

Changes in welfare equipment (form of wheelchairs) in light of history of international home care and rehabilitation exhibition

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ABSTRACT

The 49th International Home Care and Rehabilitation Exhibition (H.C.R.) that showcases the present and future of care and welfare was held at Tokyo Big Sight (Koto-ku, Tokyo, Japan) for three days from October 5, 2022. The first exhibition was held in 1974 as the “Exhibition of Modern Equipment for Social Welfare Facilities”, which was attended only by domestic companies. Because of the effects of COVID-19, the exhibition was canceled in 2020 and held on a smaller scale than usual in 2021. In 2022, 333 companies, including companies from abroad, participated in the in-person exhibition.

Healthy people may not be familiar with welfare equipment. One typical welfare equipment is a wheelchair. Throughout their long history, wheelchairs have served as mobility aid devices mainly for people with lower-limb disabilities. The form of wheelchairs should be suitable for their functions because wheelchairs are practical devices. We should consider the form of wheelchairs from the fundamental perspective of the fulfillment of their functions. We conducted a survey on the actual needs for wheelchairs to explore the possible resolutions for the above issues and consider what types of manual wheelchairs are needed. Many users want small and lightweight wheelchairs. Also, they wish to move and operate their wheelchairs using some kind of motor power (mechanism) when they go out. The development of single-purpose wheelchairs is desired so that users can select wheelchairs with different functions depending on their lifestyles and intended use.

The quality of the design of wheelchairs has been improved. Now we are verging on the era of evolution of wheelchairs. The goal of wheelchairs is to be not merely a means of

mobility but a “comfortable space” for users. It has become important for the whole society to know in advance the broad product portfolio on display at the annual H.C.R. and other occasions.

Keywords: international home care and rehabilitation exhibition (H.C.R.), welfare equipment, form of wheelchairs, support of the independence, comfortable space.

1. INTRODUCTION

The 49th International Home Care and Rehabilitation Exhibition (H.C.R.) that showcases the present and future of care and welfare was held at Tokyo Big Sight (Koto-ku, Tokyo, Japan) for three days from October 5, 2022. The H.C.R. is one of the largest exhibitions in Asia bringing together the latest equipment related to the care of and livelihood support for the disabled or the elderly. As the brochure of the H.C.R. states, “from handmade self-help devices to cutting-edge nursing-care robots”, all kinds of welfare equipment are displayed and visitors can see and touch them.

The first exhibition was held in 1974 as the “Exhibition of Modern Equipment for Social Welfare Facilities”, which was attended only by domestic companies. The name “International Welfare Equipment Exhibition” was used in 1986 when the exhibition was, for the first time, attended by 70 companies from abroad. The exhibition was established as an international exhibition in the 1990s.

Because of the effects of COVID-19, the exhibition was canceled in 2020 and held on a smaller scale than usual in 2021. In 2022, 333 companies, including companies from abroad, participated in the in-person exhibition. Including the companies that participated in the Web exhibition held online, a total of 342 companies participated in the exhibition. It has been reported that the total number of visitors over the three days was about 88,521¹⁾.

Healthy people may not be familiar with welfare equipment. One typical welfare equipment is a wheelchair. Recently, we have more occasions to see people traveling using manual or powered wheelchairs in trains and on the streets.

In this research, we will trace the historical changes in wheelchairs for the disabled and the elderly²⁾, focusing on the form (shape and functions) of wheelchairs. We will also discuss the current state of wheelchairs displayed at the H.C.R. and future prospects.

2. OUTLINE OF HISTORY OF H.C.R.¹⁾

The first exhibition in 1974 was hosted jointly by the Japan National Council of Social Welfare and the Ministry of Health and Welfare as the “Exhibition of Modern Equipment for Social Welfare Facilities” (Fig. 1). The physical burden on welfare service workers, such as lower back pain, had become a problem at that time. The exhibition was held aiming at the improvement of the working environment and the provision of safe care to persons admitted to welfare facilities through the modernization of the equipment at the facilities and labor-saving in the work process.

At the second exhibition held in 1975, the exhibition was renamed the “Social Welfare Equipment Exhibition”. Since then, the exhibition has brought together welfare equipment that supports nursing care with the aim of promoting an independent daily life for the disabled and the elderly.



Figure 1. The first exhibition in 1974¹⁾

The 13th exhibition in 1986 was held as the first international exhibition of this kind in Japan and attended by companies from Europe and the United States. Since the 19th exhibition in 1992, it has been held annually as an international exhibition. The name “International Home Care and Rehabilitation Exhibition (H.C.R.)” has been used since the 15th exhibition in 1988.

Being constantly attended by companies from abroad and more than 500 domestic companies, the H.C.R. has become a representative international exhibition in Asia and has expanded its scale to become the third largest in the world, following Medtrade (the United States) and REHACARE (Germany). Figure 2 shows the attributes of the visitors in 2018 and 2022. As shown in the figure, a broad range of people participate in the H.C.R.

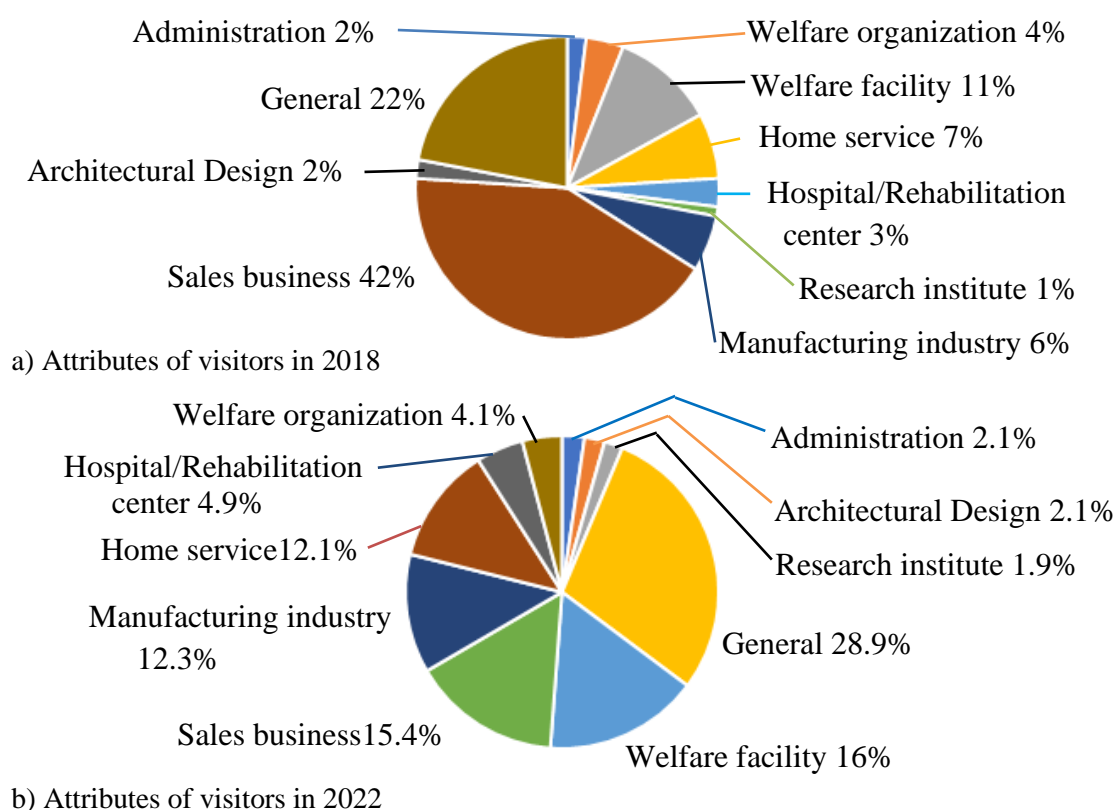


Figure 2. Attributes of visitors to the International Home Care and Rehabilitation Exhibition¹⁾

- **30th H.C.R. in 2003 “Welfare Equipment You Use”**

This exhibition was held with the aim of improving the life-related functions of individuals.

Focusing on the user-driven development of welfare equipment that promotes independence and community involvement, the exhibition featured the following topics.

- 1) Adjusting wheelchairs to postures
- 2) Improving the safety of the sitting system
- 3) Reducing the burden of transfer assistance
- 4) Promoting the effective use of welfare equipment for people with severe disabilities

- **36th H.C.R. in 2009**

Generally, visitors wander around looking at the latest welfare equipment displayed at the H.C.R. and think about how the equipment enriches the life of the disabled.

The exhibition has the same characteristics as a “trade show”. However, we will gain a new perspective when we consider how much emphasis companies and organizations are placing on “welfare”, together with the economic trends of the time.

Users of welfare equipment, that is, welfare service workers, students, and the general public including those who are deeply concerned with such equipment and those who are not, want to have a glimpse into the “current” attitude of companies toward welfare equipment. Measures against infections, including new strains of influenza, attracted a particularly high level of interest at the 36th H.C.R. and drew many visitors to the related booths. Also, Japanese Industrial Standards (JIS) are applied to powered wheelchairs and motorized care beds. The viewpoints of safety and security for users should be taken into account in the manufacturing of welfare equipment.

Because the size of the market for welfare equipment is not very large, the requirement of risk management may be a burden to manufacturers in terms of profitability. Manufacturers involved in this industry should have a high awareness of risk.

If properly used, welfare equipment will broaden the possibilities of the disabled. How the displayed equipment broadens the possibilities of users depends on the users. To that end, visitors should not only enjoy a trade show but also see and examine the possibilities and try out the equipment.

- **42nd H.C.R. in 2015**

There is a diverse product portfolio of welfare devices and other welfare equipment, and it is difficult to visualize the whole picture. The annual H.C.R. is the place where people can see the whole product portfolio and try out the equipment.

As the birthrate declines and the population ages in Japan, it has become more necessary than ever for the elderly and the disabled to use a variety of welfare equipment. It is also necessary to raise awareness of welfare equipment among their families, care workers, and government officials. = Welfare equipment supports daily life in a superaged society.

Not only advanced nursing-care robots but also a variety of welfare equipment that supports the daily life of the elderly and the disabled were displayed at the 42nd exhibition. Although called welfare equipment, the product portfolio supports the daily life of everyone who lives in a superaged society. = Welfare equipment will become essential in life as the population ages.

We may think that welfare devices and welfare equipment are something for particular people. However, even reading glasses are a type of welfare device. As the need for reading glasses increases with age, they will become part of the commodities essential for middle-aged and older people.

Assist Walker (indoor/outdoor mobility aid vehicle) and Little Keepace (rollator equipped with robot technology) are helpful for the elderly with reduced walking ability or difficulty in walking. It is expected that the use of these devices in daily life will help the elderly prevent the decrease in leg strength and maintain and enhance their walking ability.

Also, if walking assistance is helpful for users to maintain their activity, their ability to be involved in the community, including participation in gatherings of the elderly in their community and shopping on their own without helpers, is maintained and expanded. Thus, walking assistance will significantly contribute to the improvement of the quality of life (QOL) at an older age.

Considering that independence support for users may lead to the maintenance and enhancement of their activities, welfare equipment will become essential in daily life as the aging of the population further progresses.

• 46th H.C.R. in 2019

The 46th H.C.R. in 2019 was the largest international exhibition in Asia, bringing together welfare equipment from around the world from handmade self-help devices to cutting-edge nursing-care robots. The number of companies that participated in the exhibition was 438 and the number of visitors was 105,675.

Roho Cushion is a solution for preventing bedsores (pressure ulcers) by dispersing the body pressure. The height of air cells is 10 cm at the highest. The contact surface of the body is increased by sinking the body areas, such as the ischial tuberosities, buttocks, and thighs, that are prone to bedsores deeply into the air cells. Thus, the pressure applied to the surface of the body is maintained uniform. There are various types of product to choose from in accordance with the needs, physical characteristics, and environment of use of users so there is sure to be a product suited to any sitting system.

Users of self-propelled wheelchairs may stumble over a difference in level between a sidewalk and a roadway or a slight difference in level on a slope, or they may nearly fall when they try to pick something off the floor. Anyone who uses wheelchairs may experience such near misses and close calls when they are traveling. A wheelchair that is designed to prevent and reduce these near misses and close calls attracted the attention of many people at the 46th H.C.R.

3. CHANGES IN FORM (SHAPE AND FUNCTIONS) OF WHEELCHAIRS AND CURRENT STATUS

Since the enactment of the Act for Promoting Easily Accessible Public Transportation Infrastructure for the Aged and the Disabled in 2000, significant progress has been seen in the promotion of barrier-free public spaces in Japan.

Accordingly, we have more occasions to see wheelchairs in transportation facilities and on the streets. Now, wheelchairs are offered in a range of color variations. Regarding the shape, there are many functional wheelchairs of distinctive design in addition to the box-style wheelchairs seen in hospitals and welfare facilities.

Throughout their long history, wheelchairs have served as mobility aid devices mainly for people with lower-limb disabilities. The form of wheelchairs should be suitable for their functions because wheelchairs are practical devices. We should consider the form of wheelchairs from the fundamental perspective of the fulfillment of their functions.

The changes in the form of wheelchairs are classified into the following categories³⁾.

- 1) Establishment of the wheelchair industry (pre-mid 19th century: details omitted in this research)
- 2) Establishment of standard box-style wheelchairs (mid-20th century)
- 3) Stagnation of the development of standard wheelchairs and the emergence of sporty wheelchairs (from the 1980s onward: details omitted in this research)
- 4) New twists brought about by the entry of product designers (from the end of the 1980s onward)

Wheelchairs have been used as the means of indoor mobility for people with physical disabilities such as spinal cord injury and people with temporary decline in physical functions while they are admitted to hospital. The posture-holding functions of wheelchairs were found to be important for people with spinal cord injury and cerebral palsy. Measures to provide improved posture-holding functions have become indispensable.

On the other hand, as the share of wheelchairs for the elderly increases, more people with no particular disabilities have needed wheelchairs because of frail health and reduced walking ability due to age. As the aging of society advances, wheelchairs that satisfy the rapidly growing needs of the elderly are much anticipated. Keeping these contemporary issues in mind, let us trace part of the historical changes in the form of wheelchairs and also discuss the current status.

3.1 *Changes in form of wheelchairs*

It is preferable that movement disorders caused by accidents or diseases and age-related decline in locomotor functions be recovered by training and rehabilitation. However, when the recovery of original functions is difficult, those functions should be complemented using assistive devices. Such a functional complement will encourage people with movement disorders to continue their schoolwork, reintegrate into society, and be engaged in a job where they can utilize their abilities. This is highly desirable not only for those individuals but also for society.

Figures 3 and 4 show the changes in manual wheelchairs Part 1 (1920–2000) and Part 2 (2010–2022), respectively.

The oldest wheelchair in the history of Japan is said to be the wooden “*kaitenjizaisha* (rotatable vehicle)” shown in Fig. 5, which was made by a manufacturer of *jinrikisha*

(hand-pulled rickshaw).



1936 Hakone Wheelchair



Early wheelchair by Tojiro Kitajima in 1947



1950 Kitajima Folding Wheelchair



1964 wheelchair



Wheelchair around 1970



Wheelchair around 1980



Wheelchair around 2000

Figure 3. *Transition of Manual Wheelchairs: Part 1 (1920-2000)*^{3,6)}



Nisshin Medical Instruments Co., Ltd.,



Miki Co., Ltd.



Matsunaga Manufacturing Co., Ltd.



Keiai Co., Ltd.

Figure 4. *Transition of Manual Wheelchairs: Part 2 (2010-2022)*^{3,6)}

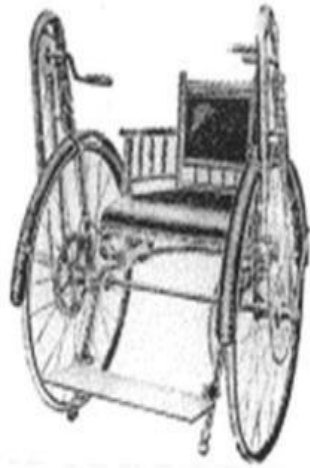


Figure 5. *Rotating wheel (1921)* ³⁾



Figure 6. *Everest and Jennings wheelchairs*³⁾

The oldest wheelchair was operated by manually rotating the crank. However, there is uncertainty in the literature. There are various views regarding the history of wheelchairs²⁾.

The first wheelchair as we know it today was called a “Hakone-type wheelchair” and was manufactured by Kitajima Tojiro Shoten (currently K&AI CORPORATION) in 1936 (Fig. 3).

The Hakone-type wheelchair consisted of a wooden seat frame and a metal base frame, and was operated by a user grabbing the wheels directly. Wheelchairs could only be afforded by wealthy people and did not come into general use at that time^{3),4)}.

3.2 From the early wheelchairs of Kitajima Tojiro Shoten to the Tokyo Paralympic Games in 1964

The early and foldable wheelchairs of Kitajima Tojiro Shoten became popular to some extent after the war. However, it is considered that the standard wheelchairs produced by E&J in the United States in 1960 had a significant impact on the form of wheelchairs³⁾; people may have been attracted to their modern design (Fig. 6).

Then, the first Tokyo Paralympic Games was held in 1964. It was astonishing that athletes from participating countries were using the latest wheelchairs at that time. The wheelchairs and the techniques for operating wheelchairs were excellent. Above all, those athletes were leading independent lives despite having to use wheelchairs.

After the Tokyo Paralympic Games, the production of standard wheelchairs started in earnest in Japan. The introduction of rehabilitation medicine also helped the development of wheelchairs.

This is getting off the main topic, but a study group on wheelchair sports was launched in the year following the Tokyo Paralympic Games. The research on wheelchairs from medical and engineering perspectives started in earnest, leading to the establishment of Japan’s first JIS for assistive devices (T 9201 manual wheelchairs) published in 1971⁴⁾.

3.3 Development of wheelchair form from 1970 to 2000

In the 1970s, rehabilitation centers with an engineering division were established one after another throughout Japan. The research and development of wheelchairs became active. Wheelchair manufacturers started to produce custom-made wheelchairs tailored to an individual's body size and disability^{4),5)}.

With the advancement of the research and development of wheelchairs for sports, the performance and manufacturing techniques of wheelchairs in general were improved by gradually adopting the advanced developed technology. At the same time, rehabilitation centers throughout Japan played a major role in improving the technology related to wheelchairs in cooperation with relevant academic societies.

As a result, the performance of wheelchairs made in Japan was improved markedly. However, with the exception of some companies that manufactured wheelchairs based on accurate personal data, manufacturers could not avoid problems such as improper fitting and structural problems of completed wheelchairs⁴⁾.

Another problem was that the physical status of a user could change because it generally took six to eight weeks from the time of ordering to the completion of a wheelchair. Under such circumstances, wheelchairs with adjustable lengths and angles (adjustable wheelchairs) attracted attention. Modular wheelchairs can be assembled immediately upon the receipt of an order if the components of each module are made in advance.

3.4 Development of wheelchair form from 2001 to 2020

Remarkable progress has been achieved on wheelchairs with the help of technological advancement.

Materials and the performance of components have been particularly improved, providing high traveling performance, ease of storage, and transportability. Aluminum alloys are mainly used as frame materials, followed by titanium alloys and carbon-fiber-reinforced plastic. Wheelchairs have become light in weight and highly rigid owing to these materials. Also, there are now more wheelchairs with special features, such as stand-up wheelchairs, six-wheel wheelchairs (central-powered wheels), and more recently, wheelchairs for specific postures (wheelchair seating and positioning), and wheelchairs equipped with a specific posture-changing mechanism^{5),6)}.

However, the development of seating performance seemed to be delayed in the process of the advancement of wheelchairs. This may be partly because Japanese people were not familiar with the lifestyle of sitting on chairs. Also, wheelchair manufacturers may have had too much interest in the mechanisms consisting of metal components and the manufacturing techniques using metal materials.

Seating technology is one of the important factors in the performance of wheelchairs because it is used at the contact point between the user and the wheelchair. Innovative approaches and outcomes are required to realize the posture-changing mechanisms that are friendly to the human body and the wheelchairs that are suitable for the daily lives and cultures of users.

4. NEEDS FOR WHEELCHAIRS SUPPORTING DAILY LIFE AND WHEELCHAIRS IN THE FUTURE

The needs for wheelchairs vary depending on the disability, physical functions, lifestyle, and environment of users. At present, the top priority is given to the functions that support independence in daily life and that satisfy the minimum need for user transportation. As a result, other functions may not be used.

The following are some of the background factors.

- 1) Issues regarding the diversity of physical functions of users
- 2) Issues regarding the environment surrounding wheelchairs
- 3) General technical issues regarding wheelchairs
- 4) Issues regarding the availability of wheelchairs

It is difficult to resolve these issues. We conducted a survey on the actual needs for wheelchairs to explore the possible resolutions for the above issues and consider what types of manual wheelchairs are needed.

4.1 Needs for wheelchairs

There are diversified needs for wheelchairs. We examined the needs of users on the basis of the results of the Survey on Actual Use of Wheelchairs conducted among wheelchair users in May 2019 in cooperation with various organizations (administrative agencies and welfare facilities)^{*1}.

*1 Shigeo Hirano: Survey on Actual Use of Wheelchairs; survey conducted in Tokyo, Kanagawa, and Chiba (total of 66 users) in May 2019.

The subjects were a total of 66 wheelchair users living in the Kanto region. Among them, 32 users use wheelchairs in and around welfare facilities, 10 use wheelchairs for commuting, and 24 use wheelchairs in their daily life, for example, getting to and from community centers and going shopping. Age and sex data are omitted in this article.

1) Difficulties in using wheelchairs

- Traveling over differences in level or through narrow openings: 23 users (34.8%)
- Going up and down hills: 16 users (24.2%)
- Getting on and off transportation facilities: 12 users (18.2%)
- Getting on and off vehicles: 10 users (15.2%)
- Others: 5 users (7.6%)

The results show that manual wheelchairs are suitable for moving on a plane but not for movement in the vertical direction. It is also impossible to travel through narrow openings unless the width of wheelchairs can be easily changed.

2) Problems in using wheelchairs

- Rain: 20 users (30.3%)
- Too heavy: 14 users (21.2%)

- Tiring: 10 users (15.2%)
- Too big: 9 users (13.6%)
- Difficulties in maintenance: 6 users (9.1%)
- Not preferred design: 5 users (7.6%)
- Others: 2 users (3.0%)

It is easy to imagine that wheelchair users have trouble when it rains because they must operate wheelchairs using their arms. Users feel their wheelchairs are too heavy because they are using wheelchairs made of metal materials (steel products). Users become tired when they are using wheelchairs possibly because the functionality of wheelchairs as chairs is ranked below the driving operation mechanism and compact size. Users feel their wheelchairs are too big. However, there is a limit to downsizing because the wheelchairs are made to fit the users' body size and cannot be made smaller than their body. The size and mounting of the main wheels need further improvement.

3) Users want a wheelchair different from the one they are using

- Different type: 21 users (31.8%)
- Lightweight: 16 users (24.2%)
- Structures and materials: 11 users (16.7%)
- Purpose-oriented: 10 users (15.2%)
- Others: 8 users (12.1%)

The results show that many users want wheelchairs of different types and lightweight. Some users also want purpose-oriented wheelchairs, such as wheelchairs with which they can reach high places, and recreational wheelchairs.

4) Development and improvement of wheelchairs (free description)

The users want wheelchairs equipped with a recliner mechanism for daily life, a brake for downhill travel, or shock absorbers, wheelchairs that are fashionable or light in weight, have seat lifting functions or can be turned in a small space like a kitchen, modular wheelchairs, and wheelchairs with adjustable components.

Some of these demands have been met or are being addressed through research and development while other demands are difficult to satisfy under current circumstances. However, these answers may represent the needs of wheelchair users.

5) Summary

Many users want small and lightweight wheelchairs. Also, they wish to move and operate their wheelchairs using some kind of motor power (mechanism) when they go out.

There are also demands for purpose-oriented wheelchairs that suit individual lifestyles. For indoor use, users often need seat-lifting functions that make it easy for them to transfer to other chairs or to perform other activities of daily living.

Discussions on issues regarding the manufacturing techniques of wheelchairs and prices and other issues related to the law (the Physically Disabled Persons Welfare Act) are not included in this article.

4.2 Wheelchairs of the future

1) First, it is necessary to make wheelchairs modular and adjustable. Wheelchairs with performance equivalent to that of custom-made wheelchairs can be provided in a short time if wheelchairs are divided into modules and the modules meeting different needs are prepared in advance.

Although a number of modules are required to meet the needs of more users, the modularization of wheelchairs should be realized soon. Also, if wheelchairs are adjustable, the needs of a user can be met by adjusting the components even if the body size and physical functions of the user change after the completion of a wheelchair.

2) The development of single-purpose wheelchairs is desired so that users can select wheelchairs with different functions depending on their lifestyles and intended use. For example, wheelchairs with adjustable seat height, functions that help users to stand up, the ability to turn in a small space, and a detachable driving assistance system are needed.

Wheelchairs with some of these functions have been developed and commercialized⁶⁾. However, the requirements essential for the hardware are lightweight, small size, and good design (form, shape, and functions) in addition to suitability to users. Other requests such as sitting comfort, good operability, and high performance should be satisfied on those bases.

4.3 Future prospects of welfare equipment

Below is a summary of what is required for promoting the emergence and utilization of new portfolios of welfare equipment.

- 1) The development of safe and easy-to-use wheelchairs for people in different states, such as the elderly, and for helpers is required.
- 2) A continuous improvement of mechanisms and components is needed to further promote the development of wheelchairs.
- 2) A framework that makes the developed wheelchairs accessible to many people who need them at low prices is required.
- 4) To achieve the above ends, the whole society should be involved in consensus-building concerning the development and diffusion of a variety of welfare equipment wherever possible. Thus, the development of welfare equipment in the areas with issues to be resolved should be implemented promptly.
- 5) It is important for the whole society to deeply understand that the use of wheelchairs leads to the support of the independence of users and the reduction of burden on care workers and helpers.

We believe that the H.C.R. is playing a significant role in disseminating the use of welfare equipment and raising awareness regarding the advantages of using welfare equipment. The number of visitors to the H.C.R. has recently been decreasing. We strongly hope that the efforts of organizers and related parties and advertisements by the media will result in raising the number of visitors.

5. CONCLUSIONS

The quality of the design of wheelchairs has been improved. Now we are verging on the era of evolution of wheelchairs. The goal of wheelchairs is to be not merely a means of mobility but a “comfortable space” for users.

After a long period of change, we have finally reached the stage where users can choose any wheelchair they like and feel excited imagining themselves using that wheelchair. Now wheelchairs will truly evolve.

While impressive technology and design often attract attention, what is important for wheelchairs is the comfort of users, usability for those who support the users, excellent fit in a sitting posture, and an easy-to-grasp assistance brake. The need for such meticulous manufacturing will remain unchanged.

Additionally, a continuously increasing number of services for the elderly have been offered within the background of the rapid aging of the population. The value of products such as welfare equipment, prosthetic limbs, and orthoses is, by their nature, fully realized only when people or their family members come to need those products.

It has become important for the whole society to know in advance the broad product portfolio on display at the annual H.C.R. and other occasions.

In order to approach the issues related to daily life in old age, it is highly beneficial that a wide range of generations from elementary school children to the elderly become familiar with a variety of welfare equipment. We sincerely hope that many people of different generations visit the H.C.R.

6. REFERENCES

- 1) International Home Care and Rehabilitation Exhibition (H.C.R.) homepage.
<https://hcr.or.jp>
- 2) Tsuguo Ohkawa et al.(1987), History of wheelchairs in Japan, Igaku Shoin, Japan.
- 3) Shizuko Yamauchi, (2009), Development of Manual Wheelchairs Seen from Design, Japan Society of Assistive Technology for Assisted Living, ed.,
- 4) Etsuzo Okikawa, (2011), Historical changes and future prospects of wheelchairs, Japanese Journal of Prosthetics and Orthotics 27 (1).
- 5) Research Report on Wheelchair Technical Issues (1st Act) ,(2016), Bicycle Industry Promotion Association Technical Research Institute.
- 6) Catalogs of wheelchair manufacturers, Keiai Co., Ltd., Miki Co., Ltd., Matsunaga Seisakusho Co., Ltd., Nisshin Medical Instruments Co., Ltd., Kawamura Cycle Co., Ltd., Kowa Seisakusho Co., Ltd.