A Friendly Rest Room: Developing Toilets of the Future for Disabled and Elderly People
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Elderly and People with Disabilities - Limitations in their Everyday Life

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Abstract: The proportion of older people (65+) in the population is increasing steadily worldwide due to longer life expectancy and decreasing birth rates. The ageing population often presents with chronic diseases that result into limitations in the activities of daily living. People with disabilities, either congenital or acquired, also face various degrees of limitations and need some form of assistance. Disabilities in general and limitations that are common in old age, including epidemiological data, are discussed. Indubitably, the need for adapting the living environment of this population becomes apparent. Three case studies with older people and people with disabilities in different situations are presented as examples of adaptation of the bathroom area. Concrete solutions that have been proposed with respect to their limitations and the way they successfully solved their problems by means of home adaptations using mostly low-tech solutions are described. Overall, these three cases encompass typical situations encountered by aging and disabled persons.

Keywords: Elderly, Disabilities, ADL, Toilet, Observational Studies

1. Introduction

It is a fact that the demography of our world changes rapidly following the Second World War. The synthesis of the population in the developed countries, but increasingly in developing countries, too, has been altered in such a way that the most common comment in the news today is the ageing of the world's population.

In the European Union (EU) almost all countries show a decrease in birth rates, with the average been 1.5 children per woman, while there should be 2.2 children per woman for natural growth of the population. At the same time life expectancy of the populations grows steadily. The average life expectancy of men in EU has reached 76 years and of women 82. Therefore, it is expected that the natural growth rate for most European countries will diminish and it is predicted to become negative by 2010, although in some countries it already is. The result of this development is that the ratio of older people in the total population is expected to increase from 17% that is the average today for the age group 65+ to 30% by 2060. Similarly, the proportion of the

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very old people, aged 80 or more, is expected to rise from 5% today to 12% in 2060 [1,2].

The ageing of the population is a phenomenon that comes with many problems for the society, the family and the health and welfare systems. Although ageing is a natural biological fact, it is also strongly correlated with increased morbidity, especially of chronic diseases, which very often cause various disabilities.

Similarly people with disabilities carried on from younger ages will have even greater limitations as they become older. Dependency rates therefore, are expected to increase greatly and will impact on health care systems as well as on the social and economic structure.

The prevalence of chronic disease and disability is an important factor for any population's health and quality of life. However, not all EU countries collect such data and existing statistical reports are based on different sources, therefore cross-country comparisons are difficult to find. In most countries relevant data are based on health surveys, but in others they are estimated from the list of people receiving social insurance disability pensions [3]. It is estimated that 10% of the EU population are disabled, while 40% have reduced mobility [4].

Cross-cultural variation was noted in self-reported disability adjusted for performance score. These differences may be due to sociocultural and physical environmental factors [5].

1.1. Definitions

Old age is widely accepted today – at least in the developed countries of our world - that starts at 65 years of age, while very old age refers to persons of 80 years old or older.

Disability is defined by WHO as a "*loss or abnormality of body structure or of a physiological or psychological function*".

Dependency is measured by the need for assistance in the activities of daily life (ADL) [6] and instrumental activities of daily life (IADL) [7] as reported by the individuals themselves (Table 1).

Table 1. Definitions of self reported activities of daily living.

Basic ADLs	**Instrumental ADLs**
Bathing	Using telephone
Dressing	Grooming
Transferring (moving from chair to bed or toilet and vice versa)	Laundry
Toileting	Shopping
Feeding self	Housework
Ambulating	Taking medicine as directed
	Managing one's own money

2. Older People with Limitations in Every Day Life

People, in the vast majority, remain independent until their old age. People aged 65 or older that are able to perform the essential activities that help them remain independent, are considered healthy and they do not need any form of assistance, although they may have developed some chronic health problem, such as high blood pressure or diabetes type II. Therefore, old age does not mean disability and consequently limitation in any ADL or IADL.

However, as old age advances the possibility for impairments emerges and increasing deterioration is a common pattern. This is even more common for the persons older than 80 years old, who are also in their majority women, a result of longer life expectancy in comparison to men. Strauss et al [8] have found that women have more limitations, according to basic ADLs, than men as age advances.

According to the report "The social situation in Europe" [9], the old age dependency ratio has increased from 21.6% in 1990 in the 15 EU countries to 24.3% in 2001 and it is expected to rise to 27.3% in 2010. In 2000 in the EU-15 the average ratio of people receiving disability benefits was 8.1%, while the older people accounted for 46.4% of the total number of people receiving any kind of benefits [9].

2.1. Most Common Problems That Lead to Limitations in Everyday Life

The main causes of death in older ages are diseases of the circulatory system, cancer, diseases of the respiratory system and external causes such as injury (including car accidents) and poisoning. Morbidity however, presents a different picture in older ages.

- Neuro-degenerative diseases such as dementias are becoming a severe problem that increases with age and results into increasing dependency until the individual becomes invalid and die. It is estimated that 4% of people between 65 and 74 will develop some form of dementia, while this proportion rises to 20% for persons 75 or more [10].
- Cardiovascular diseases are also a severe problem, with high incidence in almost all EU countries and has been found to lead to various degrees of disability [11].
- Musculoskeletal disorders lead into limitation in movement and are one of the main causes of dependency in that age group. The most common age related health problems that contribute to both musculoskeletal disorders and accidents are osteoporosis and arthritis.
- Injuries, caused by a pathological condition, either in the home or in the external environment are becoming more frequent and result into disability.
- Visual impairments among adults in the US account for 0.78% blindness and 1.98% of low vision, with the most common causes being macular degeneration, cataract and glaucoma [12]. Similar prevalence and causes have been found in Denmark [13].
- Hearing impairments are also a largely age-related problem and although it is not disabling as such, when it coincides with other conditions, then limitations are becoming even more severe.

2.2. People with Disabilities

A disability can affect any person regardless of sex, age, race, ethnic group or social class. A disability is defined as any limitation in physical, mental or intellectual health and result in different levels of need of care or assistance. A disability could be congenital or established later in life following an accident or a chronic disease.

According to a recent report disability is defined in different ways in different countries especially in terms of socioeconomic status [14]. In the characterization of disability one refers, very often, to persons younger than 65, which is the average age of retirement in Europe. However, once a person is characterized with a permanent disability, this classification usually remains for the rest of his/her life. In 1996, when the total EU-population was 300 Million, 40 million persons or 13% had some sort of disability and of those 50% were of working age [15]. According to the report compiled by EIM Business and Policy Research [3] the percentage of persons aged 16-54 years with self-reported disability was 14.3% in the 15 EU countries.

Disability is much more prevalent as age advances, because the health condition that is responsible for it usually deteriorates with age. Disabilities that start early in life, are lifespan and not likely to be cured, are often due to:

- Congenital and chromosomal defects,
- Learning disabilities,
- Injuries at birth or other perinatal complications,
- Accidents at work, traffic accidents,
- Acquired disabilities related to chronic diseases such as asthma, juvenile rheumatoid arthritis, cystic fibrosis, cancer,
- Neuro and muscle degeneration diseases, with more prevalent multiple sclerosis, are also becoming more prevalent with age, as well as more disabling.

Statistical data from the USA show that injuries cause 13.4% of all disabling conditions, while orthopaedic impairments account for half of all disabling conditions. According to ICD classification, diseases of the musculoskeletal system and connecting tissue account for 17.2%, while circulatory system diseases for another 16.7% [16]. From the same data set it is also shown that the rate of people with at least one ADL limitation was 14.4% in 1994. Older people experience disability at roughly twice the rate of those in the older working ages (45-64) and four times the rate of the younger working-age group (18-44). A still smaller fraction of children have disabilities.

2.3. Conclusion

It is clear from the above that dependency rates in the general population from both ageing and disability are increasing in the EU countries. Because of this trend more services will be required in the future in order to respond to the needs of older people and persons with disabilities. These services include mainly traditional health and social care.

Assistive technology that will increase accessibility, equity and independence, however, could play an important role and could additionally free the services from some of the costs induced by the need for traditional care. Therefore, the study -

according to the needs that emerge from users, their family and health care professionals -, of products innovation looking for new solutions, in terms of technique and use, is essential. For existing products, the aim is to assess and optimize the application of new components. It is also important to improve the functionality of the devices and their comfort, by developing new designs, applying new materials to increase safety, autonomy and dignity in the restroom. [19,20,21].

Therefore the need for adaptation of the home environment is indispensable, if there is a possibility for older people or persons with a disability to stay at home independently or with some assistance for as long as possible.

3. Three Case Studies

The following case studies[2] illustrate how the bathroom, one of the most important rooms in the house, can be adapted with the amenities and assistive technology that are currently available in the market, in order to contribute to the aim of helping people to stay at home, and to provide them with an acceptable quality of life. In addition, these case studies show how important it is to study new ways of making the life of old and/or disabled persons easier and better.

3.1. Luigi and His Wife

The actors: Luigi (96 years old) and his wife (82 years old) live on their own in an apartment on the 4th floor, in a big city. Luigi has slowness in his movements, it is difficult for him to get up from his seating, he feels back pain and also has oedema in his legs. In spite of their advanced age, the couple lives alone without needing any help in the activities of daily living. Luigi and his wife have a lucid mind and they are looking for assistive devices to support the independent living for them.

The main purpose of the intervention described here, was to find out facilitation in the bathroom, to make it possible for Luigi and his wife to carry out their every day's sanitation activities without additional help.

3.1.1. The Bathroom

The room is 160cm wide and 350cm long (see Figure 1). The door entrance is 70cm wide and all elements are localized on the left side, in the following order: Bathtub (170x70x90cm), washing machine (60x60x85cm), sink (70x50x85cm), bidet and toilet bowl (height 42cm). The distance between toilet bowl and bidet is 40cm. Near the toilet bowl there is a window and on the right side, along the wall there are two pieces of furniture that contain their personal things.

[2] Although the case studies are based on real life problems, actors' names are fictional.

Figure 1. The Rest Room

3.1.2. The Every Day Activities in the Bathroom

Luigi moves independently inside his home. He uses a walker to support shifting. When he comes near the bathroom door, he leaves the walker outside and uses different support points (the door handle, the washing machine, the sink, the drawer handle) to move to the toilet bowl. The height of toilet is lower than standard; it is –including the toilet seat- only 42 cm high. As the problems related to growing old increase, like sitting down and getting up from the toilet, Luigi becomes more dependent on his wife; she is pulling him with both hands, with the consequence of forcing her back and risking to fall down together. Following a discussion with the couple about possible solutions for these problems, it was decided to install a raised toilet seat, fixed on the toilet bowl and with support bars alongside.

When Luigi gets up from the toilet bowl, holding on the radiator or supported by his wife, he moves towards the sink, in order to continue his personal hygiene activities. He sits down on the commode chair, equipped with a cushion, because the hard surface causes pain and leads to skin problems in the sciatic region. The long support bars of the chair allow for autonomy to get up alone. Luigi adopted this solution about two years ago, when standing up became difficult for him.

When taking a bath, Luigi used to sit on the edge of the washtub, with his wife sitting in front of him in a small chair; she took off his shoes, and helped him turn inside the wash tub; he then turned himself hanging on to the water tap and she helped him to lift his legs one by one and put them inside the washtub. On the bottom of the

washtub an anti slippery carpet had been placed. Supported by his wife, Luigi used to get up and sit down on a fixed stool placed 15 cm below the edges of the washtub. When finished bathing, they used the same procedures to get Luigi out of bathtub. For the last six months Luigi has not used the washtub anymore, because he does not feel safe due to the increased difficulties for him to move.

3.1.3. Adopted Solutions

The solutions that were discussed with Luigi and his wife and eventually installed in their bathroom were:

1. Raised toilet seat with fixed support bars (Figure 2) to allow for stability and safe sitting down and getting up.
2. Swivel washtub chair (Figure 3), suitable to overcome difficulties of positioning inside of washtub. Characteristics:

    - Seat width 46 cm.
    - Swivel 360° with blocking option each 90°
    - Support bars
    - Maximum weight 130 Kg.

Figure 2. Raised toilet seat

Figure 3. Swivel chair

3.1.4. Expert's Evaluation

At the first meeting, the couple was looking forward to find solutions to support their daily activities in the bathroom, so it was necessary to understand their way of doing in order to solve their problems. Therefore, the solutions that were proposed were based on their expressed needs. It was very important for Luigi and his wife not to make structural changes in the bathroom. The solutions should fit in the actual restroom for instance by using innovative products or assistive technology.

Specifics: The toilet: Luigi considers the choice of a raised toilet seat 10 cm higher to be perfect; it allows for maintaining the foot contact with the floor, but is easier to get up from. The side handles, made of anti-slippery material and appropriately

designed, provide sufficient support for independent transfer to and from the toilet bowl. He does not use the urinal anymore and his overall mobility has improved.

The sink: By using a commode chair placed near the sink, Luigi sits down to carry out the daily morning activities of personal hygiene; he washes his face, brushes his teeth, combs his hair and shaves without help. The use of the sink is considered satisfactory by the couple.

The washtub: By using a swivel chair mounted on the washtub, Luigi is able to wash himself with minimal assistance from his wife. They now feel safe and are satisfied with this solution.

3.2. Silvia's Bathroom

The actor: Silvia is a 59 years old woman. In July 2002 she has had a hemorrhagic aneurysm resulting into compression of the brain with consequenting hemiplegia. Following discharge from a Rehabilitation Center, she lives at home with her family. The bathroom is for her currently the main problem to be addressed in order to take control of the hygiene activities independently and without assistance.

Silvia is not able to walk and uses a wheel chair to move inside her home. She is able however, to make transfers with a minimum of help (she needs somebody aside to feel safe).

The apartment has two bathrooms; a small one, with a not accessible shower box (Figure 4), and a larger one with a wash tub (Figure 5). After a thorough study Silvia and her family decided to change the main bathroom to create an accessible room for her and her needs.

3.2.1. Description of the Bathrooms

The following photographs show the components inside the two bathrooms; the small bathroom (Figure 4), the main rest room (Figure 5) and the main rest room after adaptations for Silvia (Figure 6 and 7).

3.2.2. Adopted Solutions

The toilet has a double function; as a normal toilet and as a bidet. It is about 50 cm. high and it is provided with a front opening in order to allow for the washing operations through the use of an external shower. The baked clay washbasin is provided with rests for the elbows, splashboard borders and it has a particular hollow shape which allows an easier approach for people on wheel chair. The washbasin has a mixer with clinical lever. The box shower has a shower tray floor edge and a folding seat with back and arms. An adjustable tilting mirror is fixed on the wall above the sink. The room is spacious enough to move around inside it for a wheelchair user and an assistant. Silvia now is able to use the bathroom safely and comfortably.

Figure 4. The small bathroom

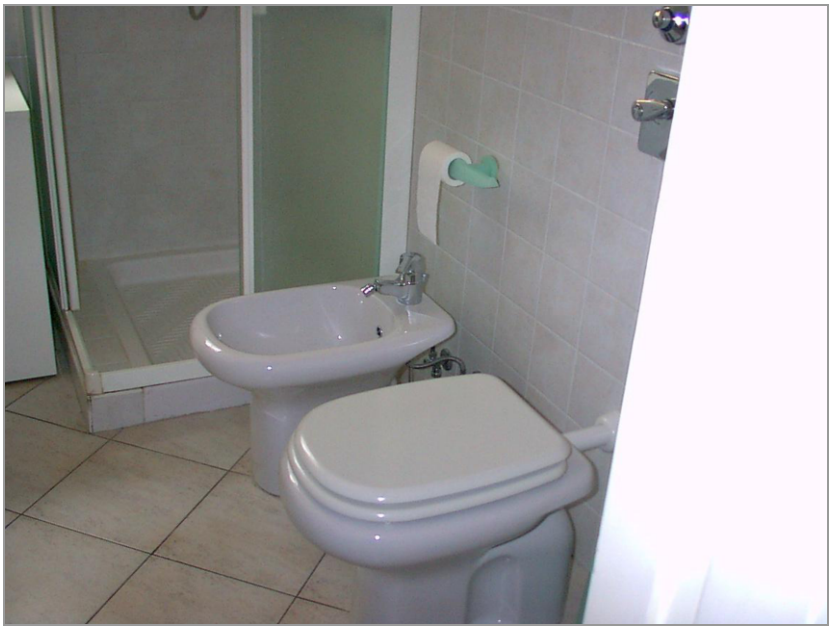

Figure 5. The main bathroom

Figure 6. The adapted shower

Figure 7. The adapted toilet and washbasin

3.3. Tina's Bathroom

Tina is a young woman of 46 years old. In 1985 she suffered a surgical complication following an operation to a severe scoliosis that led her to stay in bed for l0 years. In 1999 she became able to sit; she could then use a wheelchair and began to seek more autonomy. The first changes she has made were in the kitchen, which for her had priority in her new way of life. Then, she tried to become more independent at home. After three years not being able to use the bathroom, she decided that it was time to return to a more autonomous life, and feel the pleasure of a shower after so many years. The bathroom as it was, was however not accessible, so she decided to change the whole room and she asked for help.

3.3.1. Description of the New Bathroom.

The restroom is 225 cm. long and has a central door 60 cm. wide, sliding on rails. The room width is 180 cm. There are no windows and an appropriate fan provides the ventilation.

The changes made and the results are presented in Table 2 and Figures 8 and 9. Actions that were suggested by the expert are also presented in this table.

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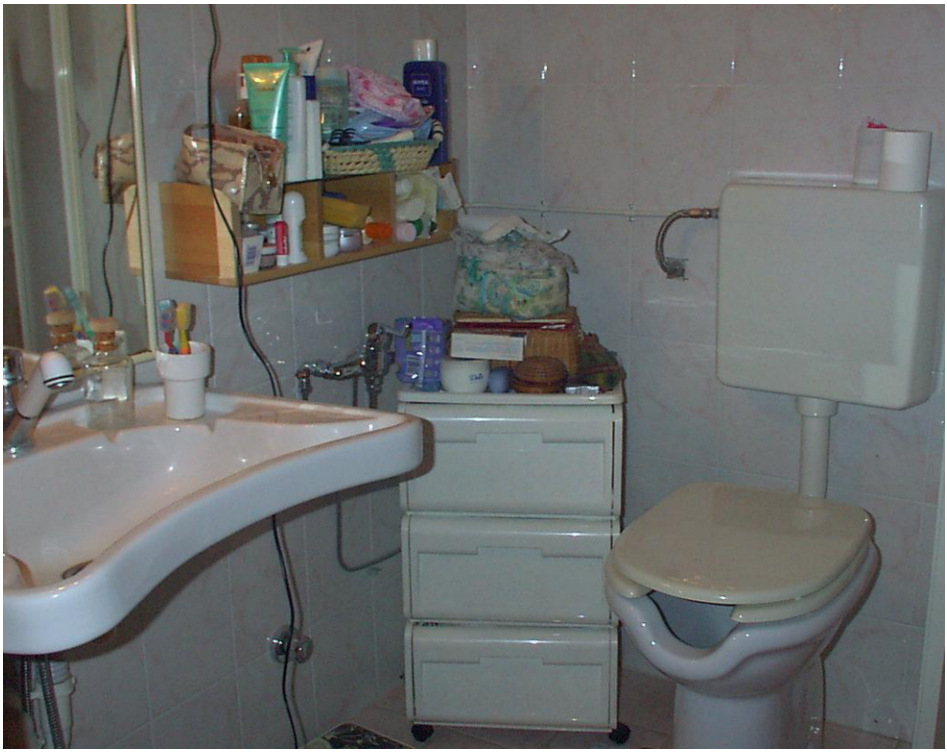

Figure 8. The sink and toilet bowl

Table 2. Tina's bathroom

Part	Success	Failure	Action Suggested
Sink	Tina considers the accessibility, the size, and height adequate. The mixer tap is easy to handle and safe.		No further action suggested.
Light point and electrical outlet		It is located too high (150 cm) and it is not accessible. To turn on the light she uses a walking stick but the electrical outlet is not usable.	Transfer the light point and electrical outlet at 100 cm high and at the left side of the sink because access is easier.
Toilet bowl		The access is impaired on the left side by the sink and on the right side by the shower box. There is no place to install support to the transfers and it is too high for the user. The bowl has an opening at the front side, designed to help with cleaning, however, it creates instability. Tina has spastic legs and the transfer can produce contractions and she does not feel safe; she fears the empty space in front of her while attempting transfer. The back hole for the delivery of cleaning water (the bidet system) is not functional.	The wheelchair should be positioned transversally to the WC to make it possible to slide up to e from the WC. The height of WC should be the same as the wheelchair. It is important the support of handles during the transfers. WC without the front opening. The bidet system would be functional with a handle shower.
Shower box		Inability to enter the shower box with the wheelchair because the floor of the shower box is lower 2,5 cm. than the bathroom floor and connected to the latter by means of a short ramp. It was initially designed to accommodate a plastic or a wooden carpet, but it has been not yet installed (when Tina's tries to get in the wheelchair she tends to tilt forward with the front wheels pivoting side wards thus creating instability). Tina feels like falling and cannot make it without help.	The user decided to eliminate the upsetting chair; alternatively, she's trying out a shower chair with the big wheels to be able to manoeuvre on her own. By this way, the transfer will be done in the bedroom (bed to shower chair and shower chair to bed). On the floor a plastic carpet will be installed.
Basket		It is situated at the right side of the sink and the access is difficult (it is too near to the corner).	There should be 2 baskets installed at both sides of the sink at the same high (100cm) but not too far as it is now.
Door		It is too narrow (60 cm.).	It should be 10 cm. wider to make the entrance and the exit in the restroom easier.
Floor	The user is happy with the non-slippery tiled floor		No further action suggested.

Figure 9. Reaching for the light point and electrical outlet

4. Conclusions

From the viewpoint of 'adding life to years', studying socioeconomic inequalities can give us clues about how much 'life' can still be added to the 'years' of elderly people and persons with disabilities that are in a socioeconomically disadvantaged position [22].

To finally conclude, the following part from an EC report [9] illustrates current needs and future developments:

"It is a feature of human life that the number of functional disabilities of all kinds tends to increase with age. Sickness, risky lifestyles, accidents and socio-economic factors all combine to create a 'disabling' process, which accumulates overtime. It is not surprising, therefore, that young people make up 5% of the people with disabilities, while people of working age constitute 46% and the remaining 49% of the people declaring disability are over 60 years of age (ECHP Data). With increasing life expectancy, prevalence of visual and hearing impairments also increase, as well as neurological disorders such as Alzheimer's disease and dementia. However, future trends in age-specific risks of becoming hampered will be a key factor in the number of elderly people that will be in need of assistance and care".

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