different demands, there are various nursing beds in the market, which can be divided into basic function type, normal function type, and advanced function type. [3]

Figure 1. Basic functional nursing bed. Figure 2. Normal functional nursing bed.

The structure and function of basic functional nursing bed are quite simple, which only needs basically manual mechanical operation to meet user’s requirements to stand up, to lean to one side, and to have dinner. However, there is no use for the user’s nursing and rehabilitation. Because of less function and simple structure, this nursing bed is not expensive. Therefore, it is quite suitable for family of general economic strength to use it as home nursing bed.

The level of normal functional nursing bed is higher than the basic functional one, since it pays more attention to user’s emotional elements and has more convenient functions. This kind of bed tries to release user’s physical burden by electrical operation with a telecontroller, which makes it more
expensive and beyond ordinary family’s purchasing strength, thus mostly being applied to middle-level hospitals and health care institutions.

![Figure 3. Advanced functional nursing bed.](image)

5. Design principles and methods for elderly multifunctional nursing bed

Elderly people need to be specially treated like children. Elderly home furniture need to be carefully dealt with to meet certain norms. The design of nursing bed need to meet the following principles:

5.1. Safety principle

Safety principle is the most basic and important principle. Most of the users of multifunctional bed are slow physically handicapped or even half paralyzed. Compared to ordinary people, they are easily hurt in their moving process. Therefore, more considerations like structure design, model design, functional design and materials choose should be given to the potential safety risks to ensure the product s’ safety when designing them.

5.2. Multifunctional principle

Because of age growth and lack of exercise, elderly patients, long-time bedridden patients, paralytic patients face problems like physical activity, osteoporosis and muscle atrophy. Especially for those long-time bedridden patients who are easy to have bedsores, which is quite difficult to be nursed and to recover. Necessary backside exercises, leg activities, and turn over exercises are very useful to effectively relieve symptoms of the back, waist, buttocks and legs. [4] Therefore, the design of multifunctional nursing bed should fully consider and display the joint activity of patients when they use it. Besides, paralyzed patients’ problems like defecating, urinating and bath should also be solved as soon as possible by the multifunctional nursing bed. In the design process, more freedom should be given to elderly people to relieve their melancholy mood.

5.3. Convenience principle

With the growth of age, elderly people has problems like declining memory and low recognition to the outside world, which require the operation part of multifunctional nursing bed have reminding function. In middle and low level health care institutions, generally one nurse takes care of at least five patients, which makes those patients cannot be well looked after and at the same time nurses have strong mental pressure. To some extent, the convenient operation of multifunctional nursing bed can improve nurse’s work efficiency.

5.4. Spatial adaptability principle

Multifunctional nursing bed are mostly used in wards or at home. Therefore, the design of the nursing bed must take into account the morphological characteristics of the human body, the patient's
perception characteristics, the patient's response characteristics, and the psychological characteristics of the patient when they use it. When choosing mechanical models and designing structures for the nursing bed, its size should be limited based on related regulations of nursing bed, by which patients’ comfort can be satisfied and at the same time this kind of bed do not take too much ward and house spaces. [5]

5.5. User’s emotional needs
The design of multifunctional nursing bed should consider elderly people’s barrier-free experience. Besides, attention should be paid to elderly people’s physiological behavior habits and their psychological needs. Barrier-free experience for them should be emphasized in designing process. The psychological needs of paralyzed people are more special. Generally speaking, they have the same needs as normal people. Deep down in their hearts, they want to be treated fairly, nor differently or specially. However, they do have actual difficulties. The focus we need to study is how to solve their problems while do not make them feel different with others. The design of nursing bed should give those paralyzed people confidence and reduce their inferiority by humanized details and warm elements. [2]

6. Design case analysis and empirical design demonstration
Now, the functions of most multifunctional nursing beds are to helping elderly people to get up, turn over and have dinner, etc. Advanced nursing beds consider the combination of wheelchair and elderly people’s need to defecate, urinate and bath.

The multifunctional bed in Fig.4 is advanced multifunctional nursing bed. The left nursing bed works by electronic operation. Besides the function of getting up, bending legs, turning over and having dinner,

The grooves in the middle part of the nursing bed have the function to solve the problem of defecating and urinating. The biggest feature is the square-part in the back which can be rotated or folded. When elderly people need to wash their hair, the back part can turn to concave type by rotating or folding. Therefore, elderly people can finish washing their hair without moving. Elderly people can avoid be hurt by moving them, at the same time, the nursing bed is kept clean. The right nursing bed also works by electric operation. Besides basic function, the biggest feature is to combine the function of nursing bed and wheelchair. There is a wheelchair design hidden in the structure of nursing bed. The buckle that chains the bed part and wheelchair part can be separated by electrical control. From the perspective of safety, this bed can also avoid accidents. From the perspective of model, other nursing bed is designed to be completely turned in to a wheelchair when needed, while the wheelchair on the right is transformed into a part of the nursing bed to reduce the volume of the wheelchair, which reduces the limitation on the use space and it is also convenient for old people to operate.

From what have been discussed, we can know that the aspects designers have considered about when they design a nursing bed are functions like whether it can help elderly people to get up, turn over, have dinner, defecate and urinate, and some will even consider about the combination of bed,
wheelchair and the washing-hair function, etc. Few designs will take old people’s detailed needs into consideration. Therefore, some detailed functions have been added to this multifunctional nursing bed by imitating old people’s behavior habits.

![Diagram of multifunctional nursing bed](image)

**Figure 5.** Schematic diagram of the structure of multifunctional nursing bed.

1. Get-up handle  
2. Telescopic infusion frame with lighting system  
3. Telescopic guardrail  
4. Multifunctional dining plate

With the decline of physical fitness, elderly people need some external aids when they get up. The get-up handle of this multifunctional nursing bed can help elderly people to get up and reduce nurse’s burden when they try to transfer those patients. Elderly people have the habit of going to the washing room at night. They need to do things like turning on the light. The get-up handle of the nursing bed is made of special luminescent material, which can send out blue light at night after special treatment. There is also a lighting switch, which helps old people to quickly turn on the light with the help of the luminescent handle. Telescopic infusion frame with lighting system can give local illumination to the nursing bed. At the same time, it also has the function of emergent hint.

The following situations always happen in hospital. When patients have emergency and give a sudden call to doctors, those doctors often can not arrive in the ward immediately and give a quick judgment on the patients. However, this nursing bed provide a solution to enable patients to call medics at the first time to ensure proper treatment by activating the red warning light in the telescopic infusion frame of the lighting system. The multifunctional dining plate also has the functions of bed tail plate. Based on patients’ need, the dining plate can be adjusted. At the same time, its’ angle can be adjusted to help users to read books or browse web pages according to their own habits.

7. Conclusion

Attention should not only be given to long-time bedridden patients but also be given to elderly people who can still move but their motion ability are degenerating. The design of nursing beds can be more extensive and the problems should be solved more carefully. And products for elderly people whose motion ability are degenerating should be designed with more consideration on their ways of living and behavior habits. Efforts should be made to help elderly people to solve inconspicuous obstacles to make them to have better life.

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