

Assistive Technology for Toileting

Toileting is an essential Activity of Daily Living (ADL), which we hope to be able to carry out in privacy, with ease and dignity. Yet a study of people over the age of 85 years demonstrated that only 43% were able to get on and off the toilet without difficulty ¹.

Disabilities in the self-care activities performed in the bathroom have been associated with future health and social problems ². People with disabilities and health practitioners agree that maintaining autonomy in toileting activity is essential in order to avoid feelings of loss of self-esteem ².

Assistive technology has the potential to facilitate transfers and to compensate for functional disabilities due to impairments such as problems in balance, reduced muscle power, coordination problems or diminished respiratory function. In the bathroom, this equipment can reduce pain and the level of difficulty. Additionally, assistive technology promotes energy conservation, comfort and safety, helping to prevent falls ².

THE ENVIRONMENT

Functional disabilities arise from a mismatch between personal ability and environment, noting that assistive technology can enhance the person/environment fit ². Extrinsic aspects of toilet environments can be divided into two categories: 'fixed toilet environment' (the floor, toilet bowl, etc.) and 'additional objects' (towels, floor carpets, etc.) ³.

Environmental strategies to maximise independence in daily life could include a systematic assessment of technology needs, individualised advice about the services of provision of assistive products, training actions on the appropriate use of the devices, as well as financial systems to facilitate access to assistive products ².

RISK OF FALLS

Falling accidents, such as falling over and slipping, occur easily in elderly people due to physical changes, such as reduced balance, functional degeneration of the nervous system, reduced gait ability and weakened muscle strength. In terms of places in which falls can occur, research indicates that bathrooms are potentially the most dangerous place ⁴ in the home.

More than half of the falls in the bathroom are related to transfers by older adults ².

The motion of standing up from sitting presents the highest risk of falls among the most frequently used motions in daily life, and bathrooms or toilets clearly top the list of spaces that cause falls. As with sitting on and standing up from a chair in daily life, sitting on and standing up from a toilet seat is also frequently performed by elderly people and people with a disability ⁴.

Everybody has their own toilet ritual, which includes a variable number of relatively small movements and tasks. The ageing process often affects some of the movements and postures that

are part of the toilet routine. This causes the ritual as a whole to disintegrate, and a task within the toilet ritual previously without a significant fall risk can suddenly change into a hazardous activity ³.

In most cases, people will first try to compensate and slightly adjust their ritual, or use already present objects for support to accommodate geriatric complaints, before relying on any additional assistive device ³.

DIGNITY

Respect for human dignity is a core value of human interaction and is desired by most people irrespective of their condition. The respect of human dignity constitutes the foundation on which human rights are based ⁵.

Independence was overwhelmingly described as impacting on patient's dignity. Studies suggest that the more dependent a patient, the more vulnerable they are to a loss of dignity, whilst independence was a protector of patient dignity ⁵.

Privacy of body was most referred to by patients when discussing dignity ⁵.

Providing toileting assistance necessarily involves transgressing peoples' personal space and infringing social norms about privacy and touch and places them at risk of violation of their personal dignity ⁶.

INCREASING INDEPENDENCE

Disabilities in the basic ADLs are defined by the need for personal assistance to perform the self-care tasks. In homes, problems in daily functioning of older people often occur in the bathroom. Toileting is the third most common ADL that older people had difficulty ².

Balance impairment is closely related to independent performance on component activities of toileting. Balance is one of the most significant predictors of functional independence. Balance is required for the majority of the component activities of toileting, which explains why it is a stronger predictor of independent toileting than cognitive or physical impairments ⁷.

Toileting ability is known to be one of the most important activities associated with burden among caregivers ⁸. Caregivers of individuals who were able to toilet independently were 71% less likely to have mild to severe caregiver burden than those who had care recipients who were not able to toilet independently ⁸.

Toileting comprises various movements. Of these movements, pulling the lower garments up and pulling the lower garments down are the most difficult ⁹.

People who remain unable to pull the lower garments up and down while standing after receiving training often have poor standing balance. Pulling the lower garments up and down in a sitting position has been proposed as a method suitable for such patients ⁹ retained their sitting balance, suggesting that even those with poor standing balance do have the ability to pull the lower garments up and down independently in a sitting position ⁹.

TOILET SEAT HEIGHT

Among the elements that disturb the motion of standing up from sitting, the height of the chair has the most critical influence. In particular, around 42% to 43% of elderly people have difficulty standing up 4.

The standard height of a toilet pan in Australia is around 400mm (Figure 1).

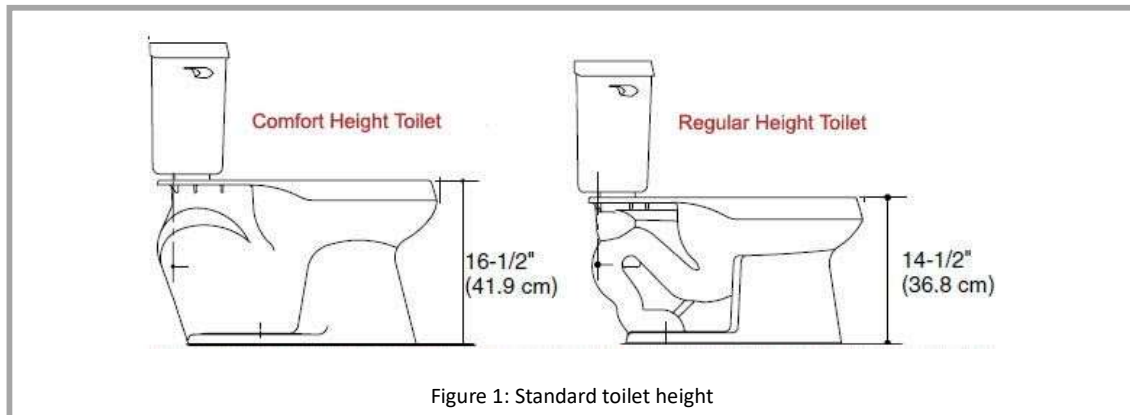


Figure 1: Standard toilet height

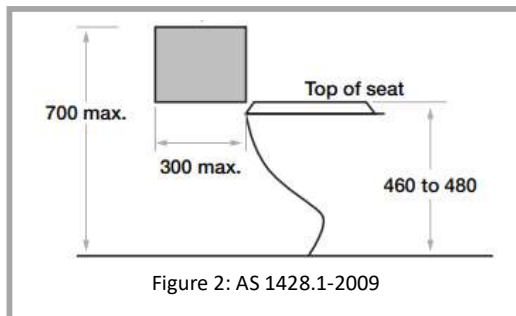


Figure 2: AS 1428.1-2009

The Australian Standard AS 1428.1-2009 - Design for Access and Mobility, relates directly to the accessibility of the Ambulant Toilet. It recommends to have a 460-480mm height range of the toilet pan seat above the finished floor level (Figure 2).

Ideal height of the surface for sit-to-stand and sit-to-walk will be individual. The height of the toilet for a person who is attempting to leave the toilet and mobilise is directly linked to falls risk during this task.

Appropriate individual height can be determined utilising the popliteal height (Distance from floor to behind the knee (Figure 3) of the individual, followed by functional assessment 10.

A seat height between 100% and 120% of popliteal height is considered optimal to prevent falls. This is because it requires less knee extension, less work by the quadriceps muscles, and less forward leaning during transfer 11 resulting in less likelihood of falls from toilet heights higher or lower than this.

Utilising anthropometric data for people over 65 in Australia the popliteal height of men and women can be approximated (Figure 4).

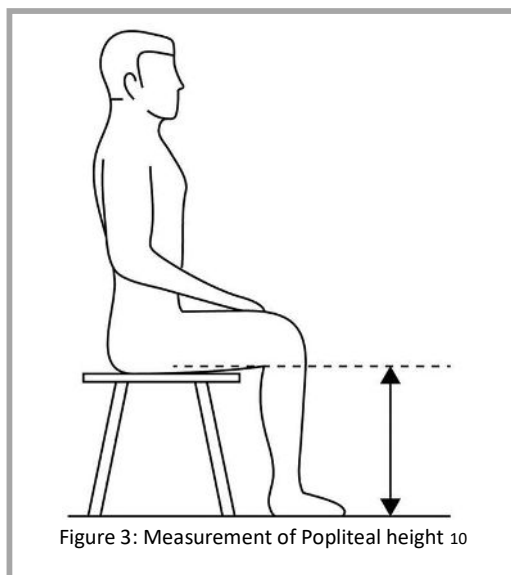


Figure 3: Measurement of Popliteal height 10

Popliteal Height	Female >65yo Australia	Male >65yo Australia
Range	310-465	372-468
Mean	379	416
5th Percentile	330	373
95th Percentile	430	460

Figure 4: Popliteal height over 65yo Australians 12

The anthropometric measurements in Figure 4 demonstrate that the mean popliteal height for women is 379mm. To achieve the goal 100-120% a toilet height between 379mm and 455mm will accommodate an average woman.

A short woman at the 5th percentile of popliteal height will ideally have a toilet seat between 330mm and 396mm

The anthropometric measurements in figure 4 demonstrate that the mean popliteal height for men is 416mm. To achieve the goal 100-120% a toilet height between 416mm and 499mm will accommodate an average man.

A tall man at the 95th percentile of popliteal height will ideally have a toilet seat between 460mm and 552mm.

A higher toilet seat resulted in a corresponding shorter time to perform the motion of standing up, which subsequently reduced muscle activity 4.

If a seat is too high will introduce other risks. Short elderly people can experience the discomfort of not being able to touch the floor with their feet, as well as reduced stability because the centre of mass is detached from the floor 4.

It is important to note that a toilet seat can be raised but can not be lowered.

A low toilet height (height less than popliteal height) is the least safe position for elderly when standing from the toilet, particularly during flexion and extension as one moves to achieve seat-off and stand. A greater risk than the toilet being too high 13.

The mean preferred seat pan height is 398 mm, within the range of the standard pan height, while mean preferred transfer height was higher 421 mm. This suggests that standard toilets may be a reasonable height for seated use but were lower than optimal for transfer 14.

ASSESSMENT

Instruments of ADL, such as the Barthel Index and the Functional Independence Measure are frequently used to assess toileting. These established instruments are useful for judging independence and the assistance required for the entire toileting task. However, generic ADL instruments do not provide a breakdown of the individual subtasks that comprise toileting 15.

It has been suggested that an assessment of the individual components of each daily activity is effective for determining rehabilitation goals and treatment planning 15.

The Toileting Task Assessment Form TTAF (Figure 5), indicates the degree of independence for individual toileting subtasks. Therefore, in the clinical setting, the TTAF may be more suitable for identifying specific areas of weakness that require intervention 15. The TTAF was found to have good content validity, interrater reliability, interrater reliability, internal consistency, and concurrent validity 15.

Toileting Tasks Assessment Form (TTAF)			General comments:	
Patient name: _____ Assessor: _____ Date: _____ Time of the day: _____				
Toilet: <input type="checkbox"/> Toilet in the ward <input type="checkbox"/> Portable toilet Score: A, independent; B, requires supervision or verbal assistance; C, requires assistance; N, not applicable				
		Task	Score	Comments
Wheelchair to the toilet seat	Approach to the toilet	1. Open and close the door		
		2. Maneuver the wheelchair towards the appropriate place for transfer to the toilet seat		
	Transfer	3. Lock the wheelchair brakes		
		4. Press the nurse call button		
		5. Take the foot off the footrest and place it on the ground		
		6. Stand up from the wheelchair		
		7. Turn while standing		
	Pull the lower garments down	8. Maintain a standing position		
		9. Pull the lower garments down		
Performance on toilet seat	Transfer	10. Sit on the toilet seat		
		11. Maintain a sitting position on the toilet seat		
	Clean up	12. Dispose incontinence pad/sanitary items		
		13. Clean up after urination and/or defecation		
		14. Flush the toilet		
		15. Press the nurse call button		
Toilet seat to the wheelchair	Transfer	16. Stand up from the toilet seat		
	Pull the lower garments up	17. Maintain a standing position		
		18. Pull the lower garments up and adjust them		
	Transfer	19. Turn while standing		
		20. Sit on the wheelchair seat		
		21. Put the foot on the footrest		
	Get out of the toilet	22. Unlock the wheelchair brakes		
		23. Open and close the door		
24. Exit the toilet room				

Figure 5: TTAF (Kitamura)

The literature in the field of assistive technology has highlighted the importance of carrying out periodic assessments of the assistive product needs due to the appearance of changes in the functional abilities of the older population over time 2.

ASSISTIVE TECHNOLOGY

A common strategy for promoting functional independence in everyday life is to recommend the implementation of adaptations in the physical environment of the bathroom area ².

Toileting aids help promote independence when toileting and improve quality of life. Such aids can be vital in enabling the older person to continue living at home and may also lighten the burden on both the individual and carers ¹.

42% of older persons who report difficulty with toileting or have diminished physical capabilities lacked low-cost devices proven to help ¹⁶.

Safer independent transfer is the highest priority toilet-related task that is affected by ageing. As a result, the majority of environmental interventions are intended to support this outcome, most commonly by raising the seat height and providing hand support ¹ (Figure 6).



Figure 6: Etac Toilet Raiser options

The height of a chair seat effects the burden on the lower limbs during the STS ¹⁷. An example height raise would be 20% of lower limb length ¹⁷. With an increase in chair height, there is reduced need for strength, decreased requirement for momentum ¹⁷, decreased need for foot repositioning (Jansen) and decreased activity of the trunk and leg muscles ⁴.

Implementation of assistive technology at the toilet has been shown to create a slower decline in function over the years following. Those implementing assistive technology earlier in the disease process were more likely to be compliant with the recommendations ¹⁹.

Introduction of an angled toilet seat can ensure the safe height for transfer is achieved whilst not compromising a person's ability to maintain stable positioning via feet reaching the floor ⁴.

Toilet seat angle could positively affect muscle activities of the lower limb and trunk, reducing the strength needed to achieve sit to stand ⁴.

Armrests on assistive technology not only assist the sit to stand but provide safety and security in the sitting position which may be affected by static or dynamic balance impairment.

Armrests that have been found to support sit to stand performance by assisting stability and increasing confidence and autonomy 20. Using the armrests lowered the motion at the hip by 50%, without influencing the range of motion of the other joints 18. Armrest position around 250mm from the seat best facilitate STS performance 20.

Swing away armrests support a lateral orientated access to the toilet seat. This is important for wheelchair users, or those with small bathrooms. It also allows other household members to flip away the armrests if not required.

GRAB RAILS

For older adults, grabrails are often a prerequisite for safe and independent toileting. Grabrails improve older persons' transfers from sit-to-stand, improve stability, and decrease the likelihood of falls. If improperly positioned a grabrail does not provide the best assistance 21.

If installed, they tend to have lower levels of rejection and disuse compared to other aids 14.

Grabrails may be horizontal, vertical or angled. They also may be multi directional, combining horizontal with vertical or angled. The orientation of the grabrail affects the user's body, including changes in peak joint angles, range of motion, forces, and torques 21.

Because people have different measurements, limitations and requirements, a single grabrail orientation provides a different level of assistance for each person 21.

Horizontal orientation may be less effective in assisting the sit to stand motion because it doesn't enable the hand to move up the grabrail, providing support in all stages of the transfer from sit-to-stand, as do vertical and angled grabrails. Several reports also have noted that the horizontal grabrail does not provide adequate support during the final stabilisation stage of the transfer. In addition, larger forces and more kinetic and kinematic outcomes occur during use of a horizontal grabrail than during use of vertical or angled grabrails 21.

Vertical or angled rails provide support throughout the sit to stand transfer. There shall be no obstruction to the passage of the hand for the full length of vertical grab rails 21.

For public buildings, Australian Standard 1428.1, Clause 10.8.2, requires a horizontal grabrail that runs behind and beside the toilet with either a vertical or angled component that begins 100 - 150mm past the front edge of the toilet seat 21 (Figure 7).

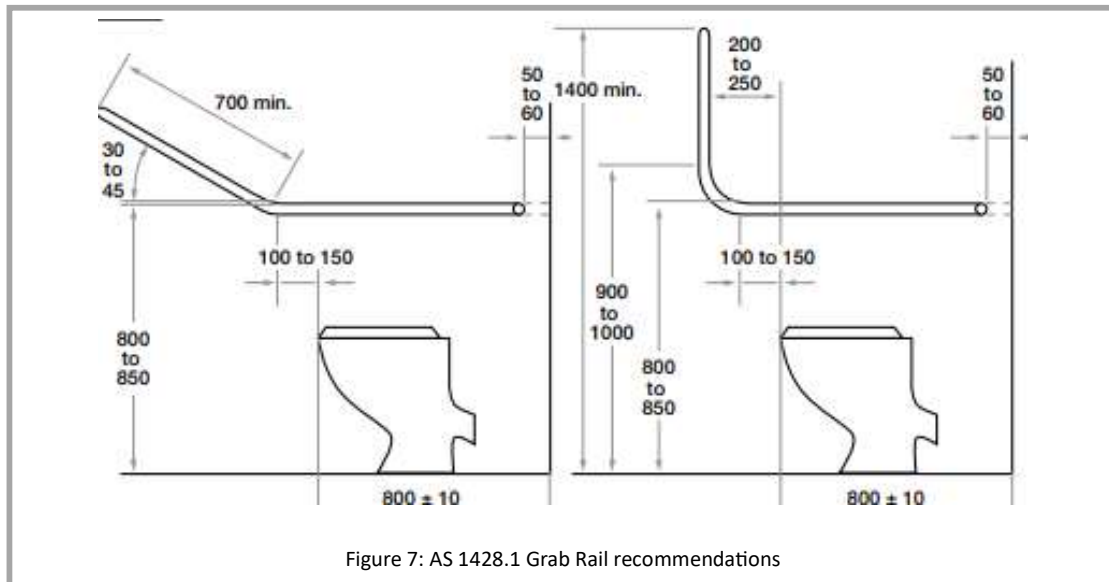
Grab rails should be positioned far enough forward to encourage client to reach for rail to assist transfer and to stabilise client at end of transfer 22.

AS1428.1 recommends that the distance from the side wall to the centre of the toilet seat is between 450 and 460mm. If distance to wall is greater than this, requiring the client to lean to reach rail, then a toilet seat raise/surround or a rail fixed to the wall or floor may be needed.

The rail should be prescribed at a height that allows the client to reach it comfortably from the seated position on the toilet. AS1428.1 recommends the horizontal section should be 800 – 810mm

high and the vertical section from 800mm to at least 1400mm from floor. This can be used as a guideline for prescription but will depend on client size and need 22.

Additional recommendations are that grab rails have a 30-40mm outside diameter or have a cross-sectional shape that fits within these limits with an edge radius of not less than 5mm. The rails must have 50-60mm of clearance to the wall. The rails must be able to withstand a force of 1100N at any point and in any direction 14.



If grab rails are installed in a home with a standard toilet (approximately 400-420mm seat height), using the height recommended in the Australian Standard it would lead to a relative rail height for the seated user up to 80mm higher than intended measure. This could adversely affect the effectiveness of the grab rail during the critical lift-off stage in a sit-to-stand transfer 14.

The presence of supports on both sides of the toilet provides a higher degree of assistance in transfer 14.

Armrest-type supports have been investigated as a determinant of sit-to-stand performance and found to make the transfer easier in terms of biomechanical measures 14. Fine-tuning of armrest placement did not form an important predictor of rise performance as measured by their biomechanical methods 14.

CONCLUSION

Adaptive equipment has an important role in fostering goals of independence and reduced falls risk. Equipment makes it easier for an older person to safely perform basic activities of daily living with less assistance and reduce injury 16.

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