

**Towards a Dignity-Conscious Assistive Technology: Transformation of Shower
Chair Design Driven by User Feedback**

Volume 1 of 2

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Declaration

I, Fred Han, declare that no portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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Table of Contents

Abstract.....	18
Chapter 1: Introduction	20
1.0 Introduction	20
1.1 Motivation for the Research.....	20
1.2 Background	21
1.2.1 Dignity as a Foundational Right and Its Challenges in Care Practice	22
1.2.2 The Role of Assistive Technology and Human Connection.....	23
1.2.3 Design-Led Approaches to Healthcare Through Assistive Technology...	27
1.3 Problem Statement	31
1.4 Research Aims	34
1.5 Research Questions	34
1.6 Research Objectives	34
1.7 Theoretical Framework	35
1.7.1 Gallagher’s Concept of Dignity (Subjective and Objective Perspectives)	36
1.7.2 Nolan et al.’s Senses Framework	37
1.7.3 Continuity Theory	38
1.7.4 Integrating Theoretical Frameworks	39
1.8 Conceptual Model	40
1.9 Overview of Research Design.....	42
1.10 Thesis Outline	45
1.11 Chapter Summary.....	48

Chapter 2: Literature Review	49
2.0 Introduction	49
2.1 Search Strategy and Hermeneutic Approach to the Literature Review	50
2.2 Dignity in Elder Care: Global and Chinese Perspectives.....	51
2.2.1 Global Perspectives on Dignity in Elder Care	52
2.2.2 Dignity and Elder Care in China	54
2.3 Assistive Technology and Dignity: The Case of the Shower Chair.....	57
2.3.1 Defining Assistive Technology in the Context of Showering	58
2.3.2 Implementation of Assistive Technology in Elder Care	59
2.3.3 Enhancing Dignity Through Design: Dignity-Conscious Assistive Shower Chairs	61
2.3.4 Alternative Dignity-Centred Design Frameworks Considered	62
2.4 The Essence of Dignity in Elder Care.....	64
2.4.1 Multifaceted Dignity in Elder Care.....	65
2.4.2 Objective Dignity in Elder Care.....	67
2.4.3 Subjective Dignity in Elder Care	69
2.4.4 The Interplay Between Objective and Subjective Dignity in Elder Care .	71
2.4.5 Challenges to Maintaining Dignity	73
2.5 Chapter Summary.....	76
Chapter 3: Methodology.....	78
3.0 Introduction	78
3.1 Epistemological and Ontological Stance	78

3.2 Justification for Participatory Design.....	80
3.3 A Triadic Framework for Participatory Inquiry.....	82
3.3.1 Moving from Transactional to Relational Design Logic	82
3.3.2 Managing Values and Power in Participatory Research	84
3.3.3 Reflexivity and the Fusion of Horizons: A Gadamerian Position.....	85
3.4 Theoretical Frameworks as Analytical Lenses	86
3.4.1 Gallagher’s Dual Dimensions of Dignity.....	87
3.4.2 Nolan et al.’s Senses Framework	88
3.4.3 Continuity Theory	89
3.5 Synthesising Theoretical Frameworks for Analytical Application.....	90
3.6 Integration of Practice-Based Methodology	92
3.7 Chapter Summary.....	93
Chapter 4: Research Design Implementation and Preparation	95
4.0 Introduction	95
4.1 Research Phase 1: Exploring Dignity in Caregiving and the Use of Assistive Shower Chairs	96
4.2 Research Phase 2: Production of Dignity-Conscious Shower Chair Prototype and User Test.....	97
4.3 Recruitment of Research Participants	98
4.3.1 Human Ethics Approval.....	98
4.3.2 Recruitment Methods	98
4.3.3 Participants’ Demographics	103

4.4 Data Collection Methods.....	103
4.5 Data Synthesis: Thematic Synthesis and Framework Application	106
4.6 Strategies for Ensuring Rigour and Interpretive Validity	107
4.7 Measurement Limitations.....	110
4.8 Chapter Summary.....	111
Chapter 5: Research Phase 1 – Iterative Design and Feedback	112
5.0 Introduction	112
5.1 Stage 1: Introductory Focus Groups	112
5.1.1 Gallagher’s Framework in Practice: Balancing Objective Challenges and Subjective Dignity in the Care Relationship.....	114
5.1.2 Nolan et al.’s Senses: A Reciprocal Framework for Dignified Care	117
5.1.3 Continuity Theory: Maintaining Identity and Self-Esteem.....	120
5.1.4 Synthesis: Dignity-Enhancing Approach to Care (With a Focus on Assistive Shower Chair Design)	121
5.2 Stage 2: Preliminary Shower Chair Design and a User-Centred Evaluation of Shower Chairs	122
5.2.1 Preliminary Shower Chair Design and its Evaluation.....	122
5.2.2 A User-Centred Evaluation of Shower Chairs	130
5.2.3 Synthesis: Dignity-Conscious Design Principles for Shower Chairs	141
5.3 Stage 3: Dignity-Conscious Shower Chair Design and Its Iterations	144
5.3.1 Initial Design.....	146
5.3.2 Design Iteration 1	150

5.3.3 Design Iteration 2	153
5.4 Stage 4: Translation of Design Principles to Design Schemes	158
5.5 Chapter Summary.....	160
Chapter 6: Prototype Production and User Testing	161
6.0 Introduction.....	161
6.1 Stage 1: Metal Structure Refinement	165
6.1.1 Material Selection	165
6.1.2 Structure Durability.....	167
6.2 Stage 2: Mechanism of Moving Parts	174
6.2.1 Folding Backrest	174
6.2.2 Front Safety Handlebar	177
6.2.3 Rotating Armrest.....	179
6.2.4 Safety Brake	182
6.2.5 Foldable Footrest.....	184
6.3 Stage 3: Non-Metal Components Refinement	185
6.3.1 Seat and Backrest	185
6.3.2 Armrests	186
6.3.3 Footrest Pedals	188
6.3.4 Section Summary	189
6.4 Stage 4: Function and Aesthetics Evaluation.....	189
6.4.1 Carers' Feedback.....	190
6.4.2 Older Adults' Feedback	195

6.4.3 Comparison of Carers' and Older Adults' Feedback	198
6.5 Stage 5: Final Prototype Refinement	202
6.6 Prototype User Testing	205
6.6.1 Safety Certification for User Testing	205
6.6.2 Participant Recruitment and Test Method.....	206
6.7 Chapter Summary.....	207
Chapter 7: Results – Evaluation of the Prototype.....	210
7.0 Introduction	210
7.1 Carers' Evaluation.....	210
7.1.1 Experienced Dignity: Operational Efficiency and Carer Competence ...	211
7.1.2 Factors Influencing Dignity – Safety: The Ergonomics of Care vs the Ethics of Restriction.....	213
7.1.3 Factors Influencing Dignity – Comfort: Recognising the Unseen Burdens	215
7.2 Older Adults' Evaluation	216
7.2.1 Experienced Dignity: Aesthetics as Affirmation	216
7.2.2 Factors Influencing Dignity – Safety: The Subjectivity of Security	218
7.2.3 Factors Influencing Dignity – Comfort: The Embodied Experience of Well- Being	219
7.3 Comparative Analysis of Carers' and Older Adults' Feedback.....	220
7.3.1 Safety: Shared Priorities - Multifaceted and Relational.....	222
7.3.2 The Comfort Dilemma: Individual Needs vs Practical Limitations.....	222

7.3.3 Design Intent and Implementation Reality	223
7.4 Chapter Summary.....	224
Chapter 8: Discussion	226
8.0 Introduction	226
8.1 Re-Evaluating Theoretical Frameworks Through Empirical Insights	226
8.1.1 Gallagher’s Dual Dimensions of Dignity: Beyond the Interplay.....	226
8.1.2 Nolan et al.’s Senses Framework: Contextualising and Prioritising Sensibilities	229
8.1.3 Continuity Theory: Adapting and Preserving Identity.....	231
8.2 Situating the Findings: A Comparison with Existing Research.....	232
8.2.1 Balancing Competing Needs: Drawing Parallels with Person-centred Care	232
8.2.2 Redefining Usability: Moving Beyond Efficiency	233
8.2.3 The Power of Aesthetics: Counteracting Stigma and Promoting Self-Worth	234
8.3 Revisiting Research Objectives: Achieving and Evidencing Dignity.....	234
8.3.1 Unveiling the Relational Complexities of Dignity.....	235
8.3.2 Towards a Dignity-Conscious Design: A Transformation Driven by User Feedback	236
8.4 Working Definition of Dignity and the Revised Conceptual Model	240
8.5 The Refinement of the Dignity-Conscious Design Principles	244
8.6 Limitations: Contextualising the Generalisability of Relational Dignity	248

8.7 Chapter Summary.....	251
Chapter 9: Recommendations and Conclusion	254
9.0 Introduction.....	254
9.1 Key Contribution to Conceptual Understanding.....	255
9.2 Methodological Contribution	256
9.3 Practical Contribution	259
9.4 Implications for Future Research and Practice	262
9.4.1 Beyond Feature-Driven Design: Toward Integrated Relational Ecosystems	262
9.4.2 A Renewed Focus on Relational Connection: Transcending Physical Support	263
9.4.3 Contextualising Cultural Values and Privacy in Dignity-Conscious Design	265
9.4.4 What Designers, Researchers, and Care Managers Can Do Differently.	267
9.5 Concluding Remarks.....	270
References	272
Appendix A The Senses Framework and Continuity Theory (Focusing on Shower Chair Design).....	291
The Senses Framework and Shower Chair Design	291
Continuity Theory and Shower Chair Design.....	295
Appendix B Human Ethics Approval (Research Phase 1)	301
Appendix C Human Ethics Approval (Research Phase 2)	303

Appendix D Qualitative Analysis: Introductory Focus Groups	305
Appendix E Market Research for Choosing Existing Shower Chairs for User Testing	311
Appendix F Qualitative Analysis: A User-centred Evaluation of Shower Chairs	316
Appendix G Analysis: A User-Centred Evaluation of Shower Chairs.....	321
Appendix H Dignity-conscious Shower Chair Design: Initial Design	338
Appendix I Dignity-conscious Shower Chair Design: Design Iteration 1.....	341
Appendix J Dignity-conscious Shower Chair Design: Design Iteration 2	344
Appendix K Prototype Safety Certification.....	347
Appendix L Summary Table of the Carers' Feedback on the Shower Chair Prototype.....	350
Appendix M Summary Table of the Older Adults' Feedback on the Shower Chair Prototype.....	351

List of Tables

Table 1. The Contribution of the Six Senses to Dignity	38
Table 2. Comparison of the Dual Dimensions of Dignity	66
Table 3. The Impact and Alignment of Objective Dignity Frameworks to Dignified Care Practice	68
Table 4. The Interplay of the Dual Dimensions of Dignity in Elder Care	72
Table 5. The Logic of Structured Design Decision-Making Methods in the Research	84
Table 6. Practice-based elements of the methodology	93
Table 7. Demographics of Participants in Research Phase 1	103
Table 8. Comparative Analysis of the Three Shower Chairs	143
Table 9. Attributes and Design Principles for the Initial Design	149
Table 10. Attributes and Design Principles for Design Iteration 1	152
Table 11. Attributes and Design Principles of Design Iteration 2	156
Table 12. Comparison of Older Adults' and Carers' Views on Iteration 2 Design Principles Linked to the Dignity Framework	158
Table 13. Design Principles and Corresponding Design Schemes	160
Table 14. Demographics of Carer Participants in Research Phase 2, Stage 4	191
Table 15. Summary of Carers' Feedback	195
Table 16. Demographics of Older Adult Participants in Research Phase 2, Stage 4	195
Table 17. Summary of Older Adults' Feedback	198
Table 18. Comparison of Carers' and Older Adults' Feedback	201
Table 19. Demographics of Participants in User Testing in Research Phase 2	207
Table 20. Summary of Analysis: Carers' and Older Adults' Feedback	222

Table 21. Summary of Research Objectives and Outcomes	240
Table 22. Summary of refined Dignity-Conscious Design Principles	247

List of Figures

Figure 1. Electric-Powered Transfer Technology	24
Figure 2. A Self-Stabilising Smart Spoon.....	25
Figure 3. 3D-Printed Arm Prosthesis	28
Figure 4. Umbrella Walking Cane	33
Figure 5. Initial Conceptual Model for the Design of a Dignity-Conscious Shower Chair, Drawing on an Integrated Theoretical Lens (a pre-empirical model, revised in Chapter 8 rather than presented as a finished version)	41
Figure 6. Iterative Participatory Design Process.....	81
Figure 7. Integration of Three Critical Theories	87
Figure 8. Initial Conceptual Model Applied as an Analytical Roadmap for the Participatory Design Process (reproduced from Figure 5).....	91
Figure 9. Research Stages and Implementation	95
Figure 10. Participating Elder Care Facilities: AiDaKang (Left) and Mingde (Right)	99
Figure 11. Process of the Stand–Pivot Transfer Technique.....	100
Figure 12. Care Activity Cards and Card-Sorting Activity.....	113
Figure 13. Preliminary Shower Chair Design	123
Figure 14. Foldable Backrest	124
Figure 15. Adjustable Seat Height	126
Figure 16. Extruding Front Handlebar	127
Figure 17. Rotatable Backrest and Footrest	129
Figure 18. Shower Chairs for User Testing	131
Figure 19. Three Design Iterations.....	145
Figure 20. 3D CAD Renderings of the Initial Design.....	147

Figure 21. 3D CAD Renderings of Design Iteration 1.....	150
Figure 22. 3D CAD Renderings of Design Iteration 2.....	154
Figure 23. Initial Prototype (A) and an Intermediate Prototype (B).....	162
Figure 24. Flowchart of Shower Chair Prototype Production.....	164
Figure 25. Rust on the Steel Structure Frame	166
Figure 26. Structure Weight Comparison Between Steel (A) and Aluminium Alloy (B)	167
Figure 27. Structure Design: 3D CAD Model (Left) and Prototype (Right)	168
Figure 28. Structure Comparison: Prototype (Left) and Conventional Shower Chair (Right)	169
Figure 29. Proposed Design Solutions to Address Issues with the Diagonal Beam	170
Figure 30. Comparison of Mounting Points: Prototype (Left) and Conventional (Right) Shower Chair.....	171
Figure 31. Comparison of the ‘T’-shaped (A) and ‘Y’-shaped (B) Joint to Support the Seat.....	172
Figure 32. Structure for Mounting Front Wheels.....	173
Figure 33. Heights of Standard (A) and Customised (B) Front Wheel.....	174
Figure 34. Folding Backrest	175
Figure 35. The Iteration of the Push Handlebar’s Lock.....	177
Figure 36. Front Safety Handlebar Rotation Directions	178
Figure 37. Front Safety Handlebar Lock Switch	179
Figure 38. Rotating Armrest: Normal Mode (Left) and Older Adult Transfer Mode (Right)	180
Figure 39. Initial Rotating Armrest (A) and Its Iteration (B).....	181
Figure 40. Safety Brake: Brake Pad (Left) and Pedal (Right)	182

Figure 41. Iterations of Safety Brake Design: Perforated Disc (A) and Metal Blade (B)	183
Figure 42. Foldable Footrest	184
Figure 43. Iteration of Seat and Backrest: 3D Printed (A) and Polyurethane Foam (B)	186
Figure 44. 3D Printed Armrests for Handlebar Rotation Test	187
Figure 45. Armrest Design Excluding Aluminium Support (A) and Durability Simulation (B)	188
Figure 46. Iteration of Footrest Pedal Design: Initial Design (A) and Final Design (B)	189
Figure 47. Dignity-Conscious Shower Chair Prototype	190
Figure 48. Final Front Safety Handlebar with a Magnet-Embedded Switch	202
Figure 49. Final Armrest Design with Shortened Front Overhang	203
Figure 50. Final Brake Pad with Middle Groove	204
Figure 51. The Two Colour Choices for the Shower Chair	205
Figure 52. The X-Shaped Support Structure (A) and the Existing Shower Chair (B)	212
Figure 53. Design Transformation from the Preliminary Shower Chair Design (Left) to the Dignity-Conscious Shower Chair Prototype (Right)	237
Figure 54. Revised Conceptual Model: From Linear Interaction to Intertwined Relationality	243

Abstract

Background: Dignity is a unique human quality and a critical aspect of elder care, but it is often overlooked in the design of assistive technologies (ATs). This practice-based research investigated the complex relationship among AT, dignity, and caregiving, emphasising shower assistance and the limitations of a function-centred approach. Maintaining dignity in elder care settings, especially when implementing AT, presents a considerable challenge. Existing AT often fails to adequately address the complex interplay between functional requirements and the subjective experiences of both older adults and carers.

Methodology: This research adopted a constructivist epistemology and a participatory design (PD) approach, involving an iterative design process and user testing at two elder care facilities in China. Data were analysed using a thematic synthesis method, which involved line-by-line coding, development of descriptive themes and the interpretation of the data from a theory-informed perspective. The dual dimensions of dignity, the senses framework, and continuity theory were integrated to guide data collection and analysis, which included semi-structured interviews and focus groups.

Key Findings: This research revealed a fundamental tension between carer priorities (efficiency and safety) and older adult values (comfort and autonomy), leading to inherent trade-offs in dignity. Participants' accounts indicated that design intent for one stakeholder often unintentionally influences the other, highlighting the relational nature of dignity in caregiving. A key contribution of this research was the identification of design principles and strategies that reduce these trade-offs and enhance dignity for both older adults and carers.

Outcomes and Contribution: The research developed a set of dignity-conscious design principles and a shower chair prototype that reflects these principles. It

challenges function-centred models through a relational approach to respectful care. The study's contributions include (a) defining dignity-conscious design principles for assistive shower chairs, refined through user evaluation; (b) providing empirical insights into dignity trade-offs within carer–older adult relationships; (c) shifting the design perspective from functional to relational ecosystems; and (d) proposing recommendations that emphasise relationality, customisation and stakeholder empowerment.

Conclusion: By integrating user perspectives and theoretical contributions, this research offers design insights and a practical example showing how ATs can be developed to ensure their functionality while also supporting more dignified and compassionate care interactions for older adults and carers. Future initiatives should incorporate ecosystem-level interventions and relational design strategies to realise technology's full potential in elder care.

Chapter 1: Introduction

1.0 Introduction

This thesis presents a practice-based doctoral research project investigating the experience of dignity through shower chairs as assistive technology (AT) within the care relationship between older adults and carers in elder care facilities. First, this chapter outlines the motivation for this research, which is rooted in my personal experience. Second, it outlines the background and emphasises the need to investigate dignity in the context of AT implementation. Third, it examines the theoretical and conceptual models that guide this research. Fourth, it describes the goals and methods involved in each phase of the research. Finally, this chapter previews the upcoming sections, offering readers a roadmap to navigate this thesis. Ultimately, this research develops a set of dignity-conscious design principles for AT using the participatory design (PD) method, offering key insights into balancing carers' priorities and older adults' desires, which are crucial for fostering dignity for both parties.

1.1 Motivation for the Research

This research was motivated by my personal experience caring for my mother, Soo Han, who passed away at the age of 67 after a decade-long battle with cerebellar atrophy. As the disease progressed and severely impacted her motor function and coordination, AT became a crucial component for her care.

Initially, I focused mainly on efficiently completing caregiving tasks, such as changing nappies and helping her transfer between the bed and wheelchair. Reflecting on those early stages, I realise now that I may have unintentionally overlooked her emotional needs, potentially compromising her dignity in those vulnerable moments. My concerns for her dignity grew as AT became more central

to our caregiving routine. For example, although I intended to preserve my mother's independence and autonomy by providing her with a wheelchair, she eventually resisted using it because she feared losing the ability to use her legs. In the moments when I grew weary from the physical strain of transferring her, I noticed her visible discomfort. In hindsight, I realise that I may have unintentionally prioritised my own needs as a carer over her emotional well-being.

These personal experiences inspired the curiosity behind this research, particularly concerning how AT might influence the dignity of older adults and their carers, especially in intimate care settings. As a design practitioner with over 30 years of experience, I saw an opportunity to explore these questions through AT design by integrating theoretical frameworks and the PD approach, which involves users as research partners. A transfer device does not just move a body; a shower chair does not merely support a seated posture. Both communicate ergonomics through their form and feel the nature of the relationship between their users. Therefore, dignity in AT cannot be an afterthought or an ethical layer added after defining function. Instead, it must be an inherent design quality from the beginning, something the device embodies rather than merely suggests. This belief drives the practice-based doctoral research outlined in the aims and objectives in Sections 1.4 and 1.6.

1.2 Background

Article 1 of the Universal Declaration of Human Rights (United Nations, 1948) declares that all human beings are born free and equal in dignity and rights. According to Cohn (2011), recognising inherent dignity and equal and inalienable rights is the foundation of freedom. Regardless of age or health status, everyone is entitled to be treated with respect and dignity. The concept of human dignity is a

central theme in the fields of development and humanitarian organisations and is often cited in their missions, vision statements and guiding principles.

1.2.1 Dignity as a Foundational Right and Its Challenges in Care Practice

In care settings, respecting dignity has become a fundamental principle of the care system. It relates to an individual's sense of worth, self-esteem and perception of being respected by others (Zirak et al., 2017). Dignity is a critical aspect of nursing, and providing dignified care is an essential objective of comprehensive care. Respecting human rights and preserving dignity are considered the ethical purposes of care (Høy et al., 2016). However, the realities of caregiving, including older adults' intrinsic reliance on carers, can pose constraints on implementing the concept of dignity in practical elder care settings. These constraints can overshadow a balanced approach to effective practice that considers both individual dignity and the complex realities of elder care environments, including limited care resources and the diverse health conditions of older adults. For instance, carers may need to make decisions on behalf of older adults to ensure their safety and well-being, which can sometimes conflict with the traditional notion of autonomy and individuality.

The concept of dignity is not straightforward, as its definition varies across sectors and perspectives. It may be impractical to establish a single, agreed-upon definition across the disciplines in which it is used and theorised (Bal, 2017). Although autonomy refers to the ability to make independent choices and the freedom to control oneself, reflecting human dignity and intrinsic worth (Baertschi, 2014; Gallagher, 2004), it should be viewed as a mutually supportive concept in elder care settings (Killmister, 2022). Independence cannot be defined solely by the absence of assistance; it encompasses self-esteem and personal growth, even when individuals require help (Hughes, 2005).

While autonomy, emphasising independence, is considered a necessary condition for high-quality care in elder care settings, a lack of capacity or quality caregiving resources among older adults can significantly influence its implementation (Boyle, 2007; Hughes, 2005). Nonetheless, given these conditions, it should be viewed as an imperative constraint rather than a negative external factor. Therefore, the perceived difference in autonomy varies across specific contexts.

In an elder care environment, dignity should be regarded as integral to relationships and mutual reliance, and the diverse conditions, needs, and challenges that individuals face must be acknowledged. This view reinforces the reciprocal nature of dignity between older adults and carers in care settings. Carers' dignity should be addressed alongside the preservation and promotion of older adults' dignity. As carers provide support and empathy to older adults, maintaining their dignity is crucial to their mental and emotional well-being, which, in turn, affects the quality of care they provide (Chochinov, 2002). Gallagher (2004) highlighted the reciprocity of dignity: *'If we, carers, give our older adults dignity, we need a little as well'* (p. 591). Jakobsen and Sørli (2010) suggested creating a respectful and supportive environment for carers by recognising their contributions and providing resources such as AT to improve care quality by mediating interactions between carers and older adults.

1.2.2 The Role of Assistive Technology and Human Connection

AT can enhance or maintain physical function and independence, reducing reliance on personal caregiving (Hoenig et al., 2003) while improving efficiency in the elder care environment. While ATs offer significant benefits in terms of functionality, comfort and ease of use from a technical perspective, their design may neglect to consider the more profound emotional, sensory, and social influences on

individuals' relationships with them (Fayazi & Frankel, 2020). For example, Figure 1 shows an imbalance in the design of a transfer device developed for individuals with impaired mobility. This machine uses motor power to lift an individual from bed and safely transfer them to a toilet, eliminating the need for carers to provide physical assistance. However, the device primarily focuses on facilitating the transfer task, neglecting the individual's emotional state during the transfer, which involves a hanging posture, especially during the cleansing process after using the toilet. Users are unfortunately treated as nothing more than an 'object' that must be moved and cleaned after using the bathroom.



Figure 1. *Electric-Powered Transfer Technology*

Note. Images from Douyin. (<https://bit.ly/4jMLNUM>)

This example illustrates the importance of including elements in AT design that address autonomy, self-confidence, self-esteem, social inclusion, and dignity while providing balanced support for the physical and emotional strain experienced

by both the care receiver and the carer. A self-stabilising smart spoon for individuals with hand tremors, such as those with Parkinson's disease, strikes a good balance in this regard by enabling independent eating without assistance, thereby maintaining and enhancing autonomy and independence (Figure 2).



Figure 2. *A Self-Stabilising Smart Spoon*

Note. Image from "This Spoon Helps People with Tremors Eat More Easily," by Eric Limer, 2013, *Popular Mechanics*. (<https://bit.ly/3YCB5Gx>) Copyright 2013 by Hearst Magazine Media, Inc.

Prioritising technical efficiency over human connection risks undermining compassionate care (Haltaufderheide et al., 2023). For example, manual wheelchair designs often prioritise lightweight frames that benefit carers more than older adults (Barili et al., 2020), potentially leading to poor ergonomic design that increases fatigue and the risk of injury. However, lightweight frames may not mean anti-user: they can also support self-propulsion, reduce transfer effort, and lower the risk of transport-related injuries for users with residual strength. The issue may not involve lightness itself, but rather a design hierarchy that prioritises carer convenience over the user's ergonomic and emotional experience. For older adults, especially, frames

that focus on the carer's experience can intensify the emotional challenge of dependency: feeling pushed instead of self-driven, and feeling moved rather than moving oneself, can strengthen a sense of passivity that diminishes the individual's sense of agency and self-esteem. Moreover, wheelchair users face not only physical discomfort but also emotional struggles due to social stigma and the internal conflict between accepting and overcoming disability (Fotteler et al., 2021). This emotional challenge may involve multiple interconnected aspects that a carer-focused design often overlooks. First, it can shift the view of the older adult from an active participant in their care to an object being moved through it. Second, it can disrupt the older adult's sense of continuity (Atchley, 1989): someone who once moved freely around their home now sits in a device with controls and features designed for someone else. Third, it may lead to a quiet shame or reluctance to ask for help, as described by carers and older adults in this study: users tend to avoid requesting adjustments because each adjustment request highlights their dependence on the carer's effort, particularly when the device visibly 'belongs' to the carer's task. While lightweight frames have technical advantages, focusing solely on lightness without considering the user's emotional state can worsen, rather than improve, the feeling of being treated as a body rather than a person.

These experiences can diminish self-confidence and create a sense of inadequacy. A more balanced approach that considers both practical caregiving tasks and older adults' desires for autonomy, emotional support, and meaningful relationships is necessary.

This practice-based research focuses on the shower chair as a key AT due to its dignity concerns and the vulnerability of older adults during intimate care. Detailed aims and objectives are outlined in Sections 1.4 and 1.6.

1.2.3 Design-Led Approaches to Healthcare Through Assistive Technology

It is crucial to address the limitations of solely using problem-solving approaches when developing AT. These approaches can generate practical solutions, but they often fail to fully address the complex needs and preferences of older adults. Even if the resulting technology is functional, it may lack the intended relevance or appeal (Spinelli et al., 2019). Therefore, a deep understanding of users, their environments and their specific challenges is required (Smith et al., 2018) to develop effective, functional, user-friendly solutions. For example, innovations in computer-aided design (CAD) and 3D printing technology allow assistive devices to be customised to meet individual preferences (Figure 3), offering significant advantages over manually modifying existing products (Howard et al., 2025). While these technological advancements improve functionality and user satisfaction, it is important to evaluate whether they adequately address the complex and significant challenges of implementation in a real-world context.



Figure 3. *3D-Printed Arm Prosthesis*

Note. Designed and photographed by Fred Han.

Design-led approaches emphasise person-centred healthcare, tailoring services to individuals' needs and considering social, economic, ethical and political factors to develop more inclusive and accessible options (Standoli, 2022). Holistic design processes address complex healthcare problems by considering the entire system, rather than isolated issues, and create ideal experiences for patients and carers (Fidsa, 2009). Implementing this approach requires significant organisational commitment to adapt to evolving market dynamics and explore innovative healthcare delivery models that provide accessible, affordable services (Bucolo & Matthews, 2010). A viable healthcare system must balance cost efficiency and user acceptance while enhancing daily life, which requires a design process that continuously integrates user feedback and supports the healthcare industry in achieving effective and inclusive outcomes (Salem & Ghassan, 2019). The challenge is to ensure that

design-led approaches go beyond simple procedural checklists; they must actively foster meaningful change that effectively addresses users' diverse needs.

'Design thinking', a human-centred approach to innovation, plays a significant role in the development of AT. Its focus on empathy and collaboration includes understanding user needs, defining problems, generating solutions, prototyping, and testing to develop person-centred solutions (Harris, 2017; Szopa & Vanderheiden, 2022), ultimately leading to better care experiences and dignified ageing. The Caring Companion Robot (PARO), developed by AIST in Japan, highlights the importance of user feedback in AT design (PARO Robots, 2014). The robot responds to touch and voice, providing social interaction that can reduce feelings of loneliness and anxiety, particularly among older adults with dementia. Design improvements informed by user feedback foster a sense of comfort and familiarity through the robot's soft, furry exterior and 'baby seal' appearance. These features are crucial for engaging users with cognitive impairments (Bradwell et al., 2021). Nevertheless, it is important to critically evaluate whether these technological solutions can genuinely replace human companionship and care. Although design thinking offers valuable insights, a comprehensive analysis is necessary to reveal the ongoing challenges and complexities of achieving meaningful innovation in AT development.

User-centred co-design represents a significant shift from conventional technology development models, emphasising the importance of involving end users and other stakeholders in the design process. This participatory approach aims not only to create usable and desirable technologies but also to effectively address real-world issues and use cases (Howard et al., 2025; Orpwood et al., 2007). This involvement is vital for navigating the complex needs of an ageing population.

However, many older adults may be inexperienced with modern technologies, requiring designers to critically assess how to adapt design activities to align with their cognitive capabilities. This adaptation must extend beyond superficial inclusivity, requiring the implementation of strategies that empower older participants (Standoli, 2022). The perception of new technologies must also evolve from viewing them merely as necessities that highlight limitations to recognising them as avenues to foster well-being, social interaction, and active lifestyles (Jovanovic et al., 2021). For instance, virtual reality technologies could be reframed as a means of enhancing social engagement, instead of being viewed solely as a solution to physical distance or mobility issues. They can provide immersive experiences that allow older adults to connect with family via virtual meetings or explore new environments, promoting well-being and an active lifestyle. This form of social interaction is closely linked to subjective dignity (Gallagher, 2004), demonstrating that thoughtful technological implementation can enhance rather than diminish dignity.

Although user-centred co-design offers significant potential, it is essential to remain mindful of the challenges associated with inclusivity and to develop technology that genuinely reflects the experiences and desires of older adults. Therefore, this practice-based research project adopts a design-led approach to developing AT—specifically, shower chairs—by involving older adults and carers as co-designers throughout the process. This ensures that the final shower chair design accurately reflects their insights into their experiences of dignity while taking into account their capabilities, limitations and caregiving realities. This commitment to participation is rooted not only in practicality but also in epistemology: dignity is a value-driven, relational concept that cannot be fully captured by abstract metrics.

Therefore, considering older adults and carers as co-knowledge holders rather than mere subjects makes participatory design the most suitable methodology for this research. This approach allows the concept to be defined and negotiated by those it concerns, an epistemological stance discussed in Sections 3.1 and 3.2.

1.3 Problem Statement

The integration of AT into elder care, particularly in intimate settings such as shower assistance, presents a complex challenge: how to uphold the dignity of both older adults and carers. While the importance of dignity in elder care practice is widely recognised, its implementation in practice is becoming increasingly challenging due to the heightened vulnerability of older adults whose chronic health conditions create dependency and influence decision-making. Oosterveld-Vlug et al. (2013) highlighted that this issue can diminish older adults' ability to assert their rights and maintain a sense of self-worth, thereby undermining the ethical foundation of care. Baertschi (2014) suggested that dignity is inseparable from the ability to control one's life. A central challenge lies in the tension between autonomy and the lived reality of dependency. Well-intentioned efforts to ensure safety through AT can inadvertently undermine an individual's sense of self-worth, autonomy, and control. The burdens placed on carers by the use of AT can lead to a less empathetic approach to caregiving, directly compromising the older adult's subjective sense of dignity.

Although design-led healthcare approaches emphasise user-centredness and contextual understanding, they often fail to address the practical aspects of dignity as applied to AT for elder care. Despite the recognised importance of dignity, existing frameworks frequently lack specific guidance for integrating dignity-preserving elements into AT design and development (Hosking et al., 2015). Furthermore,

empirical research on the application of these approaches in intimate care settings, such as shower assistance, remains limited, leaving a gap in understanding how AT can effectively promote or diminish social dignity in practice (Spinelli et al., 2019). The challenge lies in moving beyond mere functional devices that assume increased functionality and usability inherently contribute to dignity, and in proactively fostering dignity within the complex relational ecosystem of elder care.

Existing approaches to AT design struggle to fully address these tensions. An overemphasis on objective safety and carer efficiency risks overshadowing the equally important subjective experiences of older adults, reducing them to passive recipients of care rather than active partners in the care relationship (Boyle, 2007). For instance, the increasing autonomy of socially assistive and rehabilitation robots may result in decisions that conflict with human values and preferences (Sylvester et al., 2023). Reliance on AT may also inadvertently overshadow the need for human touch, compassion and a holistic approach, all of which are central to the caregiving profession (Spinelli et al., 2019). This dynamic creates a relational problem. For instance, using assistive robots to automate care tasks may reduce the need for human carers, resulting in a loss of human connection and emotional bonding (Hoenig et al., 2003) and potentially leading to feelings of isolation or depersonalisation. Hoenig et al. (2003) argued that human contact is more important and appropriate for older adults than technical assistance.

Societal attitudes and perceptions of disability can also influence the use of AT, as individuals may fear stigmatisation or being viewed as less capable, which can lead to feelings of shame and have cultural and social impacts (Fotteler et al., 2021). One example that addresses this issue is the use of an umbrella with a rubber

tip (Figure 4) as a walking aid in lieu of a traditional cane, minimising the appearance of dependence.



Figure 4. *Umbrella Walking Cane*

Note. The image was taken from <https://bit.ly/4qleWsE>

This thesis addresses three interconnected knowledge gaps. Empirically, there is limited, fragmented evidence on how shower chairs influence dignity in institutional elder care, largely based on small, culturally similar Western samples (Friesen et al., 2012; Rosendal et al., 2022). Theoretically, key dignity frameworks—Gallagher’s (2004) dual-dimensions model, Nolan et al.’s (2006) senses framework, and Atchley’s (1989) continuity theory—originated in nursing and sociology and have not yet been adapted as design principles for AT (Hosking et al., 2015). Contextually, dignity-conscious AT design has not been studied in Chinese

institutional elder care settings, despite their unique cultural values and demographic challenges (Dong, 2016; Feng et al., 2012). Thus, the thesis addresses gaps in the evidence, in the theoretical application in design, and in cultural specificity. The aims (Section 1.4) and objectives (Section 1.6) address these three aspects simultaneously.

1.4 Research Aims

This practice-based research aims to explore how the design of an assistive shower chair can support the dignity of both older adults and carers during shower assistance in Chinese institutional elder care. The research pursues this aim through a participatory design process in which dignity-conscious design principles are developed, incorporated into a prototype, and tested with users. The combination of these principles, the prototype, and a revised conceptual model in Section 1.8 forms the core contribution of the thesis.

1.5 Research Questions

- **Research Question 1:** How is dignity upheld or compromised in the relationship between older adults and carers when using AT for shower assistance?
- **Research Question 2:** How can the features of an assistive shower chair be transformed into dignity-conscious solutions that prioritise the stakeholders' dignity, leading to enhanced quality of care?

1.6 Research Objectives

To achieve this aim, the research focuses on five interconnected objectives:

- **Objective 1 – Identify** the physical, emotional and relational factors that shape experiences of dignity during shower assistance, from the perspectives

of older adults and carers in Chinese institutional elder care. (Addressed in Chapters 2 and 5; related to RQ1.)

- **Objective 2 – Synthesise** these factors into a set of dignity-conscious design principles, using Gallagher’s dual dimensions of dignity, Nolan et al.’s senses framework, and Atchley’s continuity theory as analytical lenses. (Addressed in Chapters 2–3 and 5; connecting RQ1 and RQ2.)
- **Objective 3 – Translate** these principles into an assistive shower chair prototype through iterative participatory design cycles with carers and older adults. (Addressed in Chapters 5–6; relates to RQ2.)
- **Objective 4 – Evaluate** the prototype’s effectiveness by examining how well the principles are reflected in participants’ lived experiences of dignity. (Addressed in Chapters 6–7; relates to RQ2.)
- **Objective 5 – Refine** the design principles and the conceptual model based on empirical findings to provide transferable guidance for future dignity-conscious AT design. (Addressed in Chapters 8–9; ensures the contribution.)

1.7 Theoretical Framework

This section previews the analytical lens used throughout the thesis. Since this research focuses on dignity as a basis for design decisions, it is crucial to develop an analytical vocabulary that demonstrates that dignity is precise, reflects relational and cultural differences, and is sensitive to biographical time. No single theory in the dignity literature fulfils all three criteria. Therefore, this section combines insights from three sources: Gallagher’s dual dimensions (2004) outline the difference between objective and subjective dignity; Nolan et al.’s senses framework (2006) describes the relational aspects through which subjective dignity is experienced in care; and Atchley’s continuity theory (1989) adds a temporal

perspective, viewing dignity as an identity maintained through change. Each theory addresses a gap that the others do not cover, and Section 1.7.4 explains how they form an integrated analytical lens that will be used throughout Chapters 5–8.

Before discussing these theories, it is important to note their attribution. All three originated in Western nursing, gerontology, and sociology, carrying the individualist assumptions typical of those fields—especially in relation to concepts like autonomy, self-determination, and biographical continuity, which are highly valued. In contrast, the Chinese institutional elder care setting emphasises different relational values based on Confucianism, in which seniority is the primary source of power. This viewpoint frames dignity as something achieved by fulfilling obligations to family and community, rather than as an inherent property of an autonomous individual (Fan, 2007; Nie, 2015; Wang, 2010). Accordingly, this thesis considers the three frameworks as analytical tools rather than fixed models. Chapter 2 (Section 2.2.2) situates dignity within the Chinese cultural framework, while Chapter 8 refines this concept according to empirical findings, emphasising the cultural importance of autonomy and the relational nature of the self. The following subsections will present each theory individually.

1.7.1 Gallagher’s Concept of Dignity (Subjective and Objective Perspectives)

Gallagher’s (2004) concept of dignity provides the foundational understanding, distinguishing between objective dignity (inherent human worth) and subjective dignity (personal experience). This distinction is crucial to this project, as it highlights the need for AT design to consider the fundamental rights of both older adults and their carers, along with their individual experiences. Objective dignity relates to safety, respect, and autonomy. In contrast, subjective dignity involves feelings of self-worth, control, and belonging. This framework guides the

identification of design features that enhance both types of well-being, recognising that AT must be both functional and emotionally supportive.

1.7.2 Nolan et al.'s Senses Framework

Nolan et al. (2006) developed a framework identifying six senses essential for enhancing care for older adults: security, belonging, continuity, purpose, achievement and significance. This framework builds on Gallagher's (2004) concept of subjective dignity by identifying the elements that shape it, providing focus areas for design. As summarised in Table 1, 'security' relates to creating a safe and predictable environment, whereas 'belonging' emphasises social connection and inclusion. 'Continuity' involves preserving a sense of self and connection to the past, while 'purpose', 'achievement' and 'significance' highlight the importance of meaningful activity and feeling valued.

Sense	Contribution to dignity
Security	A safe and secure environment is fundamental for experiencing the other senses. A secure environment enables older adults to feel safe, which is essential for maintaining their dignity. When individuals feel threatened or unsafe, their sense of self-worth diminishes.
Belonging	The sense of belonging to a community or group enhances self-esteem and dignity. When older adults feel connected and supported, they are more likely to feel a sense of value and respect.
Continuity	Maintaining consistent relationships and routines helps older adults feel stable and valued. This continuity fosters a sense of identity, which is crucial for maintaining their dignity.
Purpose	The sense of having a meaningful role or making a meaningful contribution fosters a sense of achievement and self-worth. When older adults feel like they have a purpose, their dignity is upheld, as they see themselves as valuable contributors.

Achievement	Recognising achievements promotes self-confidence and self-esteem. This recognition helps both older adults and their carers feel valued, promoting their dignity.
Significance	Feeling valued and important directly impacts an individual's dignity. When carers recognise the worth of older adults, or vice versa, it enhances their overall sense of dignity and respect.

Table 1. *The Contribution of the Six Senses to Dignity*

This framework facilitates the analysis of how specific design features either support or hinder sensory perception, offering a practical guide to promoting more respectful and dignified care. For instance, a feature that enables older adults to control their safety independently can promote their sense of security and achievement. The framework also helps validate design decisions through stakeholder feedback and insight during the design process.

1.7.3 Continuity Theory

Continuity theory emphasises the importance of maintaining a sense of consistency and connection to the past, even in the face of significant life changes (Atchley, 1989). This theory incorporates a vital temporal dimension into its framework, acknowledging that dignity is not a static concept but an ongoing process of adaptation and self-preservation. Internal continuity involves maintaining a stable sense of self, while external continuity involves preserving familiar routines, environments and relationships (Guedes & Melo, 2019). In shower assistance, this distinction matters: an older adult who has long washed independently and values the familiar feeling of water on their back may feel a loss of identity if a shower chair makes them passive and transfers the responsibility for washing entirely to a carer. Conversely, a chair that enables them to continue washing parts of their body or maintain their usual routine helps preserve their sense of self and continuity. This

theory helps inform design decisions related to personalisation and adaptation, ensuring that AT respects individual preferences and supports a sense of identity.

1.7.4 Integrating Theoretical Frameworks

The three theories combine into a unified analytical lens, each addressing the other's limitations. Gallagher's dual dimensions provide the foundational distinction between objective dignity, including inherent worth, safety, and bodily integrity, and subjective dignity, which relates to experienced self-worth. However, they offer limited insight into how subjective dignity is shaped and experienced in real-world contexts. Nolan et al.'s senses framework addresses this gap by defining six relational senses through which subjective dignity is experienced in care. However, it considers these senses only synchronically, as qualities of a specific moment or relationship. Atchley's continuity theory adds the missing temporal dimension, framing dignity as a stable identity maintained through change. It links a current care interactions to an older adult's broader life story. The combined lens, therefore, assesses a design decision across three perspectives: categorical (the type of dignity involved), relational (the senses that are supported or challenged), and temporal (how the continuity of self is preserved).

The analytical approach to evaluating this combined lens has two main aspects. First, it offers a multi-dimensional perspective on each design decision: a feature is assessed not only for its ability to ensure objective dignity, such as physical safety, but also for its impact on users' relational experiences and the continuity of the older adult's sense of self. Second, and more importantly, it highlights the tensions between these dimensions. For example, a feature that enhances objective dignity for older adults may reduce a carer's sense of purpose or achievement, while a feature that preserves a user's continuity might compromise

another person's security. These tensions are not failures of the framework's analysis but rather its analytical implications. They are the key points that the empirical chapters aim to test and they guide the interpretation of user-testing results in Chapter 7, as well as the framework revisions in Chapter 8. Chapter 2 places each theory within the broader literature on dignity in elder care and explains why this specific combination was chosen.

1.8 Conceptual Model

The World Health Organization (WHO, 2023) defines AT as any device or system that helps individuals with disabilities or limitations perform daily tasks and enhances their abilities. This practice-based research project suggests that designing assistive shower chairs that emphasise the dignity of older adults and their carers can improve the quality of care, as this AT influences their interactions and shapes their care relationships. However, creating assistive functions that can instantly resolve all issues related to dignity in care settings and promote dignity for all involved may be infeasible.

Therefore, this project focused on reinterpreting the functions of existing shower chairs in light of stakeholders' subjective and objective experiences of dignity within the six-senses framework. By integrating their insights and feedback, the design process can transform the function-driven shower chair into a dignity-conscious one, promoting the well-being of older adults and carers (Figure 5). In this project, 'function-driven' refers to a device designed primarily to fulfil its functional role in targeted care tasks, such as a shower chair intended to facilitate shower assistance. Conversely, 'dignity-conscious' emphasises the assistive function's capacity to prioritise and preserve the dignity of older adults and carers without compromising the quality of the assistance provided.

As illustrated in the initial conceptual model (Figure 5) developed by me, synthesising Nolan et al.'s senses framework and the objective–subjective dimensions of dignity discussed in this chapter, the central element of this project is the ‘dignity-conscious shower chair’, which represents the focus on creating technology that prioritises dignity. Arrows showing the ‘impact’ link the shower chair to both ‘older adults’ and ‘carers’, highlighting the reciprocal nature of the caregiving relationship.

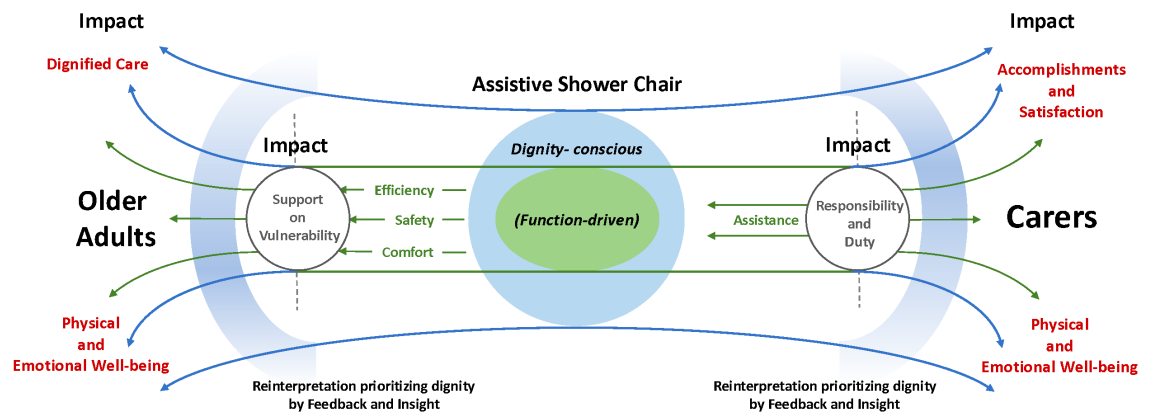


Figure 5. *Initial Conceptual Model for the Design of a Dignity-Conscious Shower Chair, Drawing on an Integrated Theoretical Lens (a pre-empirical model, revised in Chapter 8 rather than presented as a finished version)*

- **Older adults:** The impact includes improved physical and emotional well-being through enhanced support, safety, comfort and independence. These relate to the objective and subjective dimensions of dignity and the six senses within Nolan et al.'s senses framework.
- **Carers:** The impact includes increased efficiency, reduced physical strain, enhanced job satisfaction, and improved emotional well-being. These factors also contribute to both objective and subjective dignity, as well as to feelings

of purpose, achievement and significance within Nolan et al.'s senses framework.

- **‘Function-driven’ vs ‘dignity-conscious’:** The framework highlights the crucial distinction between a function-driven approach (focusing solely on the shower chair's functional aspects) and a dignity-conscious approach (prioritising stakeholders' dignity). The project's primary goal was to address this contrast with design solutions.

Figure 5 presents a conceptual diagram illustrating the anticipated relationships among an assistive shower chair, the two main stakeholders, and the dimensions of dignity described in Section 1.7. As a pre-empirical model, it makes the theoretical assumptions of the design process visible and testable, enabling the empirical chapters to confirm, refine, or challenge them. Chapter 8 (Section 8.4) revisits this diagram, considers the findings, and presents a refined version (Figure 54) that reflects the relational dynamics observed during user testing. Thus, Figure 5 serves as a working hypothesis about dignity-conscious design, which the thesis develops into its final conceptual claim.

1.9 Overview of Research Design

This practice-based research project employed a qualitative method, grounded in constructivist epistemology, to investigate the complex nature of dignity experiences during shower assistance in elder care facilities. Following Candy and Edmonds (2018), this PhD is practice-based because the designed artefact (the assistive shower chair) is not merely an outcome of research but a primary means through which new knowledge is generated and evidenced. The assistive shower chair functions as a research artefact, embodying design decisions derived from qualitative inquiry into balancing safety and autonomy, addressing relational

dynamics in caregiving, prioritising subjective dignity and emotional well-being, ensuring practicality and usability for carers, and adapting to contextual factors within elder care facilities. The artefact itself carries knowledge that cannot be fully expressed through text alone, particularly knowledge pertaining to dignity and user–technology relationships in the context of shower assistance. The iterative design process is central to how knowledge is produced in this PhD. Each design iteration of the shower chair operates as a cycle of inquiry. Through this process, knowledge emerges through practice, as each stage informs subsequent design decisions based on user feedback and theoretical reflection. Therefore, the iterative process and the artefact serve as evidence of original research findings, demonstrating how theory, user experience, and design innovation collaboratively contribute to addressing dignity in AT.

According to constructivism, knowledge is not passively received but actively constructed through interaction and social context (Mugambi, 2018). This perspective is particularly relevant to understanding dignity because it recognises that experiences of dignity are shaped by individuals’ interpretations, social contexts and power dynamics in elder care settings.

Given the sensitive and subjective nature of dignity, particularly concerning its relational aspects in the carer–older adult relationship, this project employed the participatory design (PD) method to facilitate the expression of dignity’s deeper relational and contextual dimensions through user involvement. Unlike traditional qualitative methods, which adopt a detached, observational stance, PD actively co-creates knowledge and solutions with participants.

PD’s emphasis on collaboration and shared decision-making allows users’ lived experiences and perspectives to shape the research process and its outcomes

(Spinuzzi, 2005). By involving stakeholders—older adults and carers—equally, PD enables the open exploration and critical analysis of the inherent tensions and potential conflicts between the objective and subjective aspects of dignity. For instance, if carers prioritise safety (objective dignity) and older adults prioritise autonomy (subjective dignity), the collaborative process enables these contrasting views to be openly addressed, leading to a better understanding of the complexities involved in balancing these dimensions in practice. Therefore, PD provides a more complete, contextually grounded knowledge of the dual dignity framework.

Traditional research methods may struggle to capture the nuanced ethical, social, and experiential implications of dignity in care settings. As outlined in Section 3.2, PD provides a pragmatic approach to uncovering these often-hidden dimensions through collaborative partnerships (Wilkinson, 2011), which is crucial when addressing a complex, context-sensitive concept like dignity. By empowering older adults and carers to shape the research, PD ensures that the design of the assistive shower chair is grounded in the values, preferences, and practical needs of the intended users, resulting in contextually appropriate features. To incorporate these diverse stakeholder perspectives, the research used iterative design methods, enabling continuous refinement and adaptation based on participant feedback and testing to identify design flaws or unintended consequences.

Data were collected through semi-structured interviews, focus groups, and visual methods (i.e. care activity cards and 3D CAD renderings of designs). The data were analysed through thematic synthesis, guided by the frameworks of Gallagher, Nolan et al., and continuity theory. To ensure methodological rigour, strategies such as reflexivity, triangulation, and member checking were implemented.

1.10 Thesis Outline

This section provides a roadmap outlining the structure and content of each subsequent chapter to help readers navigate and understand this thesis.

- **Chapter 2. Literature Review:** This chapter analyses the existing literature on dignity in elder care, AT design and their intersection. It examines relevant frameworks and practical challenges and proposes key research areas.
- **Chapter 3. Methodology:** This chapter outlines the methodological approach employed in the project. It explains the theoretical frameworks supporting the dual aspect of dignity. It also describes the design-led approach to healthcare and the justification for choosing PD as a method for designing, collecting and analysing data.
- **Chapter 4. Research Design Implementation and Preparation:** This chapter explains how the selected methodology was implemented in practice. It describes participant recruitment and ethics, data collection through interviews, focus groups, and visual methods. It also presents the thematic synthesis approach, the strategies adopted to ensure rigour and interpretive validity, and the measurement limitations.
- **Chapter 5. Research Phase 1 – Iterative Design and Feedback:** This chapter presents Research Phase 1, which includes introductory focus groups, a preliminary shower chair design informed by theory, and a user-centred evaluation of three existing shower chairs. It also details three iterations of a dignity-conscious design developed with participant feedback, along with the translation of design principles into design schemes that set the context for the prototype evaluation in Chapter 7.

- **Chapter 6. Prototype Production and User Testing:** This chapter describes the development of the assistive shower chair prototype. It outlines the design choices, material selection, and manufacturing processes that transformed the theoretical design into a physical device. It also explains the procedures for conducting user testing.
- **Chapter 7. Results – Evaluation of the Prototype:** This chapter analyses qualitative user testing data and synthesises feedback from carers and older adults. It discusses the research findings, including the strengths and limitations of the prototype design.
- **Chapter 8. Discussion:** This chapter interprets the research findings, contextualising them within existing literature and the relevant theoretical frameworks. It also explores the implications of these findings for AT design, elder care practices, and the promotion of dignity in care settings.
- **Chapter 9. Recommendations and Conclusion:** This chapter summarises the project's key findings and highlights its contributions. The core research questions are revisited, and the extent to which they have been addressed is discussed. It also provides suggestions for future research and practical applications.

This thesis, presented across two volumes, investigates the multifaceted challenge of designing a dignity-conscious shower chair through an iterative PD process. This thesis makes three interconnected contributions to knowledge. The first contribution is a set of dignity-conscious design principles for assistive shower chairs in the Chinese institutional elder-care setting that have not been previously outlined. The second is a functional prototype that implements these principles and

reveals previously undocumented design tensions, especially between the dignity of older adults and carers. The third is a detailed account of the PD process, including decision-making, failures, and redesigns, making this practical knowledge transferable to future AT developments. The originality lies not only in the final product but also in this documented process and the explanations of why certain design decisions succeed or fail in real-world applications.

Comprising two volumes, this thesis bridges the gap between theoretical considerations and the practical realities of AT design. Volume 1 establishes the theoretical framework, including the literature review, methodology, and analytical narrative that inform the research. Volume 2, a digital portfolio titled ‘Design of a Dignity-Conscious Shower Chair by Participatory Design Approach’, diverges from the traditional written thesis format by offering a visual documentation of the practice-led research, its development, and its outcomes.

Volume 2 enriches the reader’s understanding by incorporating the following elements:

- **Visual documentation of design development:** Sketches, CAD models, and photographs illustrating the evolution of the shower chair design from initial conception to the final prototype.
- **Prototype production details:** Visual records detailing the manufacturing processes, material choices and structural refinements undertaken to meet the research objectives.
- **Evaluation in action:** Photographs capturing key moments from prototype evaluations and user testing sessions conducted with carers and older adults in elder care settings.

- **Feature demonstration:** A video demonstrating the real-world performance of the features of the final shower chair design.

This dual-volume structure provides readers with a flexible approach to the material.

1.11 Chapter Summary

Chapter 1 introduced a practice-based doctoral research project investigating dignity in elder care, with a focus on shower chairs. It established the research motivation based on my personal experience, outlined the problem statement, emphasised the challenges of implementing dignity in the context of AT within Chinese institutional elder care, and identified three interconnected gaps that the thesis addresses. It also presented the research aims; five interconnected objectives; questions; and an integrated analytical lens that combines Gallagher's dual dimensions of dignity, Nolan et al.'s senses framework, and Atchley's continuity theory, treated as analytical tools rather than fixed models, given the Chinese, Confucian-informed context. It presented an overview of the research design, highlighting a qualitative approach grounded in constructivist epistemology and PD methodology.

Building on this foundation, Chapter 2 explores the existing research through a comprehensive literature review. It examines key theoretical frameworks and practical design challenges, identifies gaps in the literature, and proposes areas for future research to advance dignity-conscious design.

Chapter 2: Literature Review

2.0 Introduction

This chapter places the research within the existing literature on dignity in elder care and AT design. It begins by exploring global and Chinese cultural perspectives, highlighting the sociocultural factors that shape older adults' experiences of dignity. It then critically reviews the existing literature on AT design for shower assistance and the alternative dignity-centred design frameworks considered, identifying the gaps that motivate the analytical choices in this research. The chapter then justifies the integrated lens adopted for this thesis, which combines Gallagher's dual dimensions of dignity, Nolan et al.'s senses framework, and continuity theory, as the most appropriate analytical foundation for examining how design can promote dignity in the intimate context of shower assistance.

By examining the tension between objective functional requirements, such as safety and hygiene, and the subjective experiences of self-worth and autonomy, the chapter identifies practical design trade-offs involved in developing AT for elder care. A notable gap emerges from this review: existing scholarship offers limited empirical evidence on how design decisions shape the relational dynamics between older adults and carers and provides insufficient guidance for translating dignity-conscious theoretical principles into actionable design strategies. This gap informs both the structure of the chapter and the methodological approach adopted in this research.

The following section outlines the hermeneutic approach and search strategy employed to synthesise literature across the relevant fields.

2.1 Search Strategy and Hermeneutic Approach to the Literature Review

The literature review employed a multi-database search strategy, including Scopus, Web of Science, CINAHL, and Google Scholar, supplemented by the ACM Digital Library for design and healthcare publications. The search combined core elements, *dignity, elder care, assistive technology, shower chair, participatory design, and person-centred care*. Peer-reviewed literature from 1989 to 2025 was prioritised, as well as foundational texts such as Atchley (1989), Gallagher (2004), Nolan et al. (2006), and grey literature from organisations such as the World Health Organization, United Nations human rights frameworks, and Chinese elder care policy documents. Inclusion criteria prioritised empirical and theoretical works addressing dignity in care, AT design for older adults, and Chinese or comparative East–West elder care; literature on paediatric or acute clinical contexts, or on dignity in non-care settings without transferable relevance, was excluded.

A hermeneutic approach (Boell & Cecez-Kecmanovic, 2010) was adopted in lieu of a systematic review. Systematic reviews require a fixed research question and a reproducible search process (Brignardello-Petersen et al., 2024) and are thus not well-suited for practice-based design research, where questions evolve through engagement with materials, participants, and emerging insights. The hermeneutic approach views the literature review as a circular, interpretive process in which understanding of individual texts and the full body of research mutually influence one another, reflecting the philosophical hermeneutics of Gadamer (1989). This method supports the open-ended nature of practice-based questions, enables exploration into related fields such as design anthropology and the ethics of care, which a limited set of keywords might overlook, and allows the literature to develop in response to the empirical research.

The limitations of this approach must be acknowledged. Its non-linear structure makes it more challenging to present in a systematic approach, and my judgment can introduce bias in the selection. Bradford's law of scattering, as noted by Boell & Cecez-Kecmanovic (2010), emphasises that relevant literature is spread across many sources, not all of which are accessible within the time and scope of a single study. These issues were addressed through the iterative identification of core journals, a strategy common in rigorous hermeneutic reviews.

In line with the hermeneutic circle, the review was not finalised before data collection. An initial review shaped the research questions, theoretical framework, and data collection tools. After a thematic synthesis of the empirical data, the literature was revisited to enhance interpretive coherence and refine the theoretical understanding of the findings. The chapter's three themes—dignity in elder care, including global and Chinese perspectives (Section 2.2); the dimensions of dignity and the structural challenges of maintaining it in institutional care (Section 2.4); and the role of AT design, particularly the shower chair (Section 2.3) were all informed by and reshaped through the empirical work discussed in Chapters 5–8.

2.2 Dignity in Elder Care: Global and Chinese Perspectives

Dignity is a cornerstone of quality elder care, profoundly influencing the well-being of older adults. Although it is recognised as vital for enhancing the lives of vulnerable populations, the understanding and application of dignity can vary significantly across different regions. According to data from the WHO (2019) and the United Nations (Teutem, 2024), approximately 1.4 billion individuals worldwide will be aged 60 years or older by 2030, a number expected to reach 1.7 billion by 2054. This demographic shift is particularly pronounced in China, the context of this research, where approximately 402 million individuals (28% of the population) will

be aged 60 years or older by 2040 (Espinosa, 2024; WHO, 2019). There is a growing need for policies and interventions that prioritise dignity in elder care as this sociocultural context rapidly evolves.

This demographic urgency does not automatically lead to the effective integration of dignity into the design and implementation of ATs. Cultural expectations, such as prioritising filial piety and familial support, strongly influence elder care practices, creating both opportunities and challenges for maintaining dignity. Although various theoretical frameworks for respecting dignity exist, specific guidance on integrating them into the design, implementation, and use of shower chairs is lacking. The following section examines the concept of dignity in elder care from both global and Chinese perspectives, providing the foundation for a detailed analysis of its implementation across various settings.

2.2.1 Global Perspectives on Dignity in Elder Care

Care policies are increasingly prioritising dignity in elder care, as affirmed in the United Nations' Universal Declaration of Human Rights (Baillie, 2008). Research indicates that care settings that implement respect and person-centred strategies enhance relationship dynamics and improve overall care quality (Ahmed & Shalaby, 2014). Attention to dignity is essential for older adults, who often feel vulnerable when seeking assistance, thereby increasing their risk of losing dignity (Holmberg & Godskesen, 2022; Palm et al., 2020). For instance, older adults with mobility issues or cognitive impairments may require assistance with personal care, but they may also feel anxious about losing their independence.

Carers can promote the dignity of older adults by involving them in care decisions and treating them with respect. When carers prioritise the dignity of older adults, it fosters their self-worth and emotional well-being. This dynamic is crucial

for delivering high-quality care, as it enhances interactions between carers and older adults (Er et al., 2018; Gallagher, 2004).

Globally, dignity in elder care extends beyond individual interactions to encompass comprehensive policies that uphold dignity throughout care systems. Countries are increasingly incorporating human dignity into their elder care frameworks to ensure that service delivery is not only respectful but also enhances individual autonomy and quality of life. For instance, the United States' Nursing Home Reform Act stipulates that nursing homes must preserve the dignity of older adults while ensuring their highest practicable well-being (Turnham, 2008). One practical example of dignity-centred care in the United States is the provision of personalised living spaces in nursing facilities, where older adults can bring their personal belongings to maintain their identity and comfort. This approach establishes care standards that protect older adults' rights to a dignified living environment (Turnham, 2008). Nonetheless, these broad perspectives often overlook the role of AT, particularly shower chairs. While these global frameworks promote respect and autonomy, they lack concrete guidelines for implementing dignity-preserving strategies in the intimate and vulnerable context of shower assistance.

Implementing such practices can improve the quality of care, increase satisfaction, empower vulnerable groups, and prevent abuse (Roos et al., 2016). However, the particular ways in which dignity is understood and demonstrated may differ across diverse cultural and socioeconomic settings, necessitating a transition beyond universal policy implementation. For instance, Western philosophy, influenced by Kant, views dignity as a universal quality linked to individual autonomy and moral agency, emphasising equality and personal freedoms (Er et al., 2018). In contrast, in East Asia, dignity in elder care is associated with notions of

honour and face. Respect, hierarchy, and familial roles are prioritised over individual rights, and the dignity of older adults is often tied to maintaining family reputation and community ties (Lee, 2008). Therefore, understanding cultural differences in dignity is essential to quality in elder care.

Even within culturally sensitive approaches, the impact of AT, including shower chairs, on dignity is rarely explored in depth. This literature emphasises principles, policies, and cultural values but largely overlooks practical aspects of AT design, the dynamics of user interaction, and the unequal power relationship between carers and older adults. It thus defines the goals of dignified care but provides limited direction on how to realise it through design. This is the main limitation the current study addresses: the global dignity literature lacks specific design guidance for AT, meaning concrete principles or methods for translating dignity into assistive devices such as shower chairs in the intimate and vulnerable context of shower assistance. The following section explores these cultural contexts, particularly in China, where this research was conducted, providing valuable insights into the study's aims.

2.2.2 Dignity and Elder Care in China

Cultural perspectives on dignity in elder care vary, affecting the quality of care provided. In Western societies, individual autonomy and independence are considered essential for dignity (Wang, 2010). In contrast, Chinese society is deeply rooted in Confucianism, which emphasises filial piety and the duty of adult children to care for their ageing parents (Fan, 2007). While filial piety provides a strong framework for family-based elder care, its impact on subjective dignity within institutional settings is complex and does not consistently produce positive outcomes.

Confucian philosophy emphasises *jinglao* (respect for older adults) and *yanglao* (caring for older adults; Nie, 2015), which are foundational social values that uphold the dignity of older adults. This respect is demonstrated through language, behaviour and shared decision-making (Wang, 2010). Caring for older adults aligns with *xiào* (filial piety), the moral duty to support one's parents in old age—a supreme virtue in Chinese culture (Wang, 2010)—and is further reinforced by Chinese law (Dong, 2016). However, it is unclear how the increasing reliance on AT in elder care affects the expression and fulfilment of these deeply rooted values.

While these values provide a solid foundation for elder care, their impact on AT use and design remains unexplored. This gap raises the question of whether AT supports these cultural values or creates new challenges, such as diminishing the role of filial piety by relying on technology for care. Filial piety emphasises respecting older adults, which can enhance their sense of belonging and significance (Nolan et al.'s senses) by fulfilling needs and upholding dignity. However, in institutional elder care, filial piety can also create tensions. If older adults feel they are imposing on their children by requiring institutional assistance, this perception could undermine their sense of self-worth and lead to feelings of guilt.

While concerns exist, AT can support filial piety by easing the burden on carers and streamlining tasks, allowing for more attentive and personalised care. This potential involves complex challenges:

- **The tension between dependence and interdependence:** Filial piety emphasises the duty of adult children to care for their parents, but reliance on institutional care and AT can foster dependence, undermining the reciprocal nature of caregiving. How can AT be designed to promote interdependence instead of dependence?

- **The challenge of maintaining a feeling of respect in a communal setting:**

How does AT use in shared spaces affect the dignity, shame, or embarrassment of older adults? Does it create opportunities to maintain or undermine self-esteem?

- **The potential for AT to reinforce or replace human connection:** AT can improve efficiency and safety, but does it risk diminishing the emotional and social connections central to filial piety? Can AT be designed to promote meaningful interactions and support care relationships, or does it result in a dehumanised, technology-driven approach?

Demographic shifts and the migration of younger generations to cities for work have weakened traditional family structures, making it increasingly difficult for adult children to meet their filial obligations (Feng et al., 2012). This change has increased the demand for AT in elder care, promoting the dignity of both older adults and carers while addressing cultural considerations.

Despite the growing demand for AT in Chinese elder care, the sector faces significant structural challenges with implications for dignity-conscious design. China's elder care infrastructure has expanded rapidly due to demographic pressures, but this expansion has focused primarily on quantity rather than on ensuring the use of dignity-conscious devices in institutions (Dong, 2016). National policy frameworks have prioritised the expansion of institutional bed capacity rather than the design standards or relational qualities of the AT used within those settings. Furthermore, the rapid shift from family-based to institutional care—driven by urbanisation and the weakening of traditional filial structures (Feng et al., 2012)—has placed older adults and their carers in environments where the tools and devices they depend upon are often designed without consideration of local cultural values or

the relational aspects of dignity that those values reflect. In this context, the shower chair represents a critical but overlooked site of design intervention: a device used in one of the most intimate and dignity-sensitive moments of care yet lacking culturally responsive and empirically grounded design guidance. This practical gap, rooted in the specific structural and cultural conditions of Chinese institutional elder care, directly motivates the research presented in this thesis.

These global and Chinese perspectives on dignity in elder care emphasise the importance of culturally sensitive and dignity-conscious AT design. As China's ageing population necessitates respectful and supportive care, AT designs, especially shower chairs, must incorporate both international rights-based principles and local cultural values. The following section explores the multidimensional aspects of dignity in caregiving scenarios, focusing on carers' roles and the importance of fostering respectful interactions.

2.3 Assistive Technology and Dignity: The Case of the Shower Chair

This section explores how AT design, especially for shower chairs, supports and maintains dignity in elder care. It is based on a thematic synthesis from the study reviewed, focusing on the relational aspects of dignity trade-offs discussed in Chapters 5–8.

AT plays an important role in enabling independence and safety in elder care, supporting both older adults and carers. However, its implementation can also challenge dignity, potentially leading to a dehumanising care experience (Hoenig et al., 2003; Fayazi & Frankel, 2020). Among ATs, the shower chair is a distinctive and under-examined case. Since showering is one of the most intimate and physically exposed care tasks, the shower chair serves as a shared, hands-on medium in which the dignity of both the older adult and the carer is closely linked. This relational

dynamic is uncommon among other ATs. Despite the importance of preserving dignity, how shower chair design influences it, especially for both parties simultaneously, has rarely been examined. The design of shower chairs also affects carers, reducing physical strain (e.g. back pain and fatigue) and decreasing anxiety and stress (e.g. concerns about older adults' safety; Arista & Iqbal, 2020).

Transferring an older adult from bed to a shower chair requires considerable physical effort, which can be eased by features that support barrier-free transfers. These design elements reduce the physical burden on carers and enable more focused interaction with older adults, thereby affecting the interconnectedness of dignity between carers and older adults.

According to Spinelli et al. (2019), few studies have focused on the emotional effects of AT design on all individuals involved. This section examines the relationship between AT and dignity in elder care, with a specific focus on shower chairs, through a review of relevant studies, design principles, and theoretical frameworks.

2.3.1 Defining Assistive Technology in the Context of Showering

The WHO (2023) defines AT as a product or service that maintains or improves independence in mobility, vision, hearing, communication, cognition, and/or self-care. In the context of showering, AT provides safe and comfortable bathing experiences for individuals with limited physical ability. Shower chairs are designed to enhance the independence and safety of older adults while enabling carers to deliver more personalised and efficient support (Swann, 2006).

Although distinct from medical devices, some ATs may be classified as medical devices depending on their primary intended purpose (Medicine and Healthcare Product Regulatory Agency, GOV.UK, 2023). For example, a wheelchair

would be classified as a medical device if used for medical treatment or rehabilitation by individuals with mobility impairments, whereas it would be classified as AT if used to support staff responsibilities. Therefore, shower chairs, which provide support and stability during showering, are considered AT (Swann, 2006). This classification is essential for understanding the shower chair as a tool that empowers users and promotes dignified elder care.

2.3.2 Implementation of Assistive Technology in Elder Care

AT can enhance independence, improve safety, and reduce physical strain on carers (Swann, 2006). Various ATs have been developed to enhance mobility and safety during showering, including adjustable seating systems. Adjustable and stable shower chairs can reduce the risk of falls and enhance physical safety and self-confidence, aligning with the key element of objective dignity. These features also reduce the physical burden on carers, enabling them to provide more compassionate and attentive assistance (Pasupuleti, 2024), thereby increasing job satisfaction and their sense of self-worth.

Despite these potential benefits, the empirical evidence for the effectiveness of existing shower chair designs is more limited than typically believed. A systematic review of interventions to reduce bathing dependency among older adults identified only one study that met strict inclusion criteria—an observation the authors highlighted as a lack of evidence in this area (Golding-Day et al., 2017). In the specific context of shower commode research, Friesen et al. (2012) found that the existing evidence is of low methodological quality and lacks validated measurement tools. Most studies rely on small, culturally uniform, Western samples and employ cross-sectional designs, which restrict the applicability of their results to the institutional elder care setting examined in this study (Rosendal et al., 2022). These

methodological issues highlight the need for more rigorous, context-specific research focused on the design and dignity outcomes of showering AT.

The implementation of shower chairs in elder care settings focuses on safety, usability, and user satisfaction. Chen et al. (2023) found that an ergonomic shower chair design with adjustable features significantly improved older adults' comfort and independence, further enhancing their autonomy. However, to fully realise the benefits of AT, its design must consider more than just functional aspects; it must also incorporate ergonomic principles, which promote health and safety by reducing work-related disorders among carers and the risk of injury for older adults (Arista & Iqbal, 2020). Research indicates that most carers assisting with bathing experience musculoskeletal pain, which often directly impairs their ability to care effectively (Darragh et al., 2013). These results suggest that current shower chairs do not adequately support functional performance, ultimately affecting the dignity of both carers and recipients. This aligns with Gallagher's (2004) observation that carers' well-being is intrinsically linked to the quality of dignified care they provide.

The literature emphasises the importance of user-centred design methods (Szopa & Vanderheiden, 2022), such as PD and co-design approaches, for AT to identify unaddressed challenges and opportunities. This approach involves engaging end users in the design process to enhance acceptance of AT and gain insights into their needs and preferences, enabling the creation of more relevant, personalised solutions (Bradwell et al., 2021; Harris, 2017).

As Howard et al. (2025) suggest, implementing these personalised solutions requires customising AT to accommodate individual needs and preferences. However, the challenges involved must be acknowledged. These processes are inherently complex and resource-intensive, requiring substantial time and expertise from

clinicians and designers, which limits scaling up. To overcome these limitations, it is important to establish partnerships, develop standardised processes, and secure policy support (Howard et al., 2025).

2.3.3 Enhancing Dignity Through Design: Dignity-Conscious Assistive Shower Chairs

Shower chairs impact dignity. Poorly designed shower chairs with limited adjustability and stability can introduce vulnerability and discomfort, whereas well-designed shower chairs promote control, autonomy, and independence (Arista & Iqbal, 2020; Holmberg & Godskesen, 2022). Therefore, the design of shower chairs should prioritise the needs and preferences of both older adults and carers.

Understanding the importance of shower chair design for dignity requires considering what the bathing experience itself represents. Twigg (2000) describes bathing assistance as a form of bodywork—a care practice involving nakedness, intimate touch, and crossing social boundaries—where power imbalances between carer and care recipient are often revealed. This viewpoint considers the shower chair as more than a functional device; it is an important part of a personal and socially aware interaction. It suggests that the quality of such intimate care fundamentally depends on whether carers can establish a 'relational space' that fosters integrity. The study highlights a common issue: existing AT design frameworks mainly focus on the technical aspects of showering help, overlooking the relational and experiential factors that shape dignity during bathing.

An assistive shower chair is most effective when it prioritises physical safety while also promoting emotional well-being and aesthetic pleasure (Swann, 2006). Therefore, a 'function with emotion' design approach can improve older adults' self-esteem (Spinelli et al., 2019) by destigmatising weakness or loss of independence.

While complete privacy may be unachievable in communal living situations, as discussed in Section 2.4.5, a sense of privacy can be achieved through features such as adjustable screens integrated into the shower chair, which promote individual personhood.

2.3.4 Alternative Dignity-Centred Design Frameworks Considered

For the dignity-conscious design approach developed in this research, focusing on dignity, empathy, and care in design practice, several design frameworks were considered but not adopted. Explaining these options clarifies the reasoning behind the final choice and highlights the thesis's contribution to the broader field.

Compassionate design focuses on addressing niche-specific needs and promotes a mindset where designers prioritise users' dignity, empowerment, and security, guiding the concepts developed to maintain dignity, personhood, and well-being (Treadaway et al., 2018; Seshadri et al., 2019). Its advantage lies in the clear moral framework it introduces to the design process. However, for this research, its limitation is that it mainly focuses on the designer's perspective rather than the relational dynamics among users; while compassionate design offers a strong ethical position for how designers should approach vulnerability, it provides limited tools for analysing how artefacts mediate trade-offs between stakeholders, which is the primary empirical focus of this thesis.

Empathy-based design approaches. Empathic design (Postma et al., 2012) and empathetic engineering (Hosking et al., 2015) are related approaches that aim to integrate empathy into the design process. Empathic design highlights that designers should foster a deep understanding of users and their daily experiences—using methods like observation, roleplay, simulation suits, and direct exposure to user limitations—as essential sources of insight. Empathetic engineering builds on this by

integrating empathy directly into the engineering brief, especially for AT, since users may struggle to express their needs. Hosking et al. suggest methods such as immersive user simulations and structured empathetic exposure to help engineers understand users' constraints. They emphasise that designers must develop a deep, felt understanding of disability and dependency to create designs that uphold dignity. The latter approach, in particular, emphasises dignity as a core design priority rather than an ethical add-on after functionality. Both methods effectively identify functional and ergonomic problems, but they focus on the designer's perspective: they are based on what the designer contributes to the brief, rather than on interactions between older adults and carers. Their reliance on simulation-based representations is also a limitation, as these often fail to capture the emotional and psychological facets of dependency (Bolivar et al., 2018b). Since dignity in shower assistance is co-created within the carer–older-adult dyad (Sections 7.1, 7.3), these approaches served as useful orientations but were inadequate as the main method. Therefore, participatory design was maintained as the primary approach for the research.

Service design approaches recognise dignity as a fundamental principle, particularly in healthcare, where it influences both the processes and outcomes (Kim, 2021). It is treated as a universal right, alongside interpersonal care, merit, and autonomy, which are essential for human-centred design. While this framework is effective in identifying dignity-concerning areas across an organisational process, it operates at a level above the individual device, viewing the AT as a single component within a larger service network. Since this research focuses primarily on the device's design and the insights gained through its iterative development, service

design is not the ideal unit of analysis. However, its principles help shape the ecosystem-level strategies discussed in Section 9.3.

None of these frameworks was discarded for quality reasons; each holds value within its specific domain. A participatory, theory-informed approach was chosen for this research based on three context-specific considerations. First, the relational aspect of dignity in interactions between carers and older adults requires a method that considers both parties as equal co-designers, rather than as passive objects of empathetic projection. Second, the sensitive nature of intimate care is inadequately addressed by simulation-based or designer-immersion methods, as dependency cannot be simulated. Third, the iterative, practice-based mode of knowledge creation (Section 3.6) necessitates a methodology where knowledge arises through making, not through predefined values.

2.4 The Essence of Dignity in Elder Care

This section critically examines various aspects of dignity in elder care and the challenges of preserving it in institutional settings. Using Gallagher's dual dimensions of dignity, Nolan et al.'s senses framework, and continuity theory as analytical tools, this section details the theoretical groundwork that guided data collection and was further enriched by the empirical findings presented in Chapters 5–8.

A theoretical foundation is vital for understanding dignity in elder care, as it informs the subsequent analysis of the impact of AT. Gallagher's framework defines the objective (rights-based) and subjective (personally experienced) dimensions of dignity. This understanding highlights the complexities of preserving dignity across different care settings, which are influenced by individual experiences, cultural

values, and social interactions. Integrating these perspectives provides a comprehensive framework for examining how AT affects dignified elder care.

Nolan et al.'s (2006) senses framework complements Gallagher's dual-dimension model by clarifying what underpins subjective dignity in relational practice. Rooted in relationship-centred care within institutional elder care, it highlights perceived senses that are essential for both older adults and carers to experience for care to be considered dignified. Its reciprocal focus is especially relevant here, as this research views dignity during shower assistance as a co-produced outcome between carers and older adults, rather than solely depending on the care recipient.

Continuity theory (Atchley, 1989) was selected as the third analytical lens. Alternative frameworks generally fail to address this study's focus on maintaining identity through established routines. Activity theory (Jensen et al., 2024) assumes a universally desirable mode of ageing and overlooks the diversity in older adults' preferences and abilities. Disengagement theory (Dabrowski et al., 2024) tends to normalise rather than problematise the isolation and dependency often seen in ageing. In contrast, continuity theory distinguishes between internal continuity (a stable self-concept) and external continuity (familiar routines and environments), offering a precise lens to examine how shower chair design decisions either support or disrupt ongoing selfhood. Therefore, these three theoretical frameworks were chosen for this research. They were both analysed separately and integrated to synthesise the empirical findings.

2.4.1 Multifaceted Dignity in Elder Care

Gallagher's (2004) study on the dual dignity dimensions (objective and subjective) provides an essential framework for understanding the complexities of

elder care. However, the practical implementation of this framework requires careful balancing of the tensions between these perspectives (Table 2).

Objective	Dignity	Subjective
Human rights, inherent worth	Basis	Personal experience, perception of self-worth
Universal, unchanging	Nature	Context-dependent, changeable
Rights, autonomy, respect, fairness	Focus	Feelings, self-esteem, sense of control, and individual experiences

Table 2. *Comparison of the Dual Dimensions of Dignity*

Watson (2016) argues that the distinction between objective and subjective aspects does not fully explain how dignity is promoted or diminished in practice through social and relational interactions. Meanwhile, Metz (2024) suggests that rights-based approaches to dignity may underestimate the importance of relational recognition and contextual vulnerability in determining how dignity is actually experienced. Gallagher's framework was selected for this research for two reasons. Firstly, its grounding in nursing and care practice literature, along with its proven use in empirical studies of dignity in care settings (Gallagher et al., 2008; Tranvåg et al., 2014; Høy et al., 2016), makes it highly practical for designing and evaluating AT. This practicality exceeds that of more philosophical frameworks. Secondly, the dual-dimension approach, which distinguishes between objective and subjective dignity, provides a tool for analysing how AT features safeguard inherent rights or influence personal feelings of self-worth, aligning directly with the objectives of this research. A crucial issue is that Gallagher's framework does not fully address the relational nature of dignity—how it is negotiated between carers and older adults rather than solely within individuals. This limitation appears as a central theme in the empirical findings presented in Chapters 5–8.

This tension between the objective and subjective dimensions of dignity in elder care points to the limitations of a simplistic approach. A critical analysis of the multifaceted nature of dignity is essential to balance objective care principles with individuals' subjective experiences and foster self-worth, respect, and well-being among older adults and carers. Therefore, when designing a shower chair, features that uphold rights (objective dignity) should be incorporated alongside customisable elements that cater to individual preferences and enhance self-worth (subjective dignity).

2.4.2 Objective Dignity in Elder Care

In elder care, maintaining objective dignity is a fundamental ethical responsibility, independent of personal achievements or social status. A key aspect is supporting autonomy by enabling older adults to make decisions and retain control over their lives without interference (Baillie, 2008; Gallagher, 2004).

However, equating objective dignity solely with autonomy presents limitations and potential ethical concerns. This perspective assumes that individuals can always understand their best interests, which may be infeasible in elder care. For example, older adults with dementia may experience cognitive decline, resulting in compromised decision-making abilities (Jakobsen & Sørli, 2010). This challenge emphasises the need to reconsider the relationship between practical limitations and dignity in elder care (Bal, 2017), particularly given the need for paternalistic interventions in certain circumstances (Weicht, 2010). Objective dignity frameworks align theoretical rights with practical care, guiding critical aspects of quality care in elder care facilities (Wachholz & Giacomini, 2023; Table 3).

Framework	Impact	Alignment
Standardisation of Care Practices	Ensures all older adults are treated with respect and dignity	Translating theoretical rights into human rights-aligned practices
Person-Centred Care	Prioritises older adults' needs and preferences over the care process	Narrowing the gap between theory and practice
Training and Education	Helps carers understand the importance of dignity and implement it effectively	Translating theoretical concepts into practical actions
Policy Development and Implementation	Guides the development of policies protecting older adults' rights	Providing a clear pathway for care providers to follow
Monitoring and Evaluation	Ensures care practices meet dignity standards	Allowing for continuous improvement and alignment with dignity principles

Table 3. *The Impact and Alignment of Objective Dignity Frameworks to Dignified Care Practice*

Despite their importance, these frameworks face challenges. Firstly, legal and regulatory issues persist, as older adults' vulnerabilities require robust legal protections to safeguard their dignity. Existing legal frameworks may be insufficient or poorly enforced, resulting in rights violations and hindering the implementation of human rights standards in elder care (Wachholz & Giacomini, 2023; Hughes, 2005). Secondly, raising awareness and promoting empowerment are crucial. Older adults may internalise their vulnerability and accept diminished rights. Thirdly, cultural and systemic barriers, such as Confucian ideals emphasising filial piety in China, may impede the enforcement of older adults' rights (Chen & Chung, 2002; Nie, 2015). Therefore, shower chair design should promote respect for individual rights and autonomy, while also acknowledging the need for assistance.

2.4.3 Subjective Dignity in Elder Care

Several alternative frameworks have been suggested to understand the subjective dimensions of well-being and quality of life in care settings. Lenart (2014) proposes that a care-focused view of personhood highlights the importance of maintaining personal identity and recognises relationships as essential for well-being, providing a framework closely aligned with care ethics. Person-centred care frameworks offer practical guidance for care practices (Choperena et al., 2022); however, they focus more on care procedures and clinical interactions than on the design of the physical artefacts through which care is mediated. Nolan et al.'s (2006) senses framework was chosen over other options for three key reasons. First, unlike frameworks that mainly focus on the care recipient, it explicitly includes the dignity and well-being of carers alongside those of older adults, which is crucial for studying the relational dynamics between the two groups. Second, its six senses—security, belonging, continuity, purpose, achievement, and significance—serve as evaluation criteria when analysing design features, providing a practical link between theoretical principles and design decisions that philosophical frameworks do not offer. Third, it builds on Gallagher's subjective dimension, avoiding the need for an additional theoretical link and allowing seamless integration into the study's analytical framework.

Unlike objective dignity, which emphasises inherent worth, subjective dignity recognises that relationships, interactions, and environments influence an individual's perception of self-worth, which is experienced as a personal feeling rather than as a moral judgement (Tranvåg et al., 2014). An older adult's perception of being treated with respect is essential to their mental and emotional well-being and ultimately affects the quality of their care (Wachholz & Giacomini, 2023). For

instance, a carer offers subjective dignity by providing attentive care to an older adult with dementia, respecting their preferences, engaging in meaningful conversations about past experiences, and adapting communication to meet their needs. In the context of shower assistance, it is important to establish routines and personalised cleaning preferences to enhance the individual's experience.

Respect is fundamental to dignity, and its expression is shaped by cultural norms (Hall et al., 2013). As shower chairs are often used in care facilities, this context presents a significant design challenge: the need to reflect cultural values and demonstrate respect. Societal attitudes that value youth and independence can also negatively affect perceptions of dignity among older adults, potentially leading to feelings of stigmatisation (Oosterveld-Vlug et al., 2013).

It is important to recognise that Nolan et al.'s senses framework, which provides much of the operational detail regarding the subjective aspects of dignity discussed in this section, was primarily developed within a Western institutional care setting. Its applicability to the Chinese elder care context in this study should be carefully considered, especially given the differences in filial piety and family-mediated care that influence what older adults in China perceive as dignity-affirming, as explained in Section 2.2.2. This cross-cultural aspect is crucial when using the senses framework as an analytical tool in this research.

Given the impact of care settings on perceived dignity, a person-centred care approach prioritising individuals' needs, preferences, and values is crucial (Boyle, 2007; Roos et al., 2016). This approach directly supports the subjective experience of dignity, where an individual's sense of self-worth is profoundly influenced by their relationships and environment (Ahmed & Shalaby, 2014). When this is translated into design features for a shower chair, several implications arise.

I derived the following implications from the synthesis of the literature reviewed above, rather than from any single source. Firstly, autonomy must be supported through adjustable features allowing users to control their showering experience. Secondly, personalisation is essential for addressing individual preferences, health conditions, and personal history, promoting comfort and a sense of continuity. Thirdly, aesthetics can enhance self-worth and perceived independence by shifting from clinical designs to options that showcase empowerment and reduce stigma. However, organisational culture, time constraints, and heavy workloads can hinder the practical implementation of person-centred care (Wachholz & Giacomini, 2023), potentially jeopardising dignity. Therefore, subjective dignity in elder care—an interplay of autonomy, personalisation, and aesthetics—is influenced by the relational and organisational context of the care environment, rather than functioning as a standalone factor.

2.4.4 The Interplay Between Objective and Subjective Dignity in Elder Care

Understanding the interplay between objective and subjective dignity is crucial for elder care (Table 4). Objective measures, such as respecting rights and ensuring safety, are essential but insufficient without addressing older adults' emotional needs. This interplay provides the foundation for more dignified caregiving.

Feature	Objective dignity	Subjective dignity	Interplay
Foundation	Human rights, inherent worth	Personal experience, perception of self-worth	Objective dignity provides the framework; subjective dignity shapes experience.
Influence on care	Standards, policies, resources	Individual needs, preferences, and cultural context	Objective standards must be adapted to meet subjective needs for respectful care.
Impact on well-being	Reduced risk of abuse, improved access to care	Increased self-esteem, emotional well-being	Dignity enhances physical and mental health.

Table 4. *The Interplay of the Dual Dimensions of Dignity in Elder Care*

By emphasising human rights, objective dignity provides a universal framework for respect and protection (Gallagher et al., 2008), regardless of circumstances. It supports the subjective experience of dignity, in which individuals feel valued for their identities and sense of self. In caring environments that respect personal histories and preferences, older adults feel heard and valued.

Carers often face dilemmas in balancing objective care standards with the subjective needs and preferences of older adults. For example, restricting self-care to prevent safety risks can reduce autonomy and subjective dignity (Gallagher, 2004). In ethically challenging situations, carers must weigh competing priorities, using ethical frameworks and person-centred decision-making to protect rights while respecting individual preferences, values, and self-determination. An older adult's sense of self-worth can also significantly affect their willingness to engage with care and trust carers and influence their health and well-being.

In the reciprocal nature of care relationships, the two dimensions of dignity continuously interact and influence each other, shaping the holistic experience of dignity in elder care (Zirak et al., 2017). Therefore, the design of shower chairs should balance objective safety considerations with subjective experiences such as comfort, autonomy, and control, fostering an environment in which older adults preserve their sense of self.

Although the literature explains the significance of this interplay in theory, it offers limited empirical guidance on how to mediate these competing dimensions in the specific context of AT design—a gap this research directly addresses.

2.4.5 Challenges to Maintaining Dignity

Maintaining dignity in elder care is challenging, as it involves navigating power dynamics; institutional limitations; and the loss of privacy, autonomy, and social connections. This section explores these challenges, building upon the foundational understandings established in the previous sections and in Chapter 1.

Loss of Privacy and Personal Space. Prioritising efficient space usage can restrict older adults' control, privacy, and autonomy (Gallagher et al., 2008). Financial constraints affect personalisation options in communal care settings (Dong, 2016). For instance, an elder care facility in Zhongshan, China, offers various room types at different prices, influencing privacy choices. In China, traditional filial obligations often make children responsible for payment, which can be a significant financial burden. To ease this burden, older adults may opt for less private, more communal accommodations, compromising their sense of dignity. This highlights the importance of shower chair designs that enhance privacy in shared spaces, using features such as foldable screens.

Lack of Autonomy and Decision-Making. Institutional policies that reduce older adults' control over their lives can compromise their dignity. Older adults in care facilities often lack autonomy over basic decisions, such as when to wake up, what to eat, or how to organise their daily activities (Dong, 2016). However, focusing solely on autonomy may pose risks, particularly for those with cognitive impairments who require support in decision-making (Pageau et al., 2023). This tension raises questions about how to respect older adults' independence and decision-making in care practices—whether these are intrinsically linked to their ability to choose or are fundamental values that deserve respect regardless of capacity (Enzo et al., 2019). Promoting relational autonomy that considers older adults' capacity may enhance dignity and address the ethical challenges faced by carers. Therefore, shower chair design should involve adjustable components that allow older adults and carers to customise the chair to meet their needs.

Diminished Social Connections and Isolation. Limited social connections can lead to feelings of isolation, which negatively affect mental health and perceived dignity (Oosterveld-Vlug et al., 2013). Research indicates that a lack of meaningful interactions often increases rates of depression and anxiety among older adults, further undermining their sense of dignity (Hall et al., 2013). These social challenges also affect their relationships with their families, with whom they may struggle to maintain meaningful connections due to structural and logistical barriers (Boyle, 2007). Therefore, it is crucial to promote meaningful social interactions and community connections, reinforcing older adults' sense of value. Incorporating mobility features that improve ease of social interaction and facilitate communication may help address diminished social connections.

Power Dynamics. Dependence on carers can create power dynamics in relationships between carers and older adults, potentially undermining older adults' autonomy and dignity (Hughes, 2005). For example, some older adults reported that nurses were 'bossy' or treated them as if they were unable to make decisions (Šaňáková & Čáp, 2018). Confucian-influenced Chinese culture prioritises seniority as the primary source of power, potentially creating issues between older adults and carers by giving older adults control over social interactions (Fan, 2007; Nie, 2015). When carers fail to meet the Confucian cultural expectation of respect, it can exacerbate the power imbalance and diminish the self-identity and dignity of older adults. A caregiving environment that promotes mutual respect is crucial in reducing power imbalances and aligning with cultural values (Wachholz & Giacomini, 2023). As shower assistance is an integral part of the relationship between older adults and their carers, incorporating accessible, user-friendly features that empower older adults to maintain greater autonomy during showers is essential.

Institutional Constraints. Prioritising administrative efficiency at the expense of personalised interactions can compromise the dignity of older adults (Šaňáková & Čáp, 2018). Several studies have found that carers experience time pressure, resulting in depersonalised interactions with older adults (Hall et al., 2013; Jakobsen & Sørli, 2010; Wachholz & Giacomini, 2023). For instance, the emphasis on quick meal service in elder care facilities may limit carers' opportunities to engage in meaningful conversations with older adults during mealtime, thereby undermining the social aspects of dining. This example underscores the substantial institutional constraints that may compromise personalised, dignity-preserving care. Therefore, operations must incorporate dignity-preserving practices, such as designing physical spaces for personalised interactions and implementing AT to

streamline workloads. Given the time constraints carers face, shower chairs should be user-friendly and efficient, reducing their workload while enabling personalised, dignified interactions. Achieving this balance is not about fixed features; it depends on the specific, relational interactions between carers and older adults during showers. Identifying and addressing these trade-offs requires a participatory, practice-oriented design process, where both carers and older adults collaboratively develop and test the device through iterative making, rather than having it designed for them.

2.5 Chapter Summary

This chapter has established three interconnected arguments that shape the empirical and design focus of this research. First, dignity in elder care is not a singular concept but rather a dynamic tension between objective dimensions such as rights, safety, and institutional standards, and subjective aspects shaped by personal experiences, cultural backgrounds, and relationships. Both are essential, yet the literature offers limited empirical guidance on balancing them in AT design practices. This empirical gap is addressed in Chapter 5, where the two dimensions are practically examined and turned into dignity-conscious design principles (Sections 5.1.1 and 5.2.3), and in Chapter 8, which reassesses that balance based on the findings (Section 8.1.1). Second, the Chinese elder care context, while sharing universal concerns about dignity, also has unique cultural and structural factors, such as filial piety, rapid shifts to institutional care, and the lack of dignity-focused AT standards that shape how dignity is experienced and challenged during shower assistance. This contextual gap is filled by the situated participatory study carried out in Chinese elder care facilities (Chapters 4–7), which is further discussed in terms of cultural values, privacy, and generalisability (Sections 8.5 and 9.4.3). Third,

although existing research recognises that AT, especially shower chairs, can positively or negatively impact dignity, it does not adequately address the relational dynamics between older adults and carers that determine whether dignity is preserved. This theoretical and relational gap is addressed empirically through the dyadic evaluation of the prototype (Sections 7.1–7.3) and conceptually through the updated relational dignity model discussed in Section 8.4 and the conceptual insights presented in Chapter 9 (Section 9.1). Together, these three gaps highlight the need for an approach to AT design that is practical, relational, and culturally sensitive, while also preserving the dignity of all involved. The following chapter outlines the participatory, practice-based methodology used to address these gaps.

Chapter 3: Methodology

3.0 Introduction

This chapter outlines the study's methodological framework within its philosophical and practical context. It is important to clarify from the beginning that this is a practice-based design PhD, focused on generating new knowledge through the iterative and reflective design of a dignity-conscious shower chair. This is not a product development project targeting a market-ready device nor a clinical trial testing predefined hypotheses in controlled settings. It presents the epistemological and ontological stance to ensure rigour and maintain clear boundaries. It begins by explaining the philosophical framework: a constructivist approach emphasising that knowledge is actively constructed through interactions between the researcher, participants, and context (Mugambi, 2018). The theoretical frameworks are not simply applied as predetermined tools but are instead critically analysed and integrated, with user perspectives incorporated throughout the research process. This stance informs the choice of PD, which is justified for exploring the lived experiences of dignity in elder care, as the primary methodology. Strategies are employed to ensure the validity, reliability, and trustworthiness of the findings. This approach enhances understanding of the relational and contextual nature of dignity in elder care by focusing on interpretive experiences rather than solely measuring variables (Pageau et al., 2023; Tranvåg et al., 2014). This chapter concludes by highlighting how these frameworks guide data analysis and interpretation within the PD process.

3.1 Epistemological and Ontological Stance

This research adopts a constructivist epistemology, acknowledging that knowledge about dignity in elder care is actively constructed through engagement

and interaction within specific social contexts rather than passively absorbed (Høy et al., 2016; Ignacio & Paras, 2024). This position suggests that ‘reality’ is a social construct, implying that older adults’ perceptions of dignity in showering are shared mental frameworks that can be changed. This perspective suggests that there is no singular objective ‘truth’ to be discovered about dignity; instead, knowledge is contextual and bound by personal and collective experiences, and individuals assign subjective meanings and interpretations to their experiences (Jovanovic et al., 2021; Mugambi, 2018).

This epistemological stance aligns with the ontological relativist perspective, which acknowledges that reality is not inherently given but instead constructed through the categories and concepts individuals use to interpret their experiences (Hautamäki, 2020). Therefore, dignity within the reality of elder care emerges from relational dynamics, a socially constructed phenomenon shaped by cultural values, power dynamics, and individual interactions within the elder care environment (Stevens et al., 2021; Tranvåg et al., 2014). This constructivist perspective guides the design decisions in this research by highlighting the following:

- Dignity as Relational:** Constructivism highlights how intersubjective norms shape identities and values, aligning with the relational perspective of dignity. As Er et al. (2018) illustrated, dignity is constructed through social interactions and shared understandings. Design decisions should reflect this understanding by considering how AT influences interactions between older adults and carers. For example, decisions regarding adjustability prioritise individual safety (objective dignity, as seen in Spinelli et al., 2019) while also enhancing usability to improve the quality of the caring relationship (subjective dignity, as highlighted by Wachholz & Giacomini, 2023).

- **Situated Knowledge:** Dignity is rooted in social and cultural contexts and influenced by norms, values, and the judgements of others. As Nie (2015) noted, these factors shape personal choices and behaviours in China. This awareness informs design decisions about local values, including filial piety in Chinese culture (Fan, 2007); power dynamics within hierarchical relationships in elder care facilities (Chen & Chung, 2002); and practical constraints within elder care facilities, such as limited staffing resources (as discussed in Section 2.4.5).
- **Co-Construction of Meaning:** Design decisions should involve dialogue and negotiation among stakeholders. PD methods are employed to ensure that these decisions reflect a shared understanding of dignity and that the needs and preferences of those involved are addressed (Spinuzzi, 2005). This shared understanding is essential because a feature designed to benefit one party should not adversely affect another party.

This constructivist foundation necessitates a qualitative methodological approach to capture the diverse, subjective understandings of how AT impacts dignity among older adults and carers.

3.2 Justification for Participatory Design

Considering the constructivist epistemology and the socially constructed nature of dignity, PD was chosen as an appropriate methodology. PD offers a framework for understanding diverse realities by actively involving stakeholders—older adults and carers in this research—in the design process (Wilkinson, 2011; Figure 6). Including carers and older adults as active co-designers exemplifies the constructivist principle that knowledge is co-created through interaction. A note on terminology is necessary: throughout this thesis, ‘participatory design’ is used to

refer to the study's methodology. When 'co-design' appears, it signifies the same overarching approach of designing with users and is regarded as a closely related synonym from the broader design literature, rather than a distinct method.

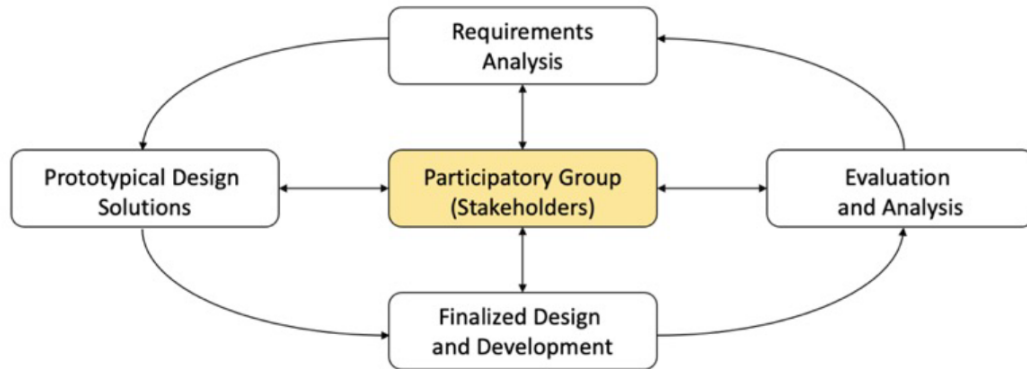


Figure 6. *Iterative Participatory Design Process*

PD directly supports the research objectives in the following ways:

- **Knowledge Co-Creation:** PD implements constructivism by involving stakeholders as active co-researchers who co-create knowledge through their participation in the design process (Spinuzzi, 2005), ensuring that their lived experiences and perspectives directly inform the design of the assistive shower chair.
- **Addressing Power Imbalances:** PD empowers the voices of older adults and carers equally during discussions, allowing exploration of hierarchical relationships within elder care (Šaňáková & Čáp, 2018) and fostering fair and cooperative development of technology.
- **Understanding Situated Dignity:** PD aligns with 'situated knowledge', emphasising local context in design and co-creating solutions with local communities (Orpwood et al., 2007; Spinelli et al., 2019). Understanding

social, cultural, and environmental influences on elder care environments is essential for developing effective design solutions.

PD also has limitations. Firstly, assertive participants can overshadow quieter voices, biasing the needs and perspectives. For instance, carers can influence decisions more than older adults with cognitive or communication challenges. Secondly, convenience samples may not reflect the broader user population (Subedi, 2021). Thus, the results gathered may not be representative. Thirdly, the effectiveness of PD depends on the quality of user involvement; even with genuine participation, limitations remain. To reduce the risk of bias, the research employed strategies—reflexive practice, data triangulation, and member checking—as outlined in Section 4.6.

3.3 A Triadic Framework for Participatory Inquiry

PD was chosen as the main approach for this research to address the intricate nature of dignity. As discussed in Section 2.4, dignity is a values-based and relational phenomenon that cannot be captured through detached observation or standard metrics. Therefore, the research methodology required a flexible approach that could balance technical design aspects with the power dynamics and interpretive complexities of the elder care environment. This section outlines the three layers of this framework: moving from transactional to relational design logic, managing values and power in participatory research, and applying Gadamerian hermeneutics to manage preconceptions.

3.3.1 Moving from Transactional to Relational Design Logic

Design decisions in product development are typically supported by structured, evaluative methods. These include the Pugh matrix, a concept selection process using comparative scoring matrices (Schmidt, 2010), the analytic hierarchy

process for pairwise evaluation of the relative importance of criteria and alternatives (Khazaii, 2016), and requirements prioritisation frameworks such as MoSCoW (Miranda, 2022) and the Kano Model (Sauerwein et al., 1996) for needs (product requirements) differentiation. While these tools offer analytical clarity and engineering precision, they generally assume a stable, predefined set of transactional criteria rather than a relational view of the user.

Designing a dignity-conscious assistive shower chair involves addressing complex technical, relational, and value-based issues. The above-mentioned tools alone are inadequate because dignity is not a simple attribute that can be measured by scores; it is a relational phenomenon visible only through direct dialogue between older adults and carers (Gallagher, 2004; Nolan et al., 2006). Converting a dignified experience into a numerical score contradicts the constructivist approach of this research. Moreover, as Sanders and Stappers (2008) note, purely evaluative methods often view users as mere respondents rather than as active co-creators, which contradicts the principles of PD (Spinuzzi, 2005).

Nevertheless, this research does not reject these structured methods. Instead, informed by Candy and Edmonds' (2018) practice-based research approach, the research integrated these tools into the design process to facilitate the co-creation of knowledge and the physical artefact. Table 5 outlines how the core principles of each structured tool were implemented in the participatory process.

Structured method	Logic of the method	How embedded in this research
Comparative scoring & weighting (Pugh matrix)	Comparative scoring of concepts against weighted criteria.	Not adopted formally; instead, used to evaluate three existing shower chairs based on dignity-informed criteria in Stage 2 (Section 5.2.2), identifying what should be maintained or challenged.

Requirements prioritisation (MoSCoW)	Prioritisation of requirements into must/should/could/won't have.	Safety-critical requirements are considered 'musts' before participant evaluation, while relational and aesthetic features are negotiated as 'shoulds' and 'coulds' through iterations in Stage 4 (Section 5.4).
Needs Differentiation (Kano model)	Distinguishes between must-be, one-dimensional, and attractive features	Used interpretively during thematic synthesis (Section 4.5) to categorise participant feedback and inform which features are 'must-be' (e.g. safety) or 'attractive' (e.g. aesthetic cues).
Specifications Mapping (AHP)	Translates user requirements into engineering characteristics via comparison.	Not adopted formally; instead, its core idea of requirement-to-specification mapping was developed through prototype iteration (Chapter 6).

Table 5. *The Logic of Structured Design Decision-Making Methods in the Research*

3.3.2 Managing Values and Power in Participatory Research

Participatory design is inherently value-laden and necessitates a deliberate redistribution of decision-making authority (Bratteteig & Wagner, 2016). In this research, power asymmetries were controlled across multiple levels: carers' practical authority over older adults, facility management's authority over carers, and my epistemic authority. These dynamics were further complicated by the Chinese institutional context, where hierarchies are deeply rooted in age, gender, and Confucian filial piety (Chen & Chung, 2002; Fan, 2007). To address these imbalances and clarify them analytically, the following procedural strategies were implemented:

- **Separation of Discussions:** Focus groups were conducted separately for older adults and carers. This created 'free spaces' where less powerful

stakeholders could articulate concerns without fear of contradicting their superiors or carers (Bratteteig & Wagner, 2016).

- **Flattening of Conversational Hierarchy:** I adopted a learner's role, using generative visual tools such as care activity cards and 3D renderings. These tools helped redirect authority from verbal explanation to shared physical references (Sanders & Stappers, 2008).
- **Iterative Validation and Disagreement Encouragement:** Consensus was not the default objective. Instead, diverse viewpoints were protected by deliberately encouraging disagreement and conducting follow-up semi-structured interviews to reveal opinions not expressed in group discussions.

3.3.3 Reflexivity and the Fusion of Horizons: A Gadamerian Position

Gadamer's hermeneutic view (1989), which suggests that understanding is never preconception-free, aligns with the iterative nature of PD: pre-understandings, or 'prejudices,' are the foundational conditions that enable understanding. In this study, the goal in interpretive work was not to eliminate my prior biases as an industrial designer but rather to allow them to be 'at risk' during interactions with participants. This process leads to 'fusion of horizons', as Gadamer calls it, in which my perspective and the participants' lived realities are brought into genuine relation. Design, in this context, is a hermeneutic activity where the horizons of the designer and user gradually merge through repeated iterations and are applied through a reflexive practice:

Reflexive Statements: At the beginning of each phase, I noted current assumptions about dignity and the expected design outcome, such as the preliminary shower chair design, as discussed in Section 5.2.1. These were reviewed at the end of

the phase to determine where participant interactions had affirmed or challenged the initial assumptions (Finlay, 2002).

- **The Hermeneutic Circle:** Data analysis was performed iteratively, switching between individual participant feedback and the evolving framework of relational dignity. This approach prevented early biases during initial interpretation and facilitated negative-case analysis, enabling opposing data to influence the design decision rather than being ignored (Morse, 2015). By synthesising these logical, ethical, and philosophical layers, the methodology ensures that the resulting ‘dignity-conscious’ design is not merely a functional product but rather the result of a rigorous, ethically responsive, and interpretively deep inquiry into the care relationship.

3.4 Theoretical Frameworks as Analytical Lenses

This research employed theoretical frameworks as analytical lenses to guide the investigation and interpret findings from the PD process. These frameworks—Gallagher’s dual dimensions of dignity, Nolan et al.’s senses framework and continuity theory—provided a structured approach to data collection, analysis, and the interpretation of stakeholder perspectives. This approach facilitated an understanding of dignity in shower assistance and identified how design features can either support or hinder stakeholders’ dignity (Figure 7). I created this diagram to integrate the three theories into a single analytical lens.

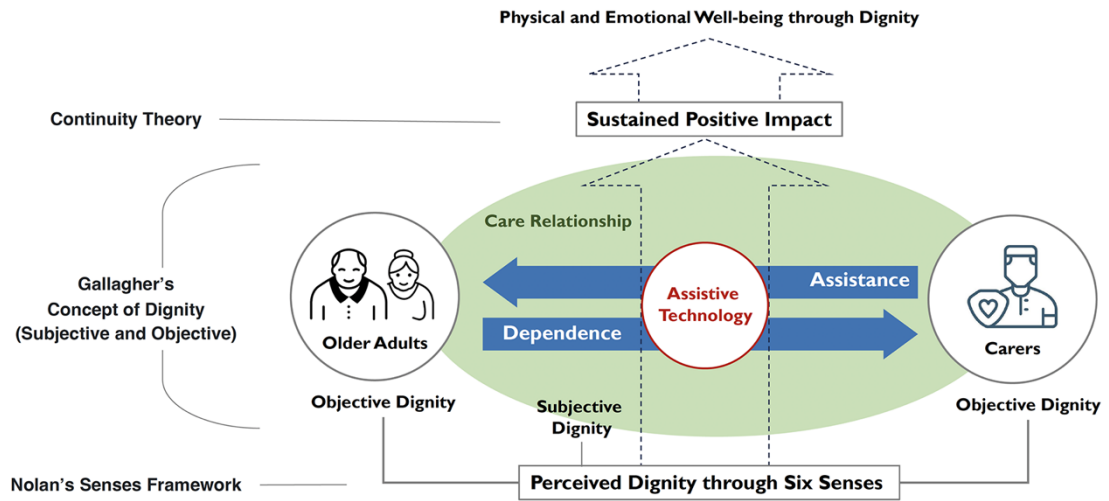


Figure 7. *Integration of Three Critical Theories*

3.4.1 Gallagher's Dual Dimensions of Dignity

Gallagher's (2004) framework, which distinguishes between objective and subjective dignity, served as an analytical lens guiding data interpretation in Research Phase 1, which included focus groups (Section 5.1) and shower chair evaluations (Section 5.2.2). It ensured that the analysis considered both inherent human worth and individual experiences of dignity.

The objective dimension of dignity emphasised design features that promote safety and security and assessed their effectiveness in protecting inherent worth and rights. The introductory focus groups explored carers' physical and emotional challenges and aimed to understand how they ensure older adults' rights in their daily routines. Gallagher's objective dimension directly influenced the evaluation of factors supporting human rights practices with shower chairs.

The subjective dimension framework guided the analysis of data on individuals' experiences and self-worth related to shower assistance. For example, discussions about daily care routines led to an exploration of factors supporting

perceived care value and dignity. To investigate how shower chair design can enhance dignity, stakeholders' subjective experiences were assessed in relation to Nolan et al.'s senses framework.

This dual-dimension approach identified tensions between objective and subjective aspects in the design of a dignity-conscious shower chair. It also provided a framework for developing the physical prototype (Chapter 6), highlighting the priorities among different objectives and demonstrating how data influenced the design process.

3.4.2 Nolan et al.'s Senses Framework

The senses framework developed by Nolan et al. (2006), which identifies six key senses—security, belonging, continuity, purpose, achievement, and significance—guided the interpretation of qualitative data from older adults and carers in Research Phase 1. The findings relate to Research Question 1 and demonstrate how the framework's emphasis on interconnected senses can help identify how design elements influence subjective experiences of shower assistance. A more detailed explanation of the framework is provided in Appendix A.

- **Stage 1: Introductory focus groups (Section 5.1)**

The senses framework structured coding of the focus group and interview transcripts by sense:

Security: Comments relating to safety, stability, the fear of falling, or trust were coded as 'security'. These aligned with questions such as 'To what extent do you feel that the safety of these shower chairs is improved or compromised when considering their effect on older adults?'

Belonging: Comments on social interaction, isolation, connection, and maintaining relationships were coded as 'belonging' during the data

collection for Research Question 1. This coding was also applied to the evaluation of design features that facilitate connection with others, such as the sitting arrangement.

Continuity: Any mentions of maintaining routines, preferences, or familiar elements from past experiences were coded under ‘continuity’.

Purpose, achievement and significance: These senses were often grouped together because they relate to feelings of self-worth, emphasising experiences during which older adults or carers perceived themselves as capable and/or valued.

- **Stage 2: Preliminary shower chair design and a user-centred evaluation of shower chairs (Section 5.2)**

The senses framework shaped the initial design parameters. Although the design was primarily ‘function-centric’, consideration was given to how design elements could improve care experiences, such as security (e.g. a stable frame and reliable brakes) and continuity (e.g. incorporating familiar features). Nolan et al.’s framework also guided interview questions to assess existing shower chairs. For instance, the interviews included questions about features enabling a comfortable shower (comfort), self-control (control), and safe transfer (security). Feedback analysis indicated potential design improvements.

3.4.3 Continuity Theory

While Nolan et al.’s senses framework includes the valuable ‘sense of continuity’, continuity theory (Guedes & Melo, 2019) provides a deeper understanding of how individuals adapt to change while maintaining their sense of self over time (a more detailed explanation of the framework is provided in

Appendix A). This perspective guided the research beyond routine identification, focusing on how AT can support continuity during significant life transitions in elder care settings. The focus on internal continuity—preserving personal identity, values, and beliefs—involved understanding participants’ daily routines and showering habits before they entered the elder care facility.

In contrast, external continuity—maintaining familiar social roles, environments, and activities—was explored through the design of the shower chair, which could help older adults retain a sense of connection to their past lives in their new environment. For instance, questions about shower preferences aimed to determine whether participants valued familiar routines (internal continuity) or safety protocols (external continuity). This dual perspective on older adults’ subjective experiences helped identify design opportunities that preserve self-identity and routines.

3.5 Synthesising Theoretical Frameworks for Analytical Application

To implement the theoretical frameworks in this PD methodology, a synthesis process was integrated to combine abstract ideas with practical design considerations. The initial conceptual model (Figure 8) for shower chair design served as a roadmap for analytical application, ensuring a cohesive and theoretically grounded approach throughout the research. This model was further developed based on the findings of the study and is presented in Section 8.4.

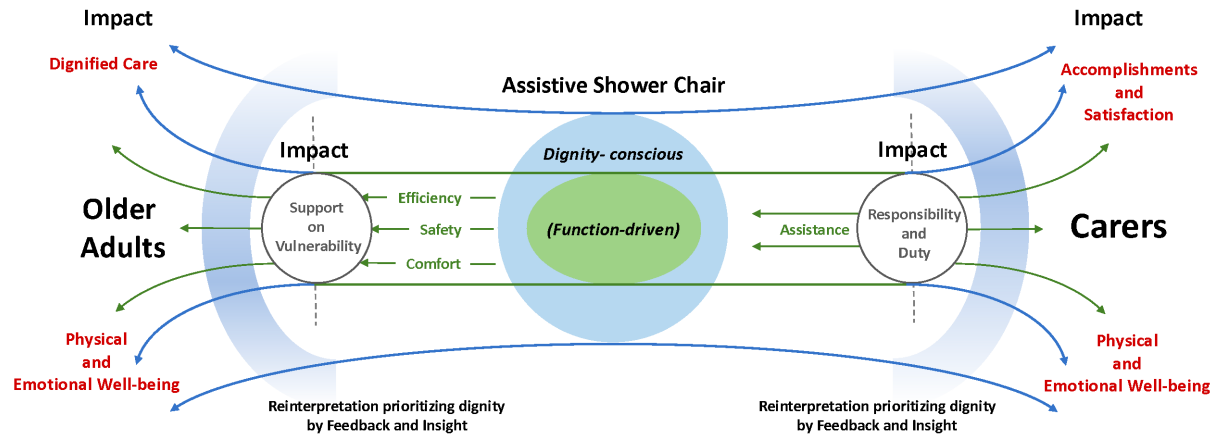


Figure 8. *Initial Conceptual Model Applied as an Analytical Roadmap for the Participatory Design Process (reproduced from Figure 5)*

The synthesis process involved several key steps:

1. **Comparative analysis:** Each theoretical framework was analysed to identify key concepts and their implications for elder care, particularly in the context of shower assistance.
2. **Identification of overlapping themes:** Overlapping themes and complementary aspects across the frameworks were identified. For example, the code 'safety' was incorporated into Gallagher's objective dimension of dignity, Nolan et al.'s sense of security, and the continuity theory's focus on stability.
3. **Development of design principles:** Design principles derived from the synthesised themes guided the evaluation of existing shower chairs, the refinement of design ideas, and the assessment of how design decisions affected stakeholders' dignity. For instance, the emphasis on physical safety and emotional security led to a design principle focused on stable structure.

4. **Creation of design element categories:** The synthesised design principles were organised into categories: adjustability and personalisation, intuitive and easy-to-use controls, and materials and ease of cleaning. This approach addressed functional requirements and both objective and subjective dignity.

This synthesis process allowed the theoretical frameworks to serve as analytical lenses throughout the research, guiding data collection, analysis, and interpretation, ensuring that the assistive shower chair design was grounded in theoretical insights and stakeholders' lived experiences.

3.6 Integration of Practice-Based Methodology

This research extended beyond traditional qualitative methods by explicitly incorporating a practice-based approach. In line with Candy and Edmonds (2018), the design and development of the shower chair prototype functioned not only as a research result but also as a key method of investigation. The assistive shower chair design outcome demonstrates a novel or significantly refined approach to dignity-informed shower assistance not previously documented in existing ATs, along with new design principles or configurations and a validated response to unmet needs identified through practice-based inquiry. Originality resides not only in the final device but also in the documented sequence of design decisions, the description of failures and responses that led to redesigns and improved outcomes, and the articulation of why certain design solutions succeeded or failed in practice.

This PhD contributes to knowledge by:

- Demonstrating how iterative design practice can function as a rigorous dignity-informed research method in AT.
- Producing an assistive shower-transfer device that embodies new, practice-derived knowledge about dignity-related issues in care settings.

- Enabling the visibility and transferability of design knowledge that would not emerge through theoretical or empirical study alone.
- Extending understanding of how ATs can be developed through practice-based inquiry rather than linear problem solving.

The iterative processes of designing, prototyping, and user testing (described in Chapters 5 and 6) played a vital role in creating knowledge, offering insights that would have been inaccessible through theoretical or observational methods alone. To effectively integrate practice-based elements into the study, the methodology was structured as detailed in Table 6.

Element	Description
Embodied Knowledge	The shower chair prototype embodied design decisions informed by the existing literature on dignity.
Learning Through Making	Each design iteration provided valuable insights into the practical challenges and limitations of implementing theoretical concepts in a real-world context.
Reflexive Design	The process of analysing user feedback, identifying design flaws, and developing new solutions fostered a deeper understanding of the complex interplay between technology, dignity, and caregiving relationships. This iterative feedback process directly shaped the development of the shower chair prototype towards the final design.
Iterative Design and Experiential Knowledge	Experiential knowledge gained by each new iteration informed the subsequent stage.

Table 6. *Practice-based elements of the methodology*

3.7 Chapter Summary

This chapter outlined the methodology used to explore how AT—namely shower chairs—can be designed to promote dignity in elder care. It began with a

discussion of the philosophical frameworks guiding the inquiry, highlighting a constructivist approach that views knowledge as actively constructed rather than passively received. It then described the theoretical foundations of the research—the senses framework, the dual-dimension dignity framework, and continuity theory—and their application to understanding the key elements of dignified care, as well as how they were synthesised for analytical purposes. The methodology focused on a person-centred, design-led strategy that engaged older adults and carers as co-designers, using a PD approach to examine their lived experiences of dignity.

This chapter also explained why structured concept-selection tools (Pugh matrix, AHP, MoSCoW, Kano model) were repurposed rather than formally adopted, and set out procedural strategies—distinct focus groups, flattened conversational hierarchy, and iterative validation—to manage power asymmetries in the Chinese institutional context. A Gadamerian hermeneutic stance was adopted, sustained through reflexive statements and the hermeneutic circle to keep my pre-understandings ‘at risk’ during participant interactions.

The chapter explained the integration of a practice-based approach, where the design and development of the shower chair prototype served as a key method of investigation, offering insights beyond theoretical or observational methods. The following chapter details the practical implementation of the research methodology, describing participant recruitment, data collection and synthesis methods, and the specific procedures used in Research Phase 1, including the iterative design and feedback process.

Chapter 4: Research Design Implementation and Preparation

4.0 Introduction

Chapter 4 outlines the practical implementation of the research methodology, detailing the procedures used to examine the relationship between dignity and AT in shower chair design. The research is structured into two phases (

Figure 9). The findings from Research Phase 1 directly informed the design and production of the physical prototype in Research Phase 2, which addresses Research Question 2. For instance, insights from the focus groups regarding safety and ease of cleaning influenced the development of features in the shower chair. The prototype was refined iteratively to ensure feasibility, with the final design promoting dignity and well-being for both older adults and carers.

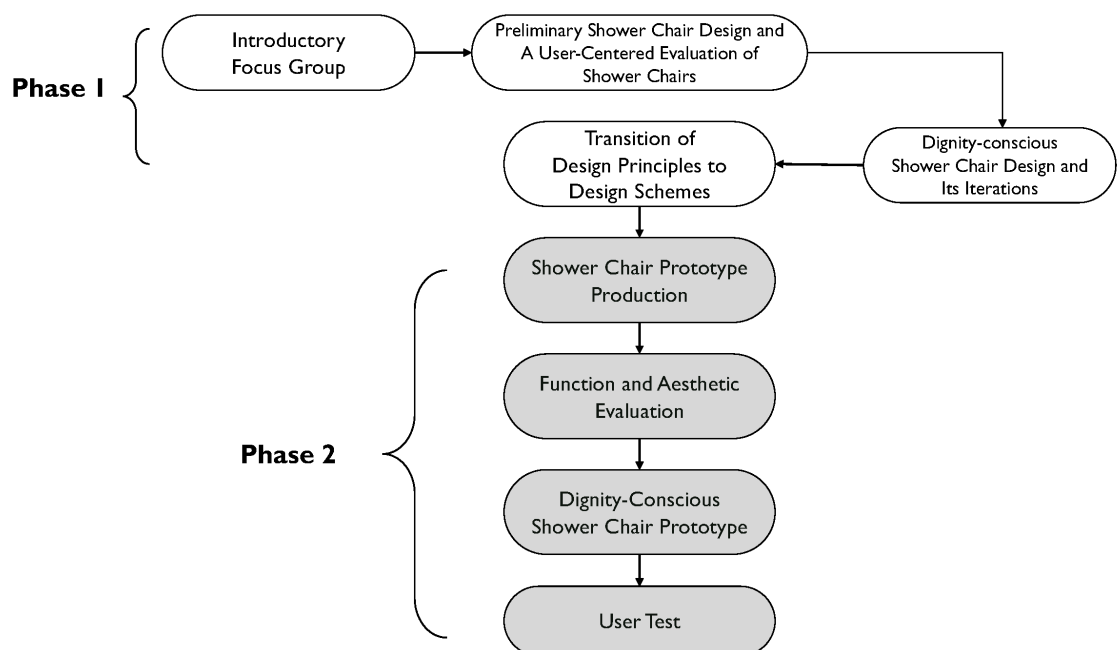


Figure 9. *Research Stages and Implementation*

4.1 Research Phase 1: Exploring Dignity in Caregiving and the Use of Assistive Shower Chairs

- **Stage 1. Introductory focus group:** This focus group aimed to understand how older adults and carers perceive various care activities in the facility, including shower assistance. The primary objective was to explore general experiences with practical care activities and gather insights into the concept of dignity. The preliminary shower chair design was also evaluated.
- **Stage 2. Preliminary shower chair design and a user-centred evaluation of shower chairs:** A preliminary design, developed without participant involvement, served as a baseline for comparison with the final design. Older adults and carers evaluated this design, which was then refined based on their feedback. The objective was to demonstrate how function-centred assistive designs could evolve into devices that are more considerate of users' dignity, consistent with Research Objective 2. To explore the practical aspects of dignity in shower assistance, participants evaluated three types of shower chairs and provided feedback through focus groups and interviews.
- **Stage 3. Dignity-conscious shower chair design and its iterations:** This stage involved designing a dignity-conscious shower chair and its iterations. The design's content and purpose were presented through 2D renderings to participants, who then shared their critical opinions and suggestions during individual interviews. Their insights were used for subsequent development.
- **Stage 4. Translation of design principles to design schemes:** This stage integrated the design principles (derived from the synthesis of Stage 2 findings) and participant feedback (Stage 3 findings) into structured design schemes. These schemes served as a crucial instrument for the design and

production of the shower chair prototype and for evaluating user test outcomes in Research Phase 2.

4.2 Research Phase 2: Production of Dignity-Conscious Shower Chair

Prototype and User Test

- **Stage 1. Shower chair prototype production:** The design elements established in Research Phase 1 served as the foundation for the prototype, which was developed through multiple interconnected phases of iteration. To ensure the prototype's safety and durability, professional manufacturers produced the prototypes. This stage included the following processes:
 - **Metal structure refinement:** To ensure structural integrity, safety, weight reduction, and compatibility with standard components.
 - **Mechanisms for moving parts:** To ensure the proper movement of functional components.
 - **Nonmetal component refinement:** To ensure the comfort and safety of nonmetal components.
- **Stage 2. Function and aesthetics evaluation:** To assess how users perceived the design's functionality and aesthetics before beginning the prototype testing.
- **Stage 3. Dignity-conscious shower chair:** This stage involved final prototype refinements based on participant feedback for user testing in elder care facilities. It included a safety inspection by an authorised institution for certification and human ethics approval for human involvement tests.

This chapter begins with a description of the participant recruitment process, emphasising ethical considerations. Next, it explains the data collection methods,

which include semi-structured interviews, focus groups, and visual tools, chosen to capture the lived experiences of older adults and carers. Then, it details the thematic synthesis approach used to analyse the gathered data, emphasising how the theoretical frameworks guided the interpretation of participants' insights.

4.3 Recruitment of Research Participants

4.3.1 Human Ethics Approval

This research was conducted in two phases, each with specific objectives and procedures that required ethical approval.

- **Research Phase 1** focused on exploring the relationship between dignity and shower assistance in elder care. It included an introductory focus group to gather general insights, tests of existing shower chairs to examine participants' experiences with various functional configurations, and an iterative design process with multiple stages of participant interviews. Human ethics approval for this phase was obtained through a proportionate review by the University Research Ethics Committee (UREC) of Liverpool John Moores University (LJMU; reference: 23/LSA/008; Appendix B).
- **Research Phase 2** involved the production and user testing of the dignity-conscious shower chair prototype. It aimed to evaluate the developed prototype's usability, safety, and impact on dignity within a real-world setting. Further ethics approval for this phase was obtained from both the LJMU UREC (reference: 25/LSA/007) and the Southern University of Science and Technology (approval number: 20230303, Appendix C).

4.3.2 Recruitment Methods

This research involved older adults and carers residing in two elder care facilities, AiDaKang and Mingde, located in Zhongshan, China (Figure 10). These

facilities were selected for their well-established elder care infrastructure, willingness to participate in research, and representation of a standard elder care model in urban China. As gatekeepers, they played a crucial role in facilitating participant recruitment by sharing information with potential participants and ensuring their comfort throughout the research process.



Figure 10. *Participating Elder Care Facilities: AiDaKang (Left) and Mingde (Right)*

Note. Photographed by Fred Han

These elder care facilities faced staffing shortages, limited resources, and time constraints, resulting in rushed care. At these facilities, each carer performed an average of 40 stand-pivot transfers (Figure 11) for older adults between the bed and wheelchair daily. This physical burden distracted carers from attending to the older adults' needs and preferences. It was also a primary reason why carers left their jobs, leading to a shortage of resources at the facility.

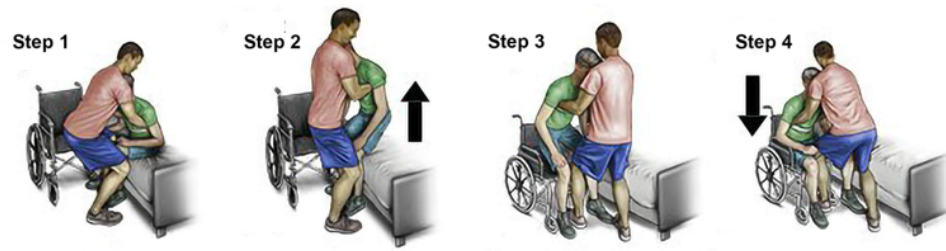


Figure 11. *Process of the Stand-Pivot Transfer Technique*

Note. Image taken from <https://tinyurl.com/3an4jbkt>

Despite these challenges, these facilities provided valuable access to a diverse range of insights into the dignity experience of carers and older adults. To ensure a representative sample, the recruitment considered the following inclusion and exclusion criteria:

- **Inclusion Criteria:**

- Older adults (regardless of age) residing in the selected elder care facilities.
- Carers who were actively involved in providing daily care to older adults within these facilities, particularly shower assistance.
- Ability to communicate effectively in Mandarin Chinese (the primary language used in the facilities) or willingness to have a translator present.
- Willingness to provide informed consent and participate in focus groups, interviews, and prototype evaluations.

- **Exclusion Criteria:**

- Acknowledging the value of inclusive research, this study prioritised ethical standards by ensuring that all participants could provide genuine informed consent. Recognising the potential for PD methodologies to inadvertently marginalise individuals with communication difficulties (as

discussed in Section 3.2), the research excluded older adults with severe cognitive impairments. The determination of cognitive impairment was based on assessments by the facility's medical staff.

- Carers who were not actively involved in providing direct care to older adults (e.g. administrative staff or external healthcare providers).

Participants who met the eligibility criteria voluntarily chose to engage in this research, having understood and consented to its objectives and processes.

Sample Size Justification and Saturation. Qualitative research investigates complex phenomena in depth, using detailed data from a smaller group, enabling a comprehensive understanding and capturing the subtleties of experiences and perspectives (Scârneci-Domnişoru, 2024; Young & Casey, 2018). Theoretical frameworks and methodological choices in qualitative research typically require smaller sample sizes, as the focus is on collecting detailed data rather than making broad generalisations. Research shows that data saturation can often be reached with relatively small sample sizes, sometimes as few as 6–9 interviews, while partial theme representation may require only 4–6 cases (Young & Casey, 2018).

The sample size for this research was determined based on the principle of data saturation. Data saturation is the point at which collecting additional data no longer yields new themes, insights, or patterns, indicating that sufficient information has been gathered to address the research questions (Braun & Clarke, 2021). Recognising that data saturation is a continuous process rather than a fixed point, this research involved six carers and five older adults, whose feedback was repeatedly assessed throughout data collection and analysis.

During the focus groups and semi-structured interviews, key data were consistently reiterated, particularly regarding the challenges of balancing efficiency

with caregiving factors. At one stage, data collection was temporarily paused to review emerging codes against previously collected data. For example, ‘safety’ initially emerged as a key theme for carers. Carers consistently mentioned physical demands of ‘transferring older adults’ (averaging 40 transfers per day) and security concerns, regardless of their work experience. After subsequent discussions repeating this theme, data collection was paused to consider new codes, such as ‘difficulty’ (e.g. managing older adults who refuse showers). This process was applied iteratively until it was determined that adding more participants would yield only redundant information, and data collection for the key theme was concluded.

Although the sample size was small, it did not undermine the findings, as qualitative research does not aim to generalise. Instead, the detailed data from each participant and the data saturation provided a strong foundation for addressing the research objectives. The findings provided valuable insights for designing a dignity-conscious shower chair for elder care facilities.

Limitations of the Sampling Method. Several limitations of the sampling method must be acknowledged. Qualitative research often faces challenges in selecting a sample that accurately represents the population. Without a rigorous sampling procedure, the findings may be overgeneralised, thereby affecting the validity of the research outcomes (Scârneai-Domnişoru, 2024). As outlined in Section 3.2, convenience sampling may not include individuals from diverse economic, social, or political backgrounds and may not yield a representative, generalisable sample. Consequently, the limited sample size and sampling method could restrict the diversity of opinions and affect the research outcomes.

Therefore, future studies should consider larger, more diverse samples to improve the generalisability of the findings and examine the complexities of human

experience and subjective data (Subedi, 2021), particularly regarding the experiences of older adults and carers across different elder care settings.

4.3.3 Participants' Demographics

A total of six carers (all females) and five older adults (one male and four females) participated in the research experiments conducted at the two elder care facilities (Table 7). The carers, aged 52 to 60 years, brought diverse experience to the research, with time in care facilities ranging from one month to 20 years. The older adults ranged in age from 74 to 99 years, representing a broad range of experiences related to dignity in elder care settings. This varied participant profile enhanced the potential to yield practical insights into carer–older adult interactions during shower assistance. All participants demonstrated sufficient communication skills to express their opinions and actively engage in meaningful discussions.

Older adults	Age	Sex	Length of residency	Carers	Age	Sex	Length of experience
CR1	84	Female	3 months	CG1	56	Female	4 years
CR2	76	Female	2 months	CG2	60	Female	6 months
CR3	93	Female	12 months	CG3	50	Female	1 month
CR4	74	Male	4 months	CG4	54	Female	8 months
CR5	99	Female	12 months	CG5	51	Female	20 years
CR6	81	Female	9 months	CG6	52	Female	15 years

Table 7. *Demographics of Participants in Research Phase 1*

Note. CR6 replaced CR2 in a user-centred evaluation of shower chairs.

4.4 Data Collection Methods

The constructivist epistemology and the selected theoretical frameworks guided the choice of data collection methods. To achieve Research Objective 1—

identifying key factors that inform shower chair design while prioritising stakeholder dignity—the research process followed established qualitative methodologies intended to elicit rich, contextualised data (Creswell & Clark, 2007). The methods were chosen to capture the lived experiences of older adults and carers, ensuring that the subjective perspectives essential to understanding dignity were adequately represented (Oosterveld-Vlug et al., 2013). All interviews and focus groups were audio-recorded with participants' informed consent. Since the sessions were conducted in Mandarin Chinese, the recordings were transcribed and translated into English for analysis, and the accuracy of the translations was verified before coding.

The research used methodological triangulation in data collection, ensuring that employing multiple methods simultaneously could confirm findings more robustly than relying on a single method (Heesen et al., 2019). This multi-method approach included semi-structured interviews, focus groups, and visual methods to strengthen validity and reliability by providing multiple perspectives and enabling cross-validation of themes. The rationale for including each method is detailed below:

- **Semi-structured interviews:** Open-ended questions effectively explore complex emotions and behaviours by allowing participants to articulate their thoughts and feelings (Peters & Halcomb, 2015). The flexibility of semi-structured interviews helps explore emerging themes and adapt questions to the unique experiences of each participant.
- **Focus groups:** Focus groups were used to foster dynamic discussions about dignity in caregiving, enabling participants to interact and collectively construct meaning (Kook et al., 2019). This approach is beneficial for examining perceptions, motivations, and the social construction of

knowledge. It can generate unexpected insights and ideas, as dialogue among participants often leads to new perspectives and connections (Simko et al., 2021). Therefore, this method contributes to a collective understanding of challenges in participatory design processes by fostering engagement.

- **Visual methods:** Care activity cards and 3D CAD renderings of shower chair designs were used for data collection. In research involving older participants, visual stimuli such as printed images have been shown to stimulate discussion by providing a focal point for conversation and helping participants share their experiences in an enjoyable way (Greenwood & Pound, 2019). Care cards were used to explore caregiving activities, assess carers' physical and emotional challenges, and evaluate older adults' enjoyment of experiences. The 3D CAD renderings of the shower chair design demonstrated its function and design objectives to participants, eliciting feedback on its perceived usability, aesthetics, and potential impact on dignity. This visual approach bridged the gap between designers and participants, ensuring that user needs informed design solutions (Wang & Masoodian, 2020).
- **Prototype:** Insights from participants' discussions and evaluations of design elements, informed by 3D CAD renderings, guided the development of the shower chair prototype. A physical prototype that enables tangible interaction with proposed features fosters collaboration among stakeholders in the design process, facilitating shared understanding and decision-making (Capjon, 2002). The prototype test provided valuable empirical data on functionality, usability, and ergonomic considerations as they relate to dignity for older adults and carers.

These methods facilitated data collection by integrating theory to address both ethical and practical implications. Gallagher's dual dignity framework focused on safety and independence, while Nolan et al.'s framework emphasised subjective feelings, offering a comprehensive exploration of participant experiences of dignity in shower chair design.

4.5 Data Synthesis: Thematic Synthesis and Framework Application

After data collection, a thematic synthesis was conducted following the principles outlined by Thomas and Harden (2008). The identified themes were incorporated into the theoretical frameworks. Then, the data were analysed using NVivo qualitative data analysis software to ensure a systematic and transparent coding process, including familiarisation with summaries, identification of key themes related to dignity, and theory-informed interpretation. The synthesis process involved the following steps:

- **Line-by-line coding:** Before the formal coding process, interview transcripts were prepared for analysis. This preparation involved clarifying the references to pronouns, such as 'he', 'she', and 'they'. As the research focused on the care relationship and participants frequently used pronouns during discussions, it was necessary to identify these references. For example, the statement 'they don't allow me' was clarified to mean 'they [carers] don't allow me'. The data were then coded by assigning descriptive labels to text segments, allowing themes to emerge (Mortelmans, 2024). This inductive stage also involved maintaining ethical standards and safeguarding participants' confidentiality.
- **Development of descriptive themes:** The initial codes were grouped into related areas to construct descriptive themes, maintaining the original data

and participants' voices. This process aimed to summarise the prevalent ideas *and* identify recurring patterns and relationships.

- **Framework application and interpretive synthesis:** This stage involved applying the theoretical frameworks—Gallagher's dual dimensions of dignity, Nolan et al.'s senses framework and continuity theory—as analytical lenses to interpret the descriptive themes. Connecting the themes to theoretical frameworks enabled each experience-based theme to offer data interpretations grounded in theory (Thomas & Harden, 2008).
- **Identification of interrelationships and key findings:** The final stage involved identifying interrelationships among themes within the interconnected theoretical frameworks, synthesising essential findings and developing broader insights into the research questions. For example, the theme of emotional concerns, initially linked to subjective dignity (perceived safety in Gallagher's view from the previous stage), was expanded to include the sense of security and belonging, as outlined by Nolan et al. (2006).

This structured thematic synthesis, transitioning from straightforward descriptions to interpretative insights grounded in theory, offered a deeper understanding of the complex factors affecting dignity in elder care. Using NVivo throughout the analysis process ensured transparency and rigour, thereby demonstrating the trustworthiness and credibility of the study findings.

4.6 Strategies for Ensuring Rigour and Interpretive Validity

To ensure the trustworthiness, credibility, and dependability of this qualitative research, a multi-layered approach to rigour was implemented. These methods aimed not only to validate the data but also to preserve the diversity of voices, which is crucial in a participatory design.

- Reflexivity and the researcher's perspective:** In line with the Gadamerian perspective from Section 3.3.3, rigorous practice was sustained through ongoing reflexivity. To address potential biases arising from my background in industrial design and my personal, cultural, and professional identities (Sveinson et al., 2025; Finlay, 2002), a reflexive journal was kept during both research phases. This journal provided a transparent record of how my initial assumptions were challenged and refined through interactions with participants, ensuring that the design decisions were based on participant experiences rather than pre-existing professional biases.
- Methodological and cross-forum triangulation:** Credibility was strengthened through methodological triangulation, using semi-structured interviews, focus groups, and visual methods to cross-verify findings (Morse, 2015). Focus groups provided a wide range of stakeholder perspectives, and individual interviews allowed deeper exploration of personal experience. A procedural method was adopted using cross-forum triangulation, in which data from different forums for older adults and carers were cross-referenced. Instead of treating 'divergent themes'—such as conflicting needs like safety measures versus cleaning efficiency—as flaws, they were regarded as valid friction points conveying the relational complexity within the care environment.
- Dialogic Member Checking:** Member checking was conducted as an ongoing, dialogic process, not just a verification of transcripts. Preliminary findings and design revisions were shared with participants to allow for co-creation. Following Koelsch (2013), if a participant disagreed with an initial interpretation, both the original statement and the revised version were kept.

This approach created an ‘audit trail’ reflecting participants’ evolving views throughout the design process.

- **Procedural Mechanisms for Multiple Voices:** To address the cultural tendency towards group harmony in China, procedural mechanisms were employed to uncover ‘marginal’ or opposing data. Negative case analysis was used to identify ‘outlier’ data that challenged the developing thematic framework (Morse, 2015). These cases prompted revisions of the design brief, ensuring that minority perspectives also shaped the prototype’s development.
- **Transparency:** Transparency was ensured through standardised reporting criteria, including detailed descriptions of experimental designs and methodologies, to resolve the reproducibility crisis in research (Prager et al., 2019). The following key practices were implemented:
 - **Transparent and accessible information:** All participants received comprehensive information about the research in plain language, detailing its purpose, participating activities, potential risks and benefits, and data security and confidentiality, ensuring informed consent and ethical participation (Arellano et al., 2023).
 - **NVivo Traceability:** The NVivo coding structure kept a clear trace of evidence. Each design principle (Table 8, Section 5.2.3) links to specific, individual remarks, making the process from qualitative data to the physical artefact fully transparent and auditable.

This combination of strategies forms the framework that reinforces the trustworthiness and credibility of the qualitative results and their subsequent design implications.

4.7 Measurement Limitations

A distinct methodological limitation should be noted, as evaluation in this study pertains to measurement rather than interpretation. Section 4.6 explains how the trustworthiness of the qualitative interpretation was demonstrated. However, it does not address whether the constructs discussed in this research—such as comfort, workload, emotional burden, perceived safety, and dignity—were evaluated using validated instruments. Such instruments were not employed.

This research used semi-structured interviews, focus groups, observational field notes, and participants' assessments of design iterations. It did not employ standardised instruments typically used in confirmatory research on the studied phenomena, such as the NASA task load index (Hart & Staveland, 1988) for workload, the comfort rating scales (Knight & Baber, 2005), the system usability scale (Brooke, 1996), and the patient dignity inventory (Chochinov et al., 2008).

The implication for reading the empirical chapters is straightforward. Claims in Chapters 5–8 about comfort, workload, emotional burden, perceived safety, and dignity reflect participants' perceptions and reported experiences—not definitive measurements. When an interview's direct quotes could be understood as either perception-level statements or outcome-level claims, this thesis treats them as perception-level statements. If the analytical writing infers a measurable outcome, that implication is suggested as a hypothesis for future verification rather than a definitive conclusion of the study.

This approach is intentional, not concessive. The research question that motivated this thesis—how dignity is experienced, negotiated, and shaped within the context of institutional shower assistance—focuses on meaning rather than effect size. The thesis's transferable contributions include an integrated theoretical

framework (Section 1.7), dignity-conscious design principles (Section 5.2.3), a prototype serving as evidence for design knowledge in practice-based research (Candy & Edmonds, 2018), and a qualitative analysis of relational dynamics in AT-mediated care. Although the qualitative findings suggest hypotheses for potential improvements in workload, comfort, perceived safety, and dignity scores, these hypotheses are not tested in this study. Chapter 9 highlights these hypotheses as the primary objectives for future mixed-methods research.

4.8 Chapter Summary

This chapter provided a detailed overview of the research methods and preparation for Research Phases 1 and 2. It first outlined the participant recruitment process, emphasising ethical considerations and strategies to ensure a diverse range of perspectives. It then described the data collection methods, including semi-structured interviews, focus groups, and visual tools, as well as the thematic synthesis approach used to analyse the data, guided by theoretical frameworks. A multi-layered approach to rigour was specified—ongoing reflexivity, methodological and cross-forum triangulation, dialogic member checking, negative case analysis, and NVivo traceability linking each design principle to source data. The chapter also acknowledged a key limitation: validated instruments were not used, so claims about comfort, workload, perceived safety, and dignity in later chapters are treated as participants' perceptions and reported experiences rather than measured outcomes. These preparations established the foundation for the later research phases, ensuring the research was conducted ethically and rigorously. The next chapter puts this methodology into practice, showing how it led to the initial development of dignity-conscious design principles for shower chairs (Section 5.2.3).

Chapter 5: Research Phase 1 – Iterative Design and Feedback

5.0 Introduction

This chapter describes the execution and outcomes of Research Phase 1, which used an iterative design approach guided by PD principles. This phase included several interconnected stages: introductory focus groups to gather user insights, the development of a preliminary shower chair design (informed by the literature but intentionally developed before user involvement), and the evaluation of existing shower chairs. These stages, together with continuous feedback, guided the development and iterative improvement of dignity-conscious shower chair designs. This chapter presents the objectives, activities, key findings, and design implications from each stage, highlighting the crucial role of user feedback and theoretical frameworks in shaping the design process.

5.1 Stage 1: Introductory Focus Groups

Research Phase 1 employed focus groups to explore the multifaceted experiences of older adults and carers in elder care facilities (see the ‘Understanding’ section in Volume 2 for detailed visual documentation of the focus group setting). Although this research focuses on dignity in shower assistance, it is essential to recognise the broader context of caregiving activities, since shower assistance constitutes only one aspect of the overall care routine.

To facilitate these discussions and gather detailed insights within the care facilities, participants—five older adults and six carers—were asked to engage in a card-sorting activity. This activity involved ranking 13 care activity cards (Figure 12) based on their perceived level of physical and emotional difficulty (for carers) and their value and enjoyment (for older adults). The activity lasted 30 minutes per participant; however, when participants demonstrated heightened engagement or

required additional time, sessions were extended accordingly. The care activity cards included tasks such as ‘sit up’, ‘walking support’, ‘dressing’, ‘undressing’, ‘toilet aids’, ‘washing face’, ‘shower assist’, ‘washing body’, ‘transfer’, ‘medication aids’, ‘washing hair’, ‘feeding food’, and ‘changing nappies’.

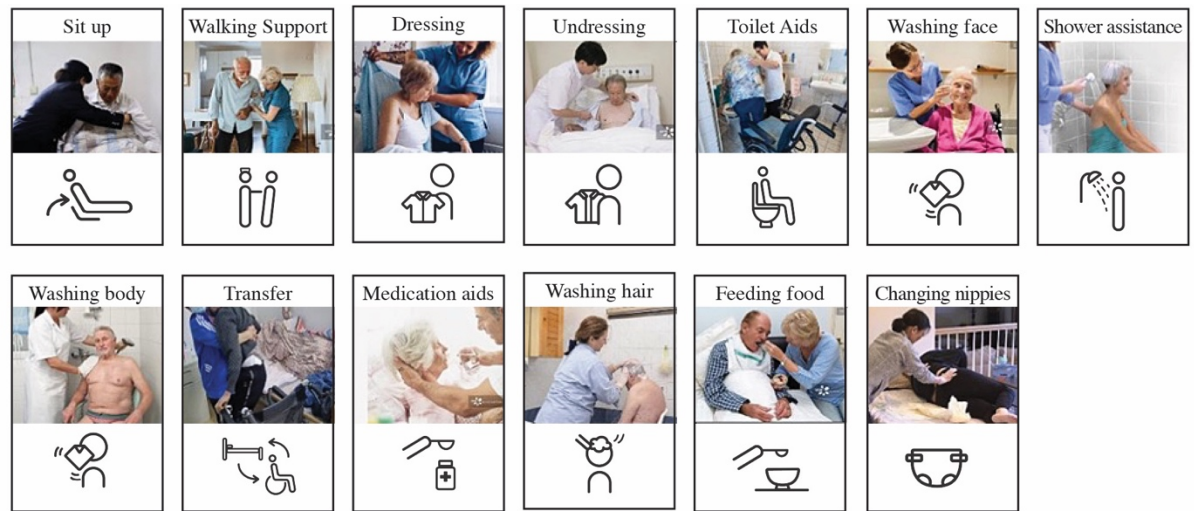


Figure 12. *Care Activity Cards and Card-Sorting Activity*

This card-sorting activity served several purposes:

- **Stimulating discussion:** The cards provided a clear starting point for conversations, encouraging participants to reflect on care activities and share experiences in detail.
- **Eliciting priorities:** The ranking exercise enabled participants to articulate their priorities and preferences, revealing which care activities they considered most challenging, valuable or enjoyable.
- **Identifying patterns:** The aggregated rankings helped identify common patterns and trends among participants, providing insights into the shared experiences of older adults and carers.

The data from these focus groups, including the card rankings and transcriptions, were analysed using NVivo. This process involved coding the transcripts for key themes and patterns related to dignity, autonomy, safety, and the carer–older adult relationship. The codes were then used to create a framework for carers and older adults, which served as the basis for the subsequent analysis (a more detailed explanation of the qualitative analysis is provided in Appendix D). The following sections describe how these themes were interpreted through the theoretical frameworks used in this research.

5.1.1 Gallagher’s Framework in Practice: Balancing Objective Challenges and Subjective Dignity in the Care Relationship

The focus group data indicated that both objective and subjective dimensions of dignity are involved in the caregiving relationship. Even when older adults experience physical or cognitive decline (impacting the *objective* dimension by potentially diminishing societal views of their value), they retain a strong desire to maintain their sense of self-worth and control over their lives (*subjective* dimension). Nevertheless, expressions of this desire are often challenged in practice. As demonstrated by statements from CG3 and CG5, carers may override older adults’ preferences for independent showering due to concerns about efficiency and safety. As CG3 stated, the preference for independent self-care is often diminished by the practical realities of caregiving: ‘*It’s a bit slow, so carers do not allow it.*’ In some instances, older adults perceive a lack of privacy, as illustrated by CR5’s sentiment: ‘*I feel a little shy and want to do it by myself, but I’m still being watched by the carer nearby.*’ These examples reveal a tension between promoting autonomy and the perceived need for carer supervision, highlighting the complexities of upholding dignity in assisted living.

From an objective standpoint, older adults in care settings may encounter challenges that threaten their inherent worth and restrict their ability to express their dignity. Carer CG1 noted that caring for older adults with limited self-care abilities is particularly demanding, especially those who have experienced a stroke or cerebral haemorrhage. These conditions, which affect physical or cognitive function, can hinder independence and participation in meaningful activities. While the intrinsic worth of these vulnerable individuals is unquestionable, limitations in mobility and functional capacity require careful attention to safety and support. The carer's role is therefore crucial: to implement appropriate safeguards while upholding the dignity of the older adult, regardless of their functional capacity or cognitive condition. However, maintaining this balance can be difficult. Carers may sometimes display impatience when older adults resist assistance or do not cooperate, which can undermine the older adult's sense of worth.

Furthermore, safety strongly influences objective dignity. The data showed that older adults are very aware of their vulnerability to falls and physical disabilities, which, in turn, increases their dependence on carers. CR4 illustrated this reality, stating, *'When I initially arrived at the nursing home, I showered alone to avoid bothering others. However, after falling once, I needed a carer to help me with showering.'* This narrative illustrates how an individual's autonomy and independence, including their control of relationships with others, can be impacted by an adverse safety incident. This may lead to an increased reliance on others, potentially diminishing the individual's objective dignity.

While essential, the need for safety can unintentionally result in restrictions that reduce autonomy and self-determination. For instance, care facilities might implement standardised showering schedules or protocols that do not align with

individual preferences. The previous statements from CG3 and CG5, '*carers do not allow it*' and '*I'm still being watched by the carer nearby*', exemplify this reality. A focus on preventing falls and mitigating risk may also result in the use of restraints, which could undermine an older adult's sense of autonomy and self-efficacy, thereby diminishing their self-worth and reinforcing perceptions of frailty and incompetence.

However, it is crucial to recognise that older adults retain their subjective sense of dignity, even in the face of these objective challenges. As the data showed, many express a desire to maintain control over their daily routines. This desire for autonomy is often intertwined with an awareness of their own vulnerability and an effort to avoid burdening carers. Several older adults associated seeking assistance with bothering carers. For example, CR4 mentioned, '*I go to the bathroom on my own and eat by myself. I don't want to trouble the carer.*' CR1 also expressed concern about minimising social burden: '*I wish carers would stay away from the unpleasant "smell" that comes with using the toilet.*'

An older adult's subjective dignity is also linked to their physical and emotional comfort, which can impact their sense of well-being. CR4's satisfaction arises from feeling supported by the carer, which fosters a heightened sense of safety and comfort. In contrast, CR2 mentioned '*discomfort caused by carers wearing gloves and not being able to feel the water temperature during showering*'. This remark reflects a concern for physical comfort and a recognition that even seemingly small sensory details can impact their subjective experience. This observation highlights the need for person-centred care. CG1 remarked, '*Some older adults lack clarity and do not make requests, while others have numerous food demands, are in a bad mood, and we may even have to try to persuade them to eat.*' This sentiment

highlights the importance of flexibility and attentiveness for carers, ensuring a personal care approach while maintaining objective standards.

The data also indicated tensions affecting both parties' subjective dignity. While recognising the objective standard of caregiving, CG1 and CG3 expressed their emotional difficulties, stating, '*Some older adults with dementia do not allow their nappies to be changed and they may hit or scratch my hair or clothes*' (CG1) and '*When older adults do not cooperate and are reluctant to shower, they may react aggressively, hitting others. It is emotionally troublesome*' (CG3). These comments reflect the challenges of providing consistent, respectful care, especially when faced with uncooperative behaviour in practice.

5.1.2 Nolan et al.'s Senses: A Reciprocal Framework for Dignified Care

Nolan et al.'s (2006) senses framework offers an invaluable perspective on the environmental and relational factors that contribute to a dignified care experience for both older adults and carers. The focus group data suggest that these senses are linked, and disruptions in one area can affect the others.

Security. The carers consistently mentioned transferring older adults as a task that not only poses a physical burden but also affects their sense of security. This sense involves the fear of potentially injuring themselves. CG1 described '*an incident involving an inexperienced new colleague, who sprained her back while assisting an older adult*'. Conversely, CG5 noted, '*Colleagues with extensive experience often suffer from chronic back issues and tend to be cautious about potential injuries.*' This scenario also affects the perceived security of older adults, who may feel nervous and grasp the wheelchair rather than placing their hands on the carer's shoulders during transfers, increasing the carer's burden and the risk of accidents.

Belonging and Significance. The reciprocal caregiving relationship fosters the social well-being of both older adults and carers, blurring the lines between the provision and receipt of care. CG5 stated, *‘I really enjoy chatting and engaging in activities with older adults.’* Carers’ enthusiasm supports older adults’ desire to engage in social interactions. These interactions are not simply about fulfilling a task or meeting a need; they are about sharing moments of connection, sharing experiences, and affirming an individual’s worth. This observation aligns with the sense of belonging, as feeling connected to others is essential for combating isolation and promoting social well-being.

Positive interactions also contribute to a sense of significance, as feeling valued and appreciated is essential for maintaining self-esteem and a sense of purpose. CR4 regarded the carer’s inquiry regarding his needs as a demonstration of attentiveness towards him, stating, *‘Having the carer ask regularly can show concern for me.’* These positive social connections can make older adults feel valued. However, the data indicated that not all interactions are equally positive or conducive to fostering a sense of belonging and significance.

The carers also appreciated older adults’ expressions of gratitude. CG1 noted, *‘When older adults have frequent bowel movements, they may feel regretful and express gratitude. They hold my hand and say thank you.’* These small moments of connection and appreciation can have a profound impact on the subjective experience of dignity for both older adults and carers.

Purpose and Achievement. The caregiving relationship also provides opportunities to foster feelings of purpose and achievement; however, these senses are experienced differently by carers and older adults. These senses are inherently

intertwined, as a sense of purpose can motivate a desire for achievement, while achieving goals, in turn, reinforces a sense of purpose and self-esteem.

For carers, maintaining a sense of purpose involves discovering meaning and value in their caregiving responsibilities, which, in turn, leads to a sense of achievement. The following statements from CG3 and CG4 illustrate this. CG3 noted, *‘This job is meaningful, and I have the opportunity to learn how to care for older adults ... I feel my hard work is worthwhile; even if I encounter an older individual with a bad attitude, it won’t affect my mood.’* CG4 remarked, *‘I cannot lose my temper as they do. I still need to treat them well, and that is what I should do.’* These statements demonstrate a commitment to compassionate care, even in challenging circumstances, fostering a sense of purpose and achievement.

However, for older adults, these two senses emerge as challenges threatened by objective concerns. Despite their confidence in their self-care abilities, opportunities to initiate or even participate actively in care activities are often limited, either by their own concerns about safety or by the restrictive protocols implemented within the care facility. CR5’s statements, *‘I can walk independently without a wheelchair; however, assistance makes it safer for the carer to support me’* and *‘Although I can walk on my own, the carer is worried about my safety and still wants to help me’*, exemplify this tension. The desire for independence outweighs their safety concerns. As a result, their sense of purpose is diminished, and their capacity for achievement is compromised.

Continuity. Preserving a sense of continuity with the past is essential for maintaining both identity and self-esteem. Given the overlap between Nolan et al.’s (2006) sense of continuity and continuity theory, which similarly emphasises the

significance of maintaining connections to the past, this theme will be addressed in the following section.

5.1.3 Continuity Theory: Maintaining Identity and Self-Esteem

Although both Nolan et al.'s senses framework and continuity theory emphasise the importance of maintaining connections to the past and preserving a sense of identity over time, their approaches differ slightly. Nolan et al.'s sense of continuity highlights the immediate environmental and relational factors that contribute to familiarity and predictability in daily life. In contrast, continuity theory (Atchley, 1989; Guedes & Melo, 2019) focuses on the ongoing process of adapting to change and maintaining a consistent sense of self across the lifespan. It follows that the implications of these theories for the experiences of older adults and carers may also differ slightly.

For older adults, continuity theory highlights the importance of preserving a sense of identity and managing disruptions to their established routines, relationships, and environments. CR2 stated her preference: *'Carers who have been around for a long time follow my own habits without making unnecessary inquiries.'* CR4 described his continued habits after moving into institutional care: *'When I initially arrived at the nursing home, I still showered.'* CR5 emphasised her ability to walk independently without a wheelchair and her preference to shower independently, even if it took longer, highlighting a desire for self-determination in daily routines. These preferences were driven by their past experiences and habits.

Although older adults may strive to sustain continuity, the realities of residing in a care facility present considerable challenges. Standardised routines, unfamiliar carers, and a diminished sense of purpose can all disrupt established patterns and undermine an older adult's sense of self. As previously discussed in

Section 2.4.5, the need for security and safety can also lead to restrictions on autonomy and self-determination, further weakening the ongoing process of adapting to change.

Nolan et al.'s sense of continuity is more linked to the carer's role, emphasising the need to provide predictability and familiarity in the immediate care environment. CR2's negative experience, *'I once complained to the manager of the nursing home about a carer who was unwilling to help me with the toilet and spoke impatiently'*, illustrates how carers' work ethic affects the maintenance of older adults' routines. CR2's experience goes beyond a comfort issue; it influences the older adult's perception of predictability, creating feelings of anxiety and uncertainty, while also impacting their capacity to trust and establish a relationship with the carer. Ultimately, it affects their ability to retain a sense of control over their routine.

5.1.4 Synthesis: Dignity-Enhancing Approach to Care (With a Focus on Assistive Shower Chair Design)

Insights from the focus groups, guided by Gallagher's concept of dignity, Nolan et al.'s senses framework, and continuity theory, revealed the complex and delicate nature of dignity in caregiving relationships. These interwoven theoretical and practical considerations can inform the design of AT, specifically shower chairs, to promote a dignified care experience for older adults and carers alike. These findings emphasise the need for shower chair designs that support autonomy, safety, social connection, and respect. Design solutions may include elements that are both safe and empowering, adaptable to individual preferences, and useful to foster positive interactions. Through designs that recognise how these factors mutually

reinforce one another, both older adults and carers can experience dignified shower assistance.

5.2 Stage 2: Preliminary Shower Chair Design and a User-Centred Evaluation of Shower Chairs

With foundational user insights gathered from the initial focus groups, Stage 2 shifted from exploring broad experiences to a more focused evaluation of shower chair designs. This stage involved two key activities: 1) the development and evaluation of a preliminary shower chair design informed by existing literature and 2) a user-centred evaluation of three commercially available shower chairs.

Combining a theoretically informed prototype with real-world comparators enabled a more nuanced understanding of the strengths and weaknesses of current approaches, laying the groundwork for subsequent iterative design refinements in Stage 3. Stage 2 aimed to identify areas for improvement, highlight ineffective aspects of the current design, and determine which theoretical details should be emphasised or disregarded. The following sections outline the preliminary shower chair design and the user-centred evaluation of existing shower chairs, detailing the methodology and findings from each.

5.2.1 Preliminary Shower Chair Design and its Evaluation

A preliminary shower chair design (Figure 13) was intentionally created prior to the participants' involvement, based on a review of existing literature. To explore the answers to Research Question 2, this design exemplifies a function-centred shower chair that prioritises safety and hygiene—recognised as essential considerations in current literature—and carer efficiency, a key element of commercially available products. It establishes a baseline for evaluating later PD

iterations that incorporated feedback from older adults and carers, rather than functioning as a proposed final solution.



Figure 13. *Preliminary Shower Chair Design*

This design was evaluated through semi-structured interviews with the five older adults and six carers who participated in the Stage 1 focus groups. The following subsections outline each design feature, examining its potential strengths and weaknesses. This evaluation considers the theoretical frameworks of Gallagher, Nolan et al., and continuity theory to assess their effects on dignity, well-being, and the care relationship. The objective of this evaluation is not to provide a definitive judgement on the design but rather to identify design flaws and learn from them, which aids in developing subsequent PD iterations.

Foldable Backrest: Continuity vs Carer Burden. The foldable backrest (Figure 14), intended to enhance hygiene for older adults with mobility impairments and prevent bedsores, aligns with the objective dimension of dignity by emphasising

safety. However, participants' feedback suggests that its primary value is in its potential to foster a sense of continuity and subjective dignity. CR2 and CR4 expressed a shared feeling, *'I can feel more water on my back like a massage, just like I did before'*, which illustrates the desire to maintain familiar sensory experiences and routines, aligning with the continuity theory principle. This connection to the past suggests that this feature might be crucial in mitigating the disruptive impact of transitioning to assisted living.



Figure 14. *Foldable Backrest*

Although the feedback suggests that this design helps promote the older adult's comfort and continuity, a potential risk of undermining the carer's sense of efficacy and control remains. As CG5 stated, *'It needs to be simple; otherwise, it's just another thing to worry about.'* This concern highlights how a complex folding mechanism could reduce a carer's ability to provide dignified care, thereby affecting their sense of purpose and achievement. The proposed benefit of pre-shower bedsores patch application, intended to improve visibility and management (CG3), is

deprioritised for the same reason: perceived operational complexity, which carers view as an added burden rather than a means to provide more thoughtful care.

Therefore, the foldable backrest exemplifies the inherent challenges of designing for dignity. Although it has the potential to support continuity and sensory comfort for older adults, its effectiveness relies on its usability and its impact on the caregiving process. Future design iterations should focus on simplicity and efficiency to ensure that the feature truly enhances the dignity of both older adults and carers.

Adjustable Seat Height: Sense of Security vs Ergonomics – A Question of Prioritisation. The adjustable seat height feature (Figure 15) aimed to enhance carer efficiency and improve the comfort and visibility of older adults during showering, inspired by the simplicity and ease of use of hair salon chairs. However, the feature received mixed feedback, presenting a conflict between competing needs. Although the design rationale prioritises carer ergonomics and improved assist efficiency, potentially contributing to carers' sense of purpose and achievement, user feedback reveals significant safety concerns. The fear, insecurity and instability associated with a higher seating position directly challenge the design's implicit prioritisation of carers' reduced physical strain (objective dignity) over older adults' subjective dignity (preference and sense of security).



Figure 15. *Adjustable Seat Height*

While carers CG1, CG4 and CG5 acknowledged potential ergonomic benefits, such as improved posture and reduced strain during cleaning, older adults CR3, CR4, and CR5 expressed overwhelmingly negative safety concerns: *‘I don’t like being high up.’* This response reflects underlying anxieties linked to a perceived loss of control and fear of falling, as frequently discussed in focus group sessions. A lack of familiarity with the lifting mechanism might worsen these concerns, highlighting a fundamental question: whose dignity is being prioritised in this design decision?

Gallagher’s framework requires consideration of both the objective and subjective dimensions of dignity. By prioritising carer ergonomics, the design risks compromising the older adult’s sense of security and autonomy. Therefore, design adjustments could include a focus on alternative solutions that ease tension and better balance the needs of both stakeholders, such as slow, controlled adjustments or enhanced safety railings that inspire confidence and a sense of predictability.

Extruding Front Handle: Hygiene, Independence and Conflicting

Perceptions. The extruding front handle, integrated with the structural frame (Figure 16), was intended to improve safety for older adults. However, this feature exemplifies the complexities of user-centred design. Although this feature aims to minimise the fall risk for older adults and aligns with an objective dimension of dignity, the overwhelmingly negative feedback from carers about post-shower hygiene reveals a critical flaw in the design. CG2 noted, *‘It’s hard to clean after a shower ... I’m worried about mould inside.’* This concern highlights the significant burden on carers to maintain a clean, hygienic environment, which is crucial for preventing the spread of infections and upholding professional standards.

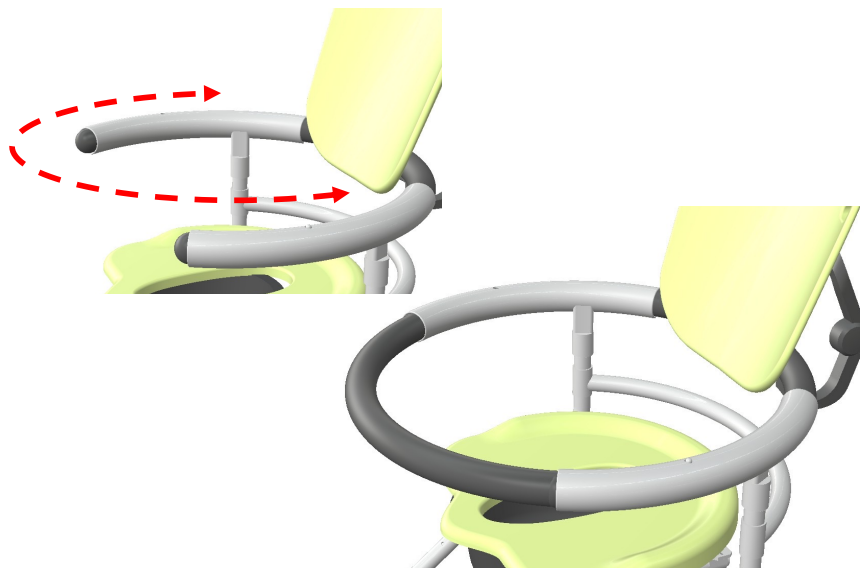


Figure 16. *Extruding Front Handlebar*

In contrast, older adults viewed the handle favourably, perceiving it as a source of safety and independence, which aligns with both Nolan et al.’s framework (sense of security and purpose) and Gallagher’s dual dignity framework (safety and autonomy). Thus, the handle may offer both physical stability and emotional

security, reducing feelings of vulnerability. The positive perspective of older adults aligns with Nolan et al.'s framework, which addresses individuals' feelings of security, comfort and self-worth within the concept of subjective dignity.

This contrasting perspective highlights a key design challenge: balancing safety with hygiene and carer well-being. Potential solutions include antimicrobial materials, a self-cleaning mechanism or alternative handle designs that are both easy to grip and easy to sanitise.

Rotatable Backrest and Footrest: Theoretical Functionality vs Lived Reality. The rotatable backrest (Figure 17) was intended to enhance safety, comfort, and autonomy. Although this feature serves the same purpose as the foldable backrest, it aims to offer choices for older adults and their carers that are tailored to personal preferences and health conditions and adaptable to the care environment, promoting autonomy and a sense of control.

However, participants widely criticised this feature, exposing significant design flaws that reveal a gap between theoretical design principles and practical implementation. Carers noted that the complexity of the adjustment method, given the short backwashing time, would disrupt the time-constrained shower process. Older adults also found it unfavourable and unnecessary, clearly preferring the foldable backrest. Although the feature aims to address both objective (safety) and subjective (autonomy and choice) aspects of dignity, it conflicts with practical realities and the effectiveness of the caregiving process.



Figure 17. *Rotatable Backrest and Footrest*

Furthermore, the adjustable footrest, which was designed to enhance older adults' sitting comfort, was deemed unsuitable. CR1's inability to bend her legs comfortably due to a pre-existing knee condition revealed a design flaw. CR3 also highlighted this issue, saying, '*I can't even bend my legs that way, so what's the point?*' This feedback indicates that the design must prioritise stakeholders' practical needs over theory and incorporate diverse user conditions. Therefore, these findings from both the rotatable backrest and the footrest highlight the need for a design approach that recognises the broader context of shower assistance, thereby enhancing the well-being and dignity of all stakeholders.

The preliminary shower chair design revealed a complex interplay of competing needs and priorities. Although the design incorporates features aimed at promoting dignity, safety, and independence based on different subjective experiences, it also demonstrates the potential for unintended consequences. Thus, it highlights the importance of grounding design decisions in a deep understanding of

users' lived experiences. Further PD iterations, informed by the theoretical frameworks of Gallagher, Nolan et al., and continuity theory, are essential to refine the design and ensure it truly enhances the well-being of both older adults and carers.

5.2.2 A User-Centred Evaluation of Shower Chairs

This stage of the research involved a user-centred evaluation of three existing shower chairs to directly inform the research questions regarding (a) how AT impacts dignity in carer–older adult relationships during showering and (b) how shower chair design can be transformed to incorporate dignity-conscious solutions.

To these questions, this stage examined three existing shower chairs to understand how design features affect the dignity of both older adults and their carers during shower assistance. The selected shower chairs represent a range of functionalities and designs available on the market. The outcomes of this comparative study, including feedback from both older adults and carers, provided valuable insights to guide the design of a dignity-conscious shower chair.

User Testing Protocol. To investigate the showering experience and its impact on dignity, a user test was conducted with three different shower chair models (Figure 18): Shower Chair A, the most common type used in assisted living; Shower Chair B, a wheelchair-based model with a reclining backrest; and Shower Chair C, which has a bed-to-chair transfer feature. The choice of these shower chairs was guided by market research (described in Appendix E) to reflect a variety of currently available functionalities and designs.

**A****B****C**

Figure 18. *Shower Chairs for User Testing*

Note. Photographed by Fred Han. A - Make: Hebei Xinyuze Medical Equipment Co., Ltd., Model: XK8060; B – Make: Tianjin Zhubang Medical Equipment Co., Ltd., Model: SYIV100; C – Make: Jinhua Kair Technology Co., Ltd., Model: YWJ-H1.

The participants in this assessment included the same older adults and carers from the preliminary shower chair design evaluation and focus groups, except one older adult, CR2, had moved out of the facility and was replaced by a new female participant. The participants were divided into three groups. Each group used each shower chair for two weeks in their usual environment, allowing for a realistic assessment of the showering experience. After each testing period, follow-up semi-structured interviews were conducted with the participants. Each interview was scheduled to last 30 minutes, but sessions were extended when participants were highly engaged or required more time. This process was repeated for each shower chair, ensuring that every participant used and provided feedback on all three.

Thematic Analysis Process. Qualitative data from the interviews were analysed using the thematic synthesis approach described in Section 4.5. NVivo was used to organise and facilitate coding. Specifically, the pre-established themes of safety, independence, comfort, and relational connection (based on Gallagher’s dual dimensions of dignity, Nolan et al.’s senses framework, and continuity theory, as outlined in Section 3.4) were used as initial categories for deductive coding. Inductive codes were also created to identify emerging themes specific to experiences with the shower chairs. The qualitative analysis is described in more detail in Appendix F.

To ensure the trustworthiness of the findings, the rigour strategies outlined in Section 4.6 were implemented, including data triangulation (comparing older adults’ and carers’ perspectives with relevant literature). The application of these strategies in the shower chair evaluation is further detailed in the following sections.

Findings: Dignity and Design Implications. This section presents the findings from the user-centred evaluation of the three shower chairs (A, B, and C). Through thematic analysis of interviews, key design implications for promoting dignity in shower assistance were identified. The following subsections present an integrated analysis of shower chairs from the carers’ and older adults’ perspectives, organised around the three identified themes: safety and security, independence and control, and comfort as connection. A detailed analysis of the data, including comprehensive interview quotes, is provided in Appendix G.

Carers’ Perspectives. The carers experienced complex challenges with the shower chairs. Their experiences highlight the trade-offs involved among safety, physical exertion, efficiency and the emotional aspects of caregiving. The design of shower chairs influences not only the physical well-being of carers but also their

ability to deliver attentive, respectful care, ultimately shaping the carer–older adult relationship. Consequently, a design strategy that emphasises both functionality and the relational dimension of care is essential.

Safety and Security – Relational Implications. All three shower chair designs presented varied challenges and conflicts regarding safety and security, affecting the physical and emotional well-being of both carers and older adults. The emphasis on safety features in design must consider the practical implications for carers, as increased physical burden can reduce attentiveness and increase the risk of injury.

- **Physical burden and accident risk:** Shower Chair A prioritised simplicity, but its design lacked specific features to effectively reduce physical strain, raising concerns about an increased workload. This observation demonstrates that simplicity alone does not ensure reduced physical strain. In contrast, Shower Chair B was perceived as bulky and heavy, increasing the physical effort required to manoeuvre it in confined spaces and heightening the risk of accidents. CG1 noted, *‘This chair is too long and heavy. I scraped against doorframes or water basins.’* These experiences undermined the sense of security and highlighted how an inadequately designed device can create a hazardous environment, potentially resulting in physical harm to both carers and older adults.
- **Balancing safety and comfort:** Shower Chair C presented a design dilemma by attempting to balance safety and comfort. The front guardrail was a point of conflict. While carers recognised its safety advantages for older adults, they also noted that it interfered with washing tasks, creating a tension between safety (objective dignity) and the carers’ burden to improve quality of care (sense of purpose and achievement). According to CG1, *‘The front*

guardrail is good for the safety of older adults, but it made my work difficult.

I had to move more during the shower. It was difficult to put my full force into washing their backs and lower bodies. At the end, I was more tired.'

This observation exemplifies a challenge in AT development, where an emphasis on one aspect (safety) can inadvertently undermine another (carer workload). The relational challenges caused by an increased workload can diminish the quality of care, as carers may have less time and energy to engage with older adults on a personal level.

Independence and Control: Facilitating Autonomy vs Managing Frustration.

Carers' perceptions of older adults' capabilities significantly influence their caregiving approach and the quality of the carer–older adult relationship. A design should aim to empower older adults and improve their independence; however, this requires a comprehensive understanding of carers' perspectives and constraints.

- **Influence of perceived mental awareness:** The data revealed that carers are inclined to grant autonomy to older adults whom they perceive as cognitively and physically capable, while exercising greater control over those with reduced capacity. For example, CG1 stated that *'older adults become cooperative and nice depending on their mental awareness and upper limb strength.'* Similarly, CG3 stated, *'When my work is relaxed, I allow them to wipe their own bodies first before helping.'* These findings demonstrate that the influence of AT design extends beyond ergonomics or efficiency in caregiving, affecting older adults' subjective dignity and the care relationship.
- **Usability contingent on cognitive abilities:** The effectiveness of AT relies on older adults' physical abilities. For example, Shower Chair C was

considered appropriate only for older adults who could cooperate and lift their hips to sit down, suggesting limited usability for older adults with paralysis or dementia. This finding indicates that when AT fails to account for varied cognitive and physical abilities, it may exacerbate existing inequalities and exclude specific groups.

- **Emotional frustration:** Shower Chair B's size and complexity diminished carers' capacity to facilitate autonomy, resulting in frustration. CG3 noted, *'This chair made me physically and mentally tired. If I am tired, I am short-tempered.'* This remark highlights the interrelation between carers' physical and emotional states and their empathy in interactions with older adults. Moreover, Shower Chair C exemplified how AT reconfigures carers' roles. For example, CG4 observed, *'Because the older people got scared when they sat on it, I had to do two tasks together: comforting a fearful older person and washing them.'* While this remark reflects an added emotional burden, it also suggests the potential to strengthen the compassionate care relationship.

Comfort as Connection – Emotional Bonds and Quality of Life. Comfort is a vital factor in the caregiving relationship, affecting its effectiveness, the emotional health of those involved and the overall quality of care. AT design should not only emphasise physical comfort but also address the emotional and social dimensions of caregiving, thereby promoting positive interactions and strengthening emotional connections.

- **Enhancing emotional comfort:** The simple and intuitive design of Shower Chair A enhanced efficiency and the emotional comfort of both carers and older adults. CG5 stated, *'When my work is easy ... I can do more for them and become friendlier.'* Similarly, CG4 remarked, *'When my work becomes*

smooth, older people feel comfortable. It makes me feel good too because they like it. Features that facilitate ‘ease of use’ improve the efficiency of caregiving and positively influence perceived objective dignity by enabling more effective physical interventions. These features also enhance subjective dignity by engaging different senses and fostering a stronger connection between carers and older adults.

- **Time constraints and task complexity:** Shower Chair C introduced time constraints and task complexity due to its safety features, which influenced carers’ capacity to engage with older adults. While reduced physical strain was noted, the time spent washing increased. CG5 stated, *‘I didn’t have to twist my waist and hold their [older adults’] weight. I didn’t have to worry about injury. But a longer time is the problem.’* Similarly, CG2 noted, *‘The time I spent using this is more than with other chairs. And it is difficult to wash them [older adults].’* These observations demonstrate a trade-off between safety and work efficiency, causing carers to rush during the shower process. They emphasise the need for designs that streamline caregiving tasks and reduce the time burden on carers, enabling them to focus on building meaningful relationships with older adults.
- **Hindering effective care:** The design of Shower Chair B affected carers’ comfort and task efficiency when washing, as well as their ability to adapt to different situations and maintain the chair. CG4 stated, *‘This chair is really bad. Because it covers the older person’s body, it was difficult to see and reach when I cleaned the buttocks and back.’* Regarding maintenance, CG2 noted, *‘This chair is difficult to clean, clumsy, and time-consuming for me to use.’* These remarks demonstrate how design flaws can impede carers’ ability

to provide effective care in an institutional setting, which is essential for fostering a sense of purpose and achievement among carers (Nolan et al., 2006).

Summary. The carers' experiences with these shower chairs highlight the importance of designing AT that extends beyond basic functionality. Designs should address the physical, emotional, and relational challenges of caregiving. Emphasising ease of use, flexibility, and reduced physical strain is essential to support carers and enable them to provide respectful, attentive, and effective care. Recognising the unintended effects of design features is also crucial, as these can negatively affect both carer well-being and the quality of care.

Older Adults' Perspectives. Shower chair design significantly impacts older adults' sense of security, independence, and overall well-being. It influences power dynamics in caregiving relationships and can either enhance or diminish feelings of comfort, dignity, and control. While certain overarching themes emerged, it is important to acknowledge that individual older adults held diverse and sometimes conflicting perspectives, shaped by their unique physical needs, cognitive abilities, past experiences, and personal preferences. The following sections will explore both the common themes and the variations in their feedback, reflecting the complexities of designing for a diverse population. Designs should reflect a commitment to person-centred care, prioritising the needs and preferences of older adults.

Safety and Security – Relational Implications (Dependence, Fear, and the Need for Reassurance). The older adults' reliance on carers significantly influenced their sense of safety and security. The relational implications of safety concerns included fear of falling and reliance on carers, which influenced older adults' sense of autonomy and dignity.

- **Dependence on carers:** The connection between older adults' sense of security and dependence on carers is illustrated by CR4's comment: *'I am scared when they move me if I fall ... I worry if they are strong enough. If not, it is dangerous. I can fall.'* The fear of falling indicates a vulnerability that transcends the physical; it reveals a desire for reassurance and a secure attachment with the carer. As such, the shower chair design's effectiveness lies in establishing a relational connection.
- **Mixed reactions to safety:** The older adults exhibited varied responses to the safety features of Shower Chair C. Although features such as the front guardrail were appreciated for their objective safety, the design presented a notable flaw that fostered a sense of insecurity. CR3 stated, *'I was scared when I was moved by the chair. It is too high for me. Especially, I was moved backwards ... I had to hold my helper.'* Shower Chair C's seating posture enabled older adults to face carers while moving, but they did not perceive this as an opportunity for communication; instead, they worried about their safety and moved backwards. This observation reveals an essential insight into the balance between security and social opportunity, highlighting that safety features alone do not ensure a sense of security, as individual perceptions and preferences are also consequential.
- **Subjective dignity:** The older adults reiterated concerns regarding safety, emphasising the importance of subjective dignity. While Shower Chair B offered comfort, concerns about slipping forward remained, highlighting the need for designs that enhance confidence and security. This observation highlights that comfort and safety are inherently linked to dignity, and design considerations should prioritise both physical and psychological well-being.

Independence and Control – Autonomy, Belonging and the Impact on Self-Esteem. The impact of AT on power dynamics was evident in the older adults' experiences, influencing their autonomy, sense of belonging and emotional well-being. Therefore, designs should aim to promote independence and control, empowering older adults to participate actively in their care and maintain their sense of self.

- **Worsened autonomy:** The design of Shower Chair B adversely affected power dynamics, diminishing older adults' autonomy and sense of belonging. CR6 (who replaced CR2, see Table 7 in Section 4.3.3 and User Testing Protocol in this section) stated, *'My helpers always rushed when they washed me with this chair.'* This illustrates how shower chair design can unintentionally disrupt established care routines, leading to feelings of disempowerment and a loss of control in older adults. Furthermore, CR1 noted, *'When she [the carer] has more time, she listens to me and talks.'* This remark highlights the interconnectedness of power and reliance, impacting the dual dimensions of dignity (autonomy and self-esteem).
- **Impact on self-esteem:** The design of Shower Chair C negatively affected older adults' self-esteem. CR4 stated, *'I thought I was locked inside. I don't know if it was good, but it was uncomfortable.'* CR3 added, *'When I was sitting, I felt I was weaker. It was a very serious machine.'* These remarks reveal how AT can affect emotional well-being, underscoring the importance of considering not only functional aspects but also the aesthetic and symbolic qualities of the design. The feeling of being 'weaker' and the association with a 'serious machine' suggest a loss of control and a diminished sense of self-efficacy. This directly supports Design Principle 4 (design for self-esteem and dignity), which emphasises that aesthetics should not be solely intended

for an attractive appearance, as they also influence how older adults perceive themselves.

Comfort as Connection – Emotional Bonds and Quality of Life. The older adults' emotional well-being was closely associated with carers' feelings and the shower chair design's ability to foster social interaction and respect. AT design should prioritise both physical comfort and the relational aspects of caregiving, fostering positive interactions.

- **Disconnect between design intent and the subjective user experience:** The comfort features of Shower Chair B, such as a soft backrest and a reclining mechanism, exemplify this disconnect. While older adults perceived comfort from the features, carers highlighted their negative impact, including compromised hygiene, increased workload, and diminished opportunities for building carer–older adult relationships. Shower Chair C revealed a trade-off between comfort and connection. Although ergonomically beneficial for some carers, this design presented increased time demands, resulting in a time-constrained care routine that limited meaningful interaction, demonstrating how intended efficiency can hinder relational quality.
- **Mixed effects on emotional well-being:** Comfort features exhibited mixed effects on emotional well-being and interpersonal connections. Some older adults found the shower chairs enjoyable and secure. For example, CR6 remarked, *'It's fun to be seated. And I don't need to be scared when they put me in the chair.'* However, others experienced feelings of confinement and discomfort. This divergence indicates that although comfort is associated with a sense of safety, the 'safety' features of the shower chair may be

perceived as restrictive and dehumanising rather than comforting and supportive.

Summary. The varied experiences of older adults using these shower chairs highlight the importance of tailored design strategies that address their individual needs and preferences. While safety remains a primary concern, designs must also promote autonomy, dignity and a sense of connection. Effective AT design should enable older adults to participate in their care by recognising their lived experiences and incorporating their perspectives into solutions that genuinely enhance their quality of life.

5.2.3 Synthesis: Dignity-Conscious Design Principles for Shower Chairs

The user-centred evaluation of three existing shower chairs revealed critical insights into the complex relationship among AT, dignity, and caregiving. Although each shower chair was designed to offer support and enhance the showering experience, their designs had varying and often unintended consequences for both older adults and carers. The synthesis below (Table 8) summarises the key findings from the thematic analysis, emphasising the trade-offs present in existing shower chair designs and outlining practical design principles for developing dignity-conscious solutions.

Theme	Stakeholder Perspectives	Shower Chair A	Shower Chair B	Shower Chair C
Safety and Security	Carers	Low physical strain, simple use; concern for increased workload during transfers. Clear	High physical strain due to weight/size; exacerbated accident risk.	Reduced physical strain due to the transfer feature, but increased time/complexity is a concern; trade-offs

		view during cleaning.		with transfer assistance.
	Older adults	Relies on trust in carer competence; can feel insecure; comfort is important.	Enhanced comfort in the reclining seats but heightened anxiety from potential slipping; restricted manoeuvrability.	Mixed feelings of safety and comfort regarding front guardrail; can feel locked in; backward movement causes feelings of insecurity.
Independence and Control	Carers	Easy to use, supports the autonomy of older adults; clear access for washing older adults.	Diminished capacity and emotional frustration; operational complexity due to dimensions.	Usability contingent on cognitive abilities; offers a distinctive transfer feature but takes longer to activate.
	Older adults	Limited opportunities for independent action; relies on carer attentiveness to ensure safety.	Worsening power dynamics and reduced autonomy; carer prioritising speed.	Easy to wash but requires more assistance, which lowers level controls; loss of self-esteem from loss of independence.
Comfort as Connection	Carers	Potential for attentive care through ease of use, <i>enhancing emotional comfort for older adults.</i>	Limited connection with older adults; diminished patience due to the complexity of use.	Frustration due to time constraints and task complexity.
	Older adults	Easy to feel connected with the carer; emotional comfort and	Limited perceived comfort; weakened connection.	Mixed feelings of comfort with the front guardrail; feeling secure versus feeling controlled.

feelings of
safety.

Table 8. *Comparative Analysis of the Three Shower Chairs*

The key findings and their corresponding design principles (DPs) are as follows:

1. **Safety is multifaceted (DP1):** Safety extends beyond merely preventing falls or reducing physical exertion. It includes both objective (measurable risks) and subjective (a sense of security) considerations. Designs must address both aspects to promote a true sense of security and well-being for both older adults and carers.

***Implication for Design:** Consider features that provide physical safeguards and a sense of security and control with visually perceived assurances, such as robust structure and material.*

2. **Independence and control are crucial for dignity (DP2):** Designs that unintentionally increase dependence or reduce autonomy may negatively affect older adults' self-esteem and sense of worth. Carers should also feel supported and empowered to promote older adults' independence.

***Implication for Design:** Design for supported independence. Include features that allow older adults to maintain autonomy and participate in control during the showering process to the best of their ability, while ensuring carer assistance is easily accessible.*

3. **Comfort extends beyond the physical (DP3):** Comfort is not merely about offering a soft seat or an adjustable backrest. It also includes emotional

reassurance, relational engagement, and a sense of well-being. Designs should facilitate positive interactions between older adults and carers.

Implication for Design: *Foster relational connection through design.*

Potential features may facilitate a feeling of being cared for, communication, and shared experiences between older adults and carers.

- 4. Design for self-esteem and dignity (DP4):** Aesthetics should not be solely intended for an attractive appearance, as they also influence how older adults perceive themselves and how they believe others perceive them. Reducing clinical appearances and incorporating culturally resonant finishes help diminish feelings of vulnerability and social stigma, thereby promoting dignity and self-worth.

Implication for Design: *Apply non-clinical aesthetics to promote self-esteem.*

Ensure that materials and forms minimise the visibility of clinical hardware designed to assist individuals and promote social comfort, making it appear intentional as an object while maintaining its assistive functionality.

These principles, initially established in Phase 1, served as the basis for developing and iteratively refining a new shower chair design. The principles were revisited after prototype testing and restructured around an overarching relational principle: dignity is relationally negotiated, as discussed in Chapter 8 (Section 8.4). The design iterations aimed to incorporate user feedback into a comprehensive solution that enhances dignity, as described in the following section.

5.3 Stage 3: Dignity-Conscious Shower Chair Design and Its Iterations

The principles outlined in Section 5.2.3 were incorporated into the initial design, which was subsequently refined through two iterations (Figure 19). Each iteration was shared with most of the participants from the user-centred shower chair

evaluation, presented as 3D CAD renderings. Feedback was gathered through individual interviews (see the ‘Exploration’ section in Volume 2 for visual documentation of the design explorations). However, due to some older adults’ health issues and carers’ work schedules, not all participants were able to provide feedback on every iteration; participants were randomly selected from those available for each interview. The number of participants varied across iterations (three older adults and five carers for the initial design, four older adults and six carers for Iteration 1, two older adults and three carers for Iteration 2). The iterative process incorporated participants’ insights. This section summarises the iterative process for developing the shower chair design. Comprehensive documentation, including the design synopsis, participants’ feedback, and critical design implications for each iteration, is provided in Appendices H, I and J.

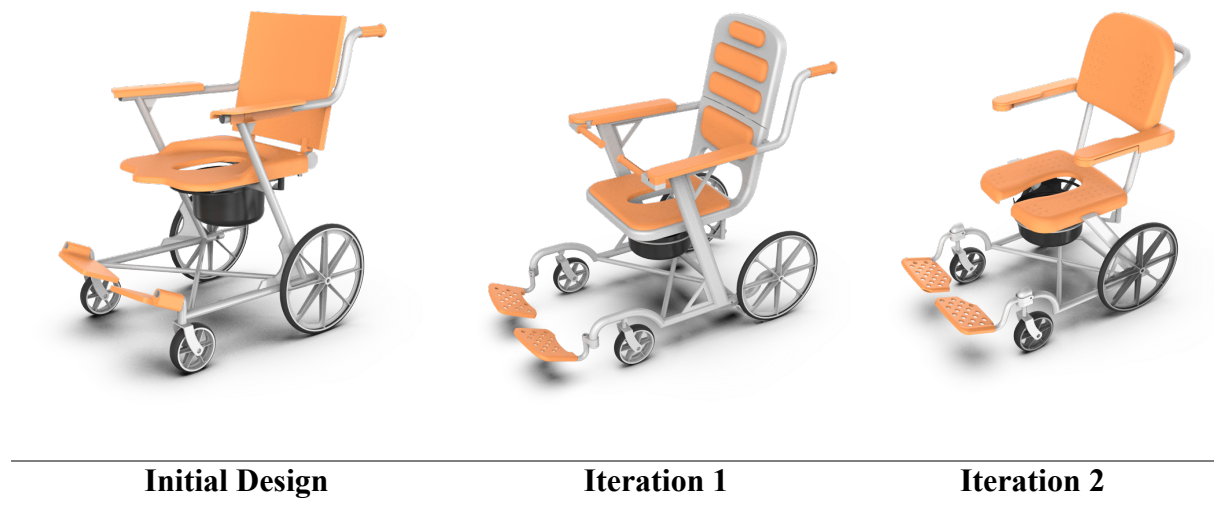


Figure 19. *Three Design Iterations*

5.3.1 Initial Design

This section summarises the initial design. A more comprehensive report, including design objectives and quotations from participants' interviews, is provided in Appendix H.

Design Synopsis. The initial design (Figure 20A) prioritised pragmatic considerations of cleaning and aesthetics while integrating safety and dignity. It aimed to diverge from traditional 'clinical appearances' of AT and to streamline caregiving tasks. A key design element was replacing the vertical beam near the footrest with a diagonal beam (Figure 20B) to improve access for cleaning the lower limbs. Larger wheels were incorporated to improve usability and comfort when navigating steps within the care facility, and the armrests were inclined (Figure 20C) to facilitate easier bed-to-shower transfers.

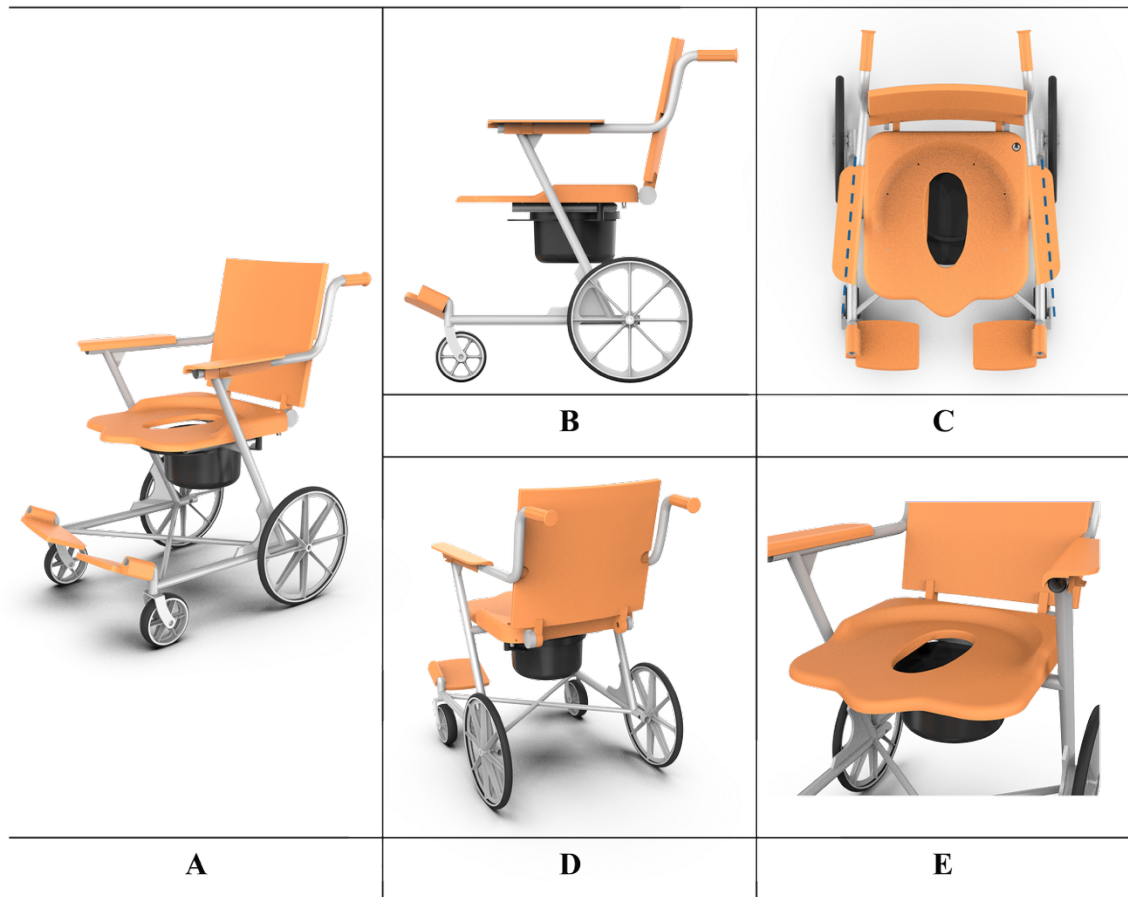


Figure 20. *3D CAD Renderings of the Initial Design*

Participant Feedback. The initial design was presented to three older adults (CR2, CR4, and CR5) and five carers (CG2, CG3, CG4, CG5, and CG6). While the carers appreciated the improved access for cleaning provided by the diagonal beam, they expressed concerns about its perceived structural fragility. The older adults did not share this concern. Feedback on the inclined armrests was unfavourable, and their effectiveness in facilitating transfers remained uncertain. The older adults found the initial seat design uncomfortable due to the wood-like material and the sharp edge of the central protrusion (Figure 20E). They also noted that the shower chair's design differed from traditional aesthetics, a point also acknowledged by the carers.

Design Implications. The following insights were informed by participants' feedback (Table 9):

- Reinforce both the actual and perceived stability of the diagonal beam.
- Address safety concerns related to sharp corners and optimise the size of the toilet bucket opening.
- Refine the armrest design to better support independence.
- Optimise seat comfort.

Feature	Design elements	Intended benefit	Feedback	Relevant design principle
Diagonal beam	Replaced the vertical beam with a diagonal beam near the footrest.	Enhance cleaning access by creating a larger opening and reducing 'clinical appearance'.	Carers liked cleaning access but perceived structural weakness.	Design for self-esteem and dignity (DP4); Independence and control (DP2).
Increased wheel sizes	Incorporated larger front and rear wheels.	Improve usability and comfort when navigating steps within the care facility.	Participants gave no direct feedback on wheel size specifically, but manoeuvrability is a general concern that this aims to address.	Independence and control (DP2).
Inclined armrests	Inclined armrests to create a larger front opening.	Facilitate easier bed-to-shower chair transfers without adding to chair size or complexity.	Participants gave unfavourable feedback, raising doubts about the armrests' effectiveness in supporting transfers.	Independence and control (DP2).
Seat design	Added a protruding middle to guide leg positioning and offer support.	Guide leg positioning and offer support.	Older adults found the feature uncomfortable and unnecessary due to its sharp edge. The material was also questioned.	Comfort extends beyond the physical (DP3).

Table 9. *Attributes and Design Principles for the Initial Design*

5.3.2 Design Iteration 1

This section summarises the first design iteration. A more comprehensive report, including design objectives and quotations from participants' interviews, is provided in Appendix I.

Design Synopsis. Building on the initial design and participants' feedback, Design Iteration 1 (Figure 21A) was developed to address safety concerns and improve the perceived sturdiness of the structure. The improvement also aimed to retain the desired aesthetics (a reduced clinical appearance) from the initial design while enhancing cleaning effectiveness. The primary objective was to balance objective safety, perceived safety and user experience.

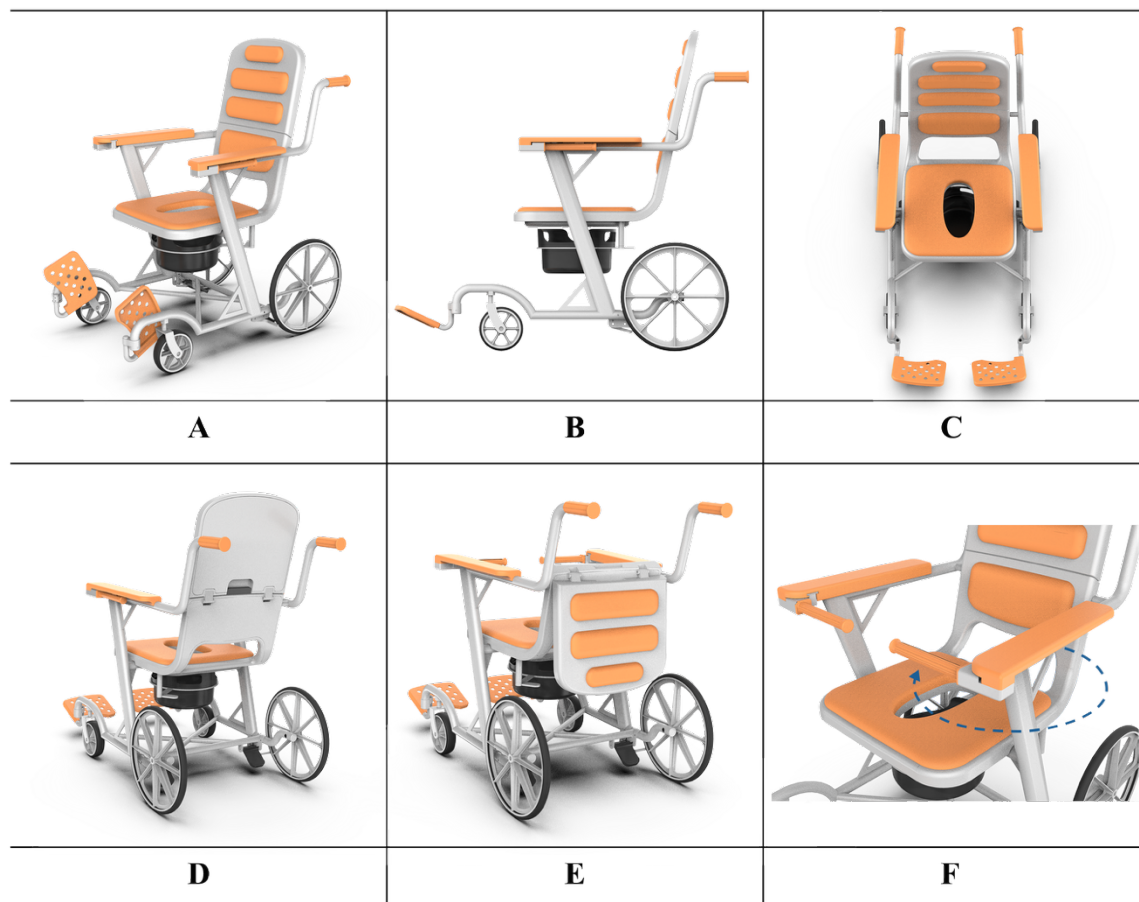


Figure 21. 3D CAD Renderings of Design Iteration 1

Participant Feedback. The updated design (Figure 21A) was presented to four older adults (CR1, CR2, CR3 and CR4) and all six carers, and their feedback was recorded. The carers responded favourably to the reinforced diagonal beam structure (Figure 21B), noting its increased stability. This observation emphasises the crucial role of visual cues in shaping trust and confidence in the design. Nonetheless, the carers perceived the backrest and seat as bulky (Figure 21D) and expressed concerns about the practicality of the segmented cushion pads (Figure 21C) for promoting adequate water drainage. Furthermore, the usability of rotatable handlebars (Figure 21F) and the folding mechanism of the backrest (Figure 21E) emerged as primary concerns among carers, due to the complexity of operating these features. They emphasised the importance of ease of use and suggested a one-handed operation. In contrast, the older adults favoured the folding backrest panel because it could enhance comfort by increasing water contact on their backs.

Design Implications. The following insights were informed by participants' feedback (Table 10):

- Strike a balance between visual sturdiness and lightweight design (to avoid excessive bulk or cumbersomeness).
- Re-evaluate the segmented cushion pad design and consider alternative materials to ensure effective water drainage.
- Simplify the rotation and folding mechanisms to enable easy operation, with a focus on one-handed use.

Feature	Design elements	Intended benefit	Feedback	Relevant design principle(s)
Reinforced diagonal beam	Thicker diagonal beam with larger, hollow triangular support panels.	Improve sturdiness and safety appearance while reducing weight.	Participants gave positive feedback for improved sturdiness and safety appearance.	Safety is multifaceted (DP1); Design for self-esteem and dignity (DP4).
Modified backrest	Increased height, divided into two parts: 1) a foldable upper part with segmented cushion pads, and 2) a lower part attached to the seat.	Improve back support, carer access, cleaning, sitting comfort, and water drainage; ensure older adult safety and prevent falls.	The carers found the backrest and seat bulky and questioned the effectiveness of cushion pads for drainage. They reacted positively to the foldable design but emphasised the need to enhance comfort.	Comfort extends beyond the physical (DP3); Safety is multifaceted (DP1); Independence and control (DP2).
Integrated front handlebars	Handlebars integrated with the armrest, rotatable.	Ensure safety, prevent obstructions during transfers, and empower older adults' autonomy.	Carers liked that handles could be hidden, inquired about locking mechanisms, and emphasised the need for simplicity.	Independence and control (DP2); Safety is multifaceted (DP1).

Table 10. *Attributes and Design Principles for Design Iteration 1*

5.3.3 Design Iteration 2

This section summarises the second design iteration. A more comprehensive report, including design objectives and quotations from participant interviews, is provided in Appendix J.

Design Synopsis. The second design iteration (Figure 22A) focused on simplifying the overall design to improve usability while retaining safety and aesthetic appeal. This simplification included shortening the diagonal beam (Figure 22B) to lessen both visual and actual weight. Removing the diagonal beam allowed the armrest to be detached, enabling rotation (Figure 22F) and easier barrier-free transfers between bed and shower chair. The folding backrest (Figure 22E), initially made of two sections in Iteration 1, was also redesigned as a single-piece seat (Figure 22D). Polyurethane was chosen for the seat and backrest material due to its skin-friendly properties.

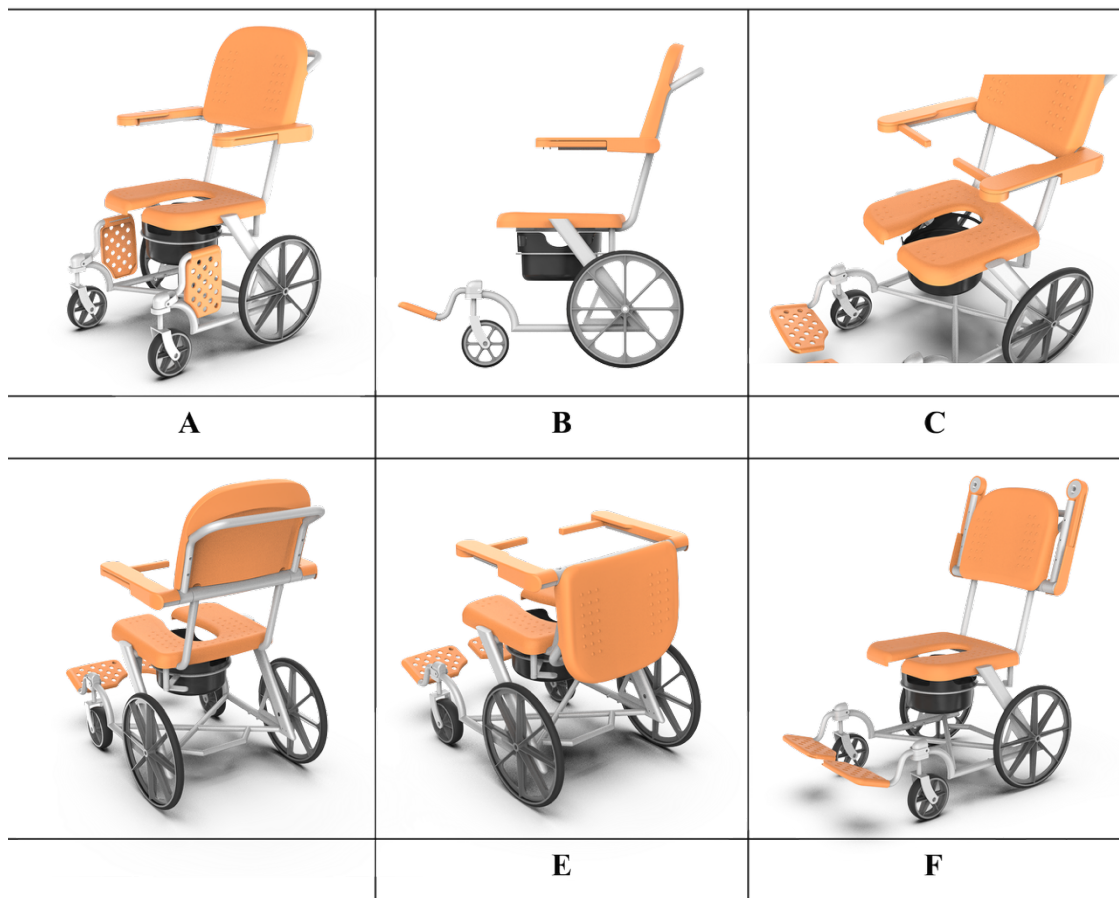


Figure 22. *3D CAD Renderings of Design Iteration 2*

Participant Feedback. The modified design was presented to two older adults (CR2 and CR3) and three carers (CG1, CG2, and CG5), generating mixed feedback. The carers noted a lighter appearance from the shortened diagonal beam, perceiving it as an easily operable feature; however, the older adults did not perceive any benefit from this change. The front safety handlebars (Figure 22C) remained a desirable safety component. The redesigned backrest and seat were well received due to their simplicity and lightweight aesthetic (Figure 22D). While the protruding hemisphere texture (Figure 22E) was aesthetically pleasing, the carers doubted its potential for preventing slippage in real-world conditions. The carers noted that the

redesigned push handle (Figure 22D) improved manoeuvrability and control, although they remained uncertain about its practical application without testing a physical prototype. One carer noted the challenge of assessing the value of design choices based solely on 3D CAD renderings, emphasising that emotional experience and design comprehension are best achieved through real-world testing.

Design Implications. The following insights were informed by participants' feedback (Table 11):

- Aesthetics should go beyond a merely pleasing look and also enhance perceived safety.
- Testing with a prototype is critical for gathering user insights.
- Safety and easy mobility for care efficiency remain essential elements for future development.

Feature	Design elements	Intended benefit	Feedback	Relevant design principle(s)
Shortened diagonal beam	Shorter diagonal beam, detaching armrest from the structural beam.	Reduce weight; enable armrest rotation for barrier-free transfers.	The carers noticed lighter weight and easier usability. CR2 noted that the edge of the beam was sharp and potentially dangerous for older adults during transfers from bed to shower chair.	Safety is multifaceted (DP1).
Unified material seat/backrest	Single material (polyurethane) for both seat and backrest, with a protruded hemisphere texture.	Improve simplicity and comfort; prevent slippage.	Well received for simplicity, comfort, and lightweight appearance. Carers presented doubts about the effectiveness of the anti-slip texture.	Comfort extends beyond the physical (DP3); Safety is multifaceted (DP1).
Redesigned handlebar	Handlebar functioning as a lock-and-unlock switch for rotating the backrest, enabling one-handed operation.	Streamline assistance, enhance carer comfort, foster a sense of security for the older adult, and allow the carer to maintain contact with the older adult's back.	Appreciated for easy navigation and backrest folding. The carers and older adults did not recognise the value of a one-handed operation design for folding and its safety impact.	Safety is multifaceted (DP1); Comfort extends beyond the physical (DP3).

Table 11. *Attributes and Design Principles of Design Iteration 2*

To compare the perspectives of older adults and carers and connect emerging themes to the integrated dignity framework used in this thesis, Table 12 summarises

the four design principles for Iteration 2 from each stakeholder perspective and links them to the relevant dignity dimensions.

Design principle / theme	Older adults' perspective	Carers' perspective	Linked to dignity dimension(s)
Safety is multifaceted (DP1)	Concern with stability and the felt sense of being secure during transfers and showering; trust in the device as a precondition for relaxing into care.	Need for the chair to remain stable under handling; reduction of fall risk during caregiving; confidence in operating mechanisms one-handed where possible.	Objective dignity (physical safety); sense of security (Nolan).
Independence and control are crucial for dignity(DP2)	Desire to retain agency during showering; ability to control posture, pace, and the level of assistance received.	Recognition of older adults' autonomy; managing the boundary between adequate and excessive assistance; the chair as a means of supporting, not replacing, the older adult's effort.	Subjective dignity; sense of purpose and sense of significance (Nolan).
Comfort extends beyond the physical (DP3)	Physical comfort (seat surface, draught, support) and relational comfort (not being	Reduction of physical strain and emotional labour during care; perception of the older	Subjective dignity; sense of continuity and sense of belonging (Nolan).

	rushed; feeling attended to).	adult's ease as a marker of caregiving quality.	
Design for self-esteem and dignity (DP4)	Avoidance of clinical, stigmatising appearance; preference for everyday-product aesthetics that do not signal frailty.	Pride in offering a non-medical-looking chair to older adults; the appearance of the chair as a signal of how the older adult is regarded.	Subjective dignity; sense of significance and sense of belonging (Nolan).

Table 12. *Comparison of Older Adults' and Carers' Views on Iteration 2 Design Principles Linked to the Dignity Framework*

The comparison highlights two key patterns. First, both older adults and carers share concerns about safety and comfort, but they differ in how they define independence: older adults see it as maintaining their own agency, while carers view it as providing adequate assistance without overstepping. Second, nearly every design principle addresses both an objective aspect of dignity, such as physical safety, protection, and function, and one or more relational aspects, including Nolan's concepts of belonging, significance, and purpose. The integration of these dimensions—rather than treating them separately—is what makes the principles genuinely dignity-conscious, as this research explains. Full participant feedback supporting this synthesis is included in Appendix H.

5.4 Stage 4: Translation of Design Principles to Design Schemes

The design principles (Section 5.2.3), derived from synthesising findings from the user-centred evaluation of shower chairs (Section 5.2.2), guided the iterative design process. These principles were 1) safety is multifaceted, 2)

independence and control are crucial for dignity, 3) comfort extends beyond the physical, and 4) design for self-esteem and dignity. Although these design principles can inform the fundamental design intent for features in a shower chair, their broad implications indicate the need for specific but structured guidance in the form of design schemes to be applied during prototype production. These design schemes are crucial instruments, guiding not only the decision-making process in prototype development but also the evaluation of user test outcomes.

Considering the implications of each design principle, the design schemes are organised into three categories (Table 13): experienced dignity, factors influencing dignity – safety, and factors influencing dignity – comfort.

- **Experienced dignity:** This category directly reflects the study’s core aim—to understand how the design impacts the *lived experience* of dignity for both older adults and their carers. It aims to capture the holistic sense of dignity that participants directly associate with their experience of using the shower chair. It reflects the overall feeling of being respected, valued and recognised for one’s inherent worth.
- **Factors influencing dignity – safety:** This category acknowledges the non-negotiable importance of safety and explores how the design of specific elements and mechanisms contributes to or detracts from users’ perceptions of safety and security. It directly addresses the design principle that safety is multifaceted, examining both objective experiences and subjective feelings of safety.
- **Factors influencing dignity – comfort:** This category recognises that comfort is not merely a physical state but also encompasses emotional and social well-being. It adheres to the design principle that comfort extends

beyond the physical, investigating how design features affected users' sense of safety and comfort.

Design principle	Design scheme	Aims
Safety is multifaceted (DP1)	Factors influencing dignity – safety	Explores how the design (e.g. features and materials) contributed to objective safety (e.g. reducing falls and preventing injury) <i>and</i> to users' subjective sense of security.
Independence and control are crucial for dignity (DP2)	Factors influencing dignity – safety; experienced dignity	Explores the perception of control and the degree of self-sufficiency experienced while using the shower chair.
Comfort extends beyond the physical (DP3)	Factors influencing dignity – comfort	Examines how design choices influenced users' psychological and emotional well-being, evaluating whether they felt worthy and respected and whether they experienced any positive effects.
Design for self-esteem and dignity (DP4)	Factors influencing dignity – comfort; experienced dignity	Examines how users' self-perception and sense of worth are affected, especially through aesthetics, personalisation and design choices that reduce clinical appearance and enhance a positive self-image. This is a primary indicator of their subjective sense of dignity.

Table 13. *Design Principles and Corresponding Design Schemes*

By using these design schemes, the research facilitates a deeper understanding of the trade-offs and tensions involved in designing AT for elder care and a structured analysis for the prototype user test.

5.5 Chapter Summary

This chapter discussed the PD approach to exploring dignity in the design of assistive shower chairs. Research Phase 1 consisted of four stages: introductory focus groups, a preliminary design and user-centred evaluation of shower chairs,

shower chair design iterations, and the creation of design schemes. The design schemes, developed through iterations with user feedback, enhance functionality and usability by integrating three key theoretical frameworks. Building on the insights gained from Research Phase 1, the following chapter details prototype production and user testing (Research Phase 2).

Chapter 6: Prototype Production and User Testing

6.0 Introduction

This chapter describes the transition from theoretical and iterative design refinement (Research Phase 1) to the development of a functional assistive shower chair prototype (Figure 23B; see the ‘Realisation’ section of Volume 2 for visual documentation of the prototype production). It describes the production process, highlighting the rationale behind the design decisions that influenced the final design, acknowledging the tensions between conceptual objectives and the practical context of elder care. It concludes with a description of the preparations for actual prototype user testing (detailed in Chapter 7), including safety certifications, human ethics approval and participant recruitment.

**A****B**

Figure 23. *Initial Prototype (A) and an Intermediate Prototype (B)*

The third design of the shower chair in Research Phase 1 served as the foundation for the prototype and underwent multiple stages of refinement. This refinement (outlined in Figure 24) included design adjustments to incorporate standard components, which were off-the-shelf items selected for typical dimensions and materials commonly used in wheelchair or shower-chair applications. These components, like metal beams, hinges, and wheels, enhance production efficiency by utilising readily available parts, eliminating the need for customisation. The visible surface discolouration of the wheels in Figure 23 is due to photographic conditions; no rust was observed on the castors during use. The mechanism for moving parts, such as rotating and folding hinges, was refined through improved structural design developed via designer-led iterative sketching, prototyping, and adjustments in collaboration with a professional manufacturer to achieve effective movement. Each

design stage presented distinct challenges, requiring careful consideration of material properties, structural integrity, user safety, and carer usability.

An initial prototype (Figure 23A) was produced, focusing on mechanisms and durability to ensure safety while addressing the functional requirements derived from the synthesis of theoretical frameworks and participant feedback. A professional prototype manufacturer specialising in metal fabrication produced metal structures with moving components. They tested the prototype's durability and made necessary adjustments through iteration.

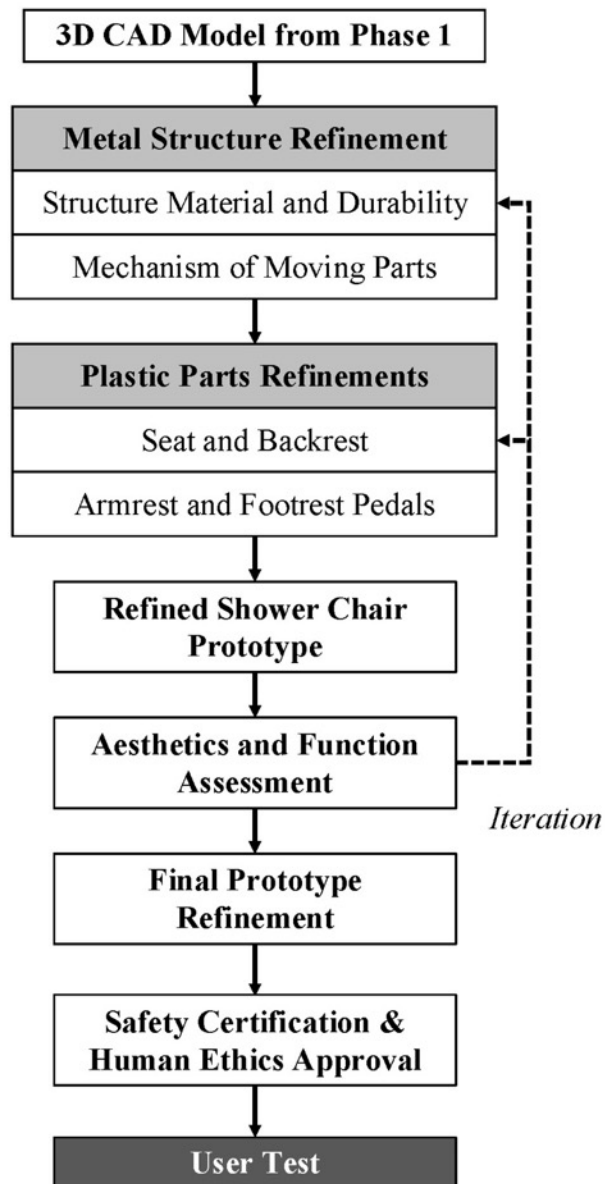


Figure 24. *Flowchart of Shower Chair Prototype Production*

The process for the non-metal components, including the seat, backrest, armrest, and footrest, involved fabrication from polyurethane (PU) and polycarbonate (PC). Before fabrication by a professional manufacturer, these components were initially 3D printed to ensure precise dimensions and compatibility with the metal framework; necessary adjustments were implemented through iterative refinements. The prototype manufacturer assembled, tested, and iteratively

refined the metal structure and plastic parts until they met user testing requirements. The completed prototype (Figure 23B) was presented to the participants for evaluation of its aesthetics and functionality before user testing. The following sections describe each refinement step and the reasons behind the adjustments.

6.1 Stage 1: Metal Structure Refinement

The metal structure design, focused on safety and functionality, ensured structural reliability, user comfort and ease of use for carers, as addressed in Research Phase 1. This section details the design enhancements implemented in the prototype, focusing on material choice, the durability of the non-traditional diagonal beam structure and the supporting connections used to attach components.

6.1.1 Material Selection

The structure was initially built with steel to assess its structural adequacy during the prototype phase, with surface treatment scheduled after confirming its integrity. In practice, however, the steel structure raised significant issues with rust (Figure 25) and weight due to the material properties. Rust occurred during storage, even in a dry environment, with atmospheric humidity causing observable corrosion within two weeks. Since prototype production was completed by hand and was thus time-consuming, the planned post-integrity surface treatment could not be applied before corrosion became extensive and could not be fixed with surface treatment alone. This might not have been an issue in a faster, mass-production process. Although rust could be addressed with paint or other surface treatments, the weight issue was critical, as it conflicted with the design requirements for ease of use, manoeuvrability, and reduced carer strain. Using an aluminium alloy addressed this by reducing the structure's weight from 15.8 kg (steel, Figure 26A) to 8.1 kg (aluminium alloy, Figure 26B).

Aluminium alloy 6063-T1 was chosen because it is commonly used for assistive-device frames due to its moderate extruded yield strength, good extrudability for tubular profiles, and corrosion resistance suitable for humid bathroom environments (Properties and Selection: Nonferrous Alloys and Special-Purpose Materials, 1990). The professional prototype manufacturer recommended increasing the thickness of the pipe beams from 2.0 mm to 2.5 mm due to reduced strength in the heat-affected zone at welded joints (Mathers, 2002). However, I did not independently verify the durability of the post-weld heat treatment, a limitation acknowledged in the prototype documentation.



Figure 25. *Rust on the Steel Structure Frame*

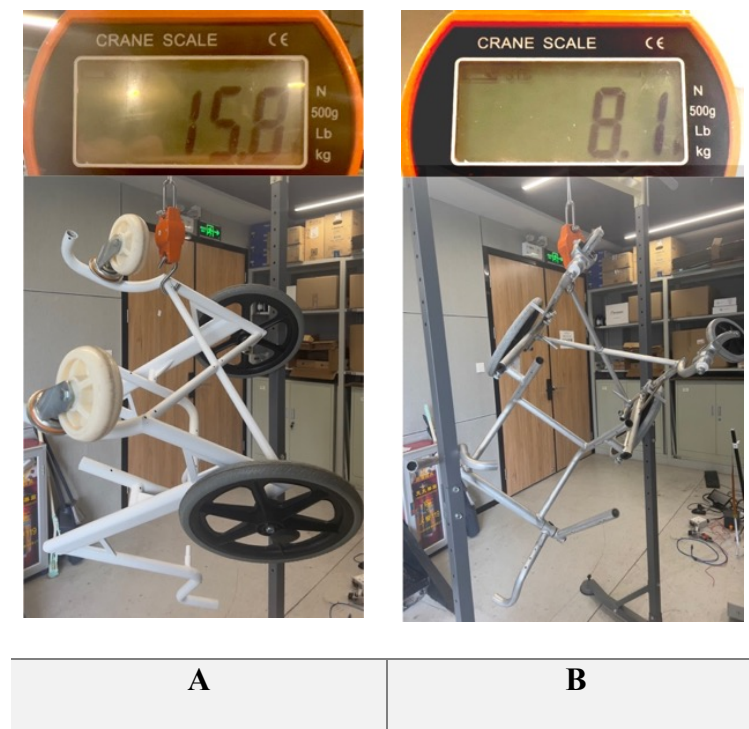


Figure 26. *Structure Weight Comparison Between Steel (A) and Aluminium Alloy (B)*

6.1.2 Structure Durability

As emphasised by both the theoretical frameworks and the design principles, the primary focus in development was on the shower chair's structural strength for safety. Reinforced structural components, such as additional stretchers and middle braces, were incorporated to enhance the shower chair's durability and rigidity (Figure 27). Additionally, the structure incorporated a cylindrical pipe with a 25 mm diameter and 2.5 mm thickness, which aligns with one of the available standard dimensions.



Figure 27. *Structure Design: 3D CAD Model (Left) and Prototype (Right)*

The diagonal beam (Figure 28, left) was crucial in distinguishing the design from conventional shower chairs, providing improved access for washing older adults' lower limbs. However, it raised significant concerns about the chair's

strength, as it replaced the vertical supporting beams (Figure 28, right) that typically support the user's weight while sitting.



Figure 28. *Structure Comparison: Prototype (Left) and Conventional Shower Chair (Right)*

In the participants' feedback on the initial design (Research Phase 1), they also expressed concerns about the structure's strength, perceiving it as potentially weak. This issue emerged as a primary challenge in developing the prototype:

- Increasing the thickness of the diagonal beam proved effective to enhance structural strength. However, this made the structure appear heavier (Figure 29A) than the original design (Figure 29B). The thicker beam might have appeared visually heavier, potentially influencing carer perception, although this was not explicitly tested in this study.

- Steel, a more rigid material than aluminium, was also considered for the diagonal beam. However, although bimetallic aluminium-to-steel joining can be feasible in certain industrial settings—such as bicycle and automotive manufacturing using specialised techniques like friction welding or bi-metallic transition inserts—it was considered impractical in this context due to limited supplier access to these processes. Additionally, the prototype was primarily designed for short-term user testing rather than long-term daily use in the facility.
- Strengthening the structure with a larger triangular supporting bracket influenced the overall design, emphasising the diagonal beam. The larger bracket (Figure 29C) made the sleek diagonal beam appear shorter than in the original design (Figure 29B), affecting its distinctive aesthetic appeal.

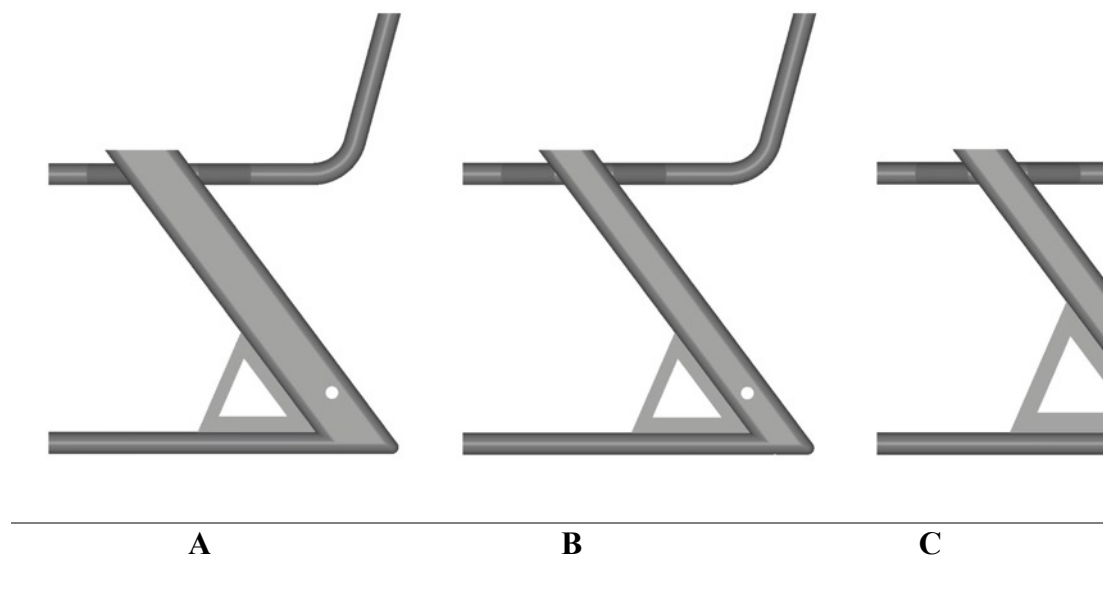


Figure 29. *Proposed Design Solutions to Address Issues with the Diagonal Beam*

The size of the triangular bracket was increased to enhance structural strength, as this can be achieved through design solutions. The bracket's position

inward of the rear wheel may reduce its visibility without interfering with the distinctive visibility of the diagonal beam (Figure 28, left). The diagonal beam also impacted the central supports for seat placement. Compared to the conventional shower chair, which features a four-point mounting structure, this design limits the mounting points to two side walls and uses diagonal beams (Figure 30).



Figure 30. *Comparison of Mounting Points: Prototype (Left) and Conventional (Right) Shower Chair*

Different joint designs were developed and evaluated with the prototype to ensure the seat's safety. Initially, a 'T'-shaped joint was used to attach the middle braces supporting the seat to the diagonal beam (Figure 31A). However, informal designer-led testing, in which I manually sat on and moved the prototype rather than using a systematic instrumented test, showed perceptible front-to-back rocking, suggesting the connection lacked sufficient rigidity. This instability could compromise older adults' sense of security (Nolan et al.'s framework). The 'Y'-shaped joint design (Figure 31B) was therefore chosen to ensure stability.

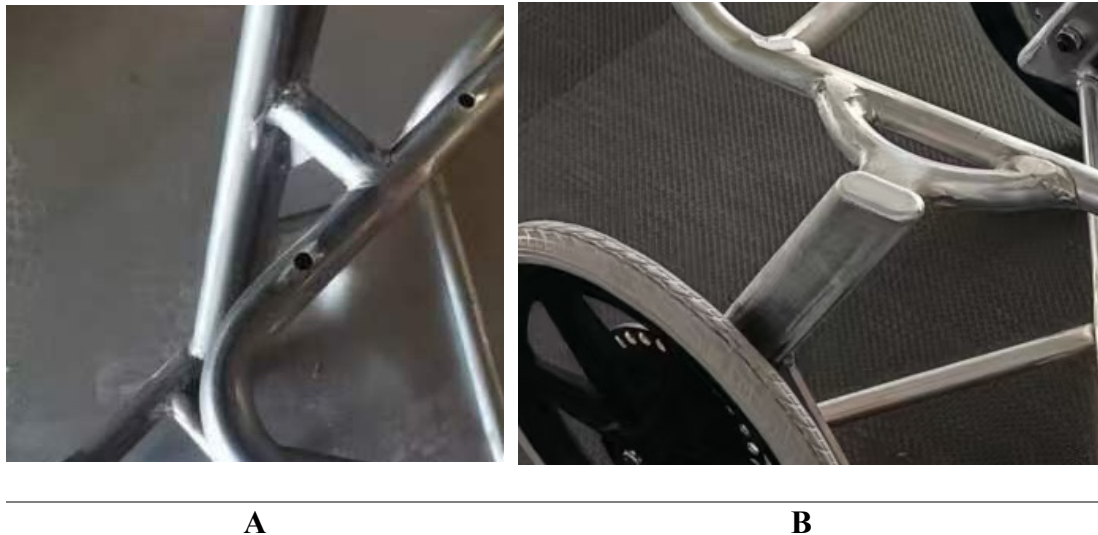


Figure 31. *Comparison of the ‘T’-shaped (A) and ‘Y’-shaped (B) Joint to Support the Seat*

The connection of the front wheel to the main structure also presented multiple challenges following the removal of the vertical front beam, which typically supported the front wheels. The identified issues were resolved through prototype testing:

- The front wheel’s mounting frame was welded to the main structure (Figure 32). However, it could not ensure that the concentrated load at the front could support the weight of an older adult (approximately 981 N for a 100 kg user; treated as a quasi-static occupant load). To reduce the concentrated load, the crossbeam was integrated with the welding point, forming a three-point joint that strengthened the weld and distributed the load in three directions.



Figure 32. *Structure for Mounting Front Wheels*

- Standard front wheels with an 8-inch diameter, larger than those on conventional wheelchairs, were used to address carers' feedback regarding the steps in the facility (identified during Phase 1 carer interviews and on-site observation) in the facility. However, the height of the standard wheels above the fork ranged from 65 mm to 80 mm (Figure 33A), resulting in a total height of 254 mm. This protrusion affects the safety and comfort of older adults when they enter and exit the shower chair. Therefore, customisation of the standard wheel necessitated reducing its height (Figure 33B). This was achieved by selecting an alternative wheel fork with the same wheel diameter and reducing the length of the vertical beam connecting the fork to the shower chair's main structure. The customised front wheel in Figure 33B is a different colour from the one in Figure 33A because it was supplied with a black wheel by the alternative fork. This difference in appearance results from variations in the off-the-shelf components used, not a deliberate aesthetic choice.

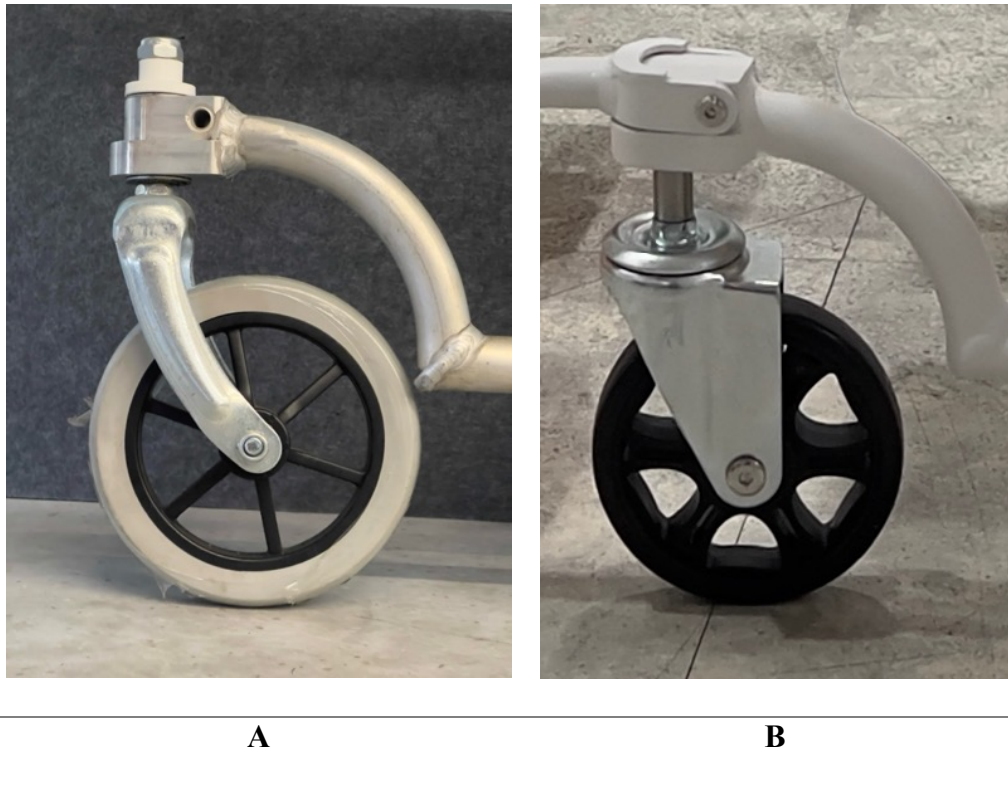


Figure 33. *Heights of Standard (A) and Customised (B) Front Wheel*

6.2 Stage 2: Mechanism of Moving Parts

The shower chair's design includes several adjustable features that support person-centred care, which is essential for maintaining the subjective experience of dignity. These features comprise a foldable backrest, a rotating front safety handlebar, a rotating armrest and a brake. This section explains the rationale for design decisions regarding the selection of specific mechanisms or materials.

6.2.1 Folding Backrest

The folding backrest (Figure 34) is designed for one-handed operation, allowing the carer to use their other hand to gently contact the older adult's back, ensuring safety and respect. In their evaluation of Iteration 2, despite positive feedback on the push handle design, the carers could not recognise the value of a

one-handed folding operation without an authentic experience with the actual product. Therefore, this feature was integrated into the prototype.



Figure 34. *Folding Backrest*

The handlebar of the folding backrest serves two functions, acting as a lock-and-unlock switch for the backrest and as a push rod for carers using the shower

chair. Pulling the handle unlocks the backrest, allowing it to rotate. When rotated back, it automatically locks into place. To enable this function, a gap is required between components for smooth movement. However, this gap caused the handle to shake when the shower chair was pushed, resulting in unstable operation and affecting emotional comfort. Initially, products with similar mechanisms, such as travel luggage and cart trolleys, were analysed to address the issue. However, these mechanisms often required two-handed operation. The subsequent solution was adding a lock to the handle (Figure 35A). While this method may prevent handle shaking, it also compromises one-handed operation by requiring an additional step. The final design incorporated plastic inserts—visible as the black components at the two highlighted positions in Figure 35B; the specific polymer grade was not separately recorded in the prototype documentation, which is acknowledged as a documentation limitation. This was intended to reduce shaking and secure the handle by filling the gap. It should be acknowledged that this revised handlebar configuration was not formally re-evaluated with users or carers after the change; the effect on shaking and one-handed operability is therefore reported as the intended outcome of the design adjustment rather than as a tested result.

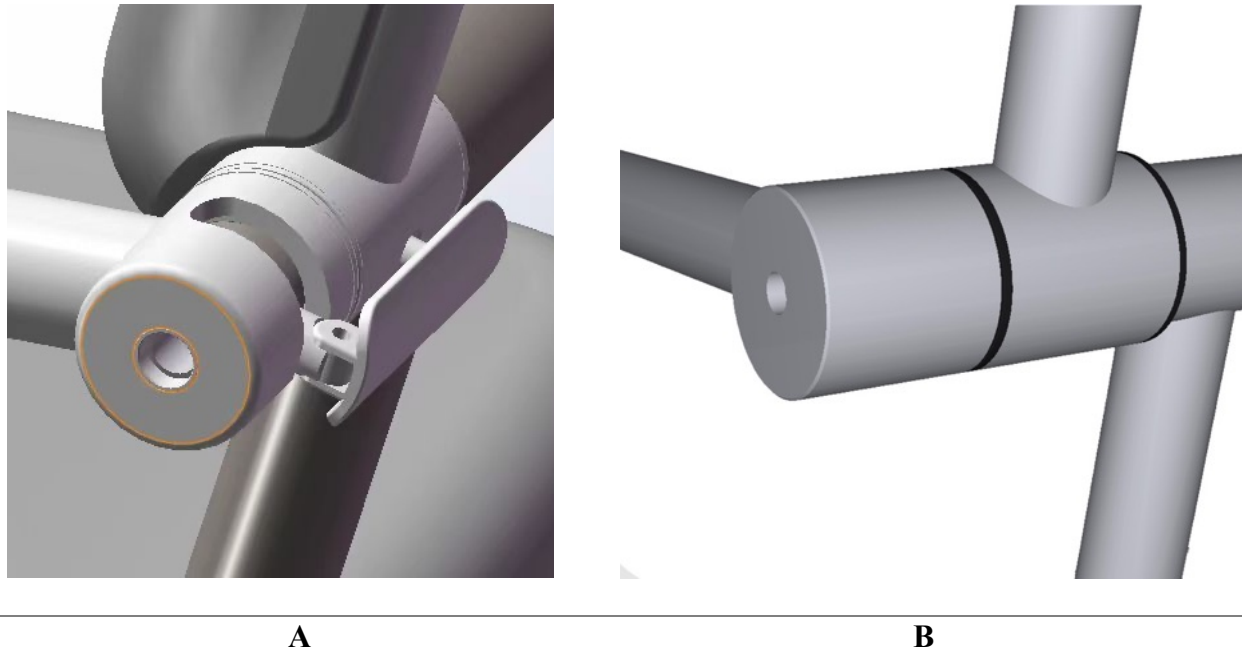


Figure 35. *The Iteration of the Push Handlebar's Lock*

6.2.2 Front Safety Handlebar

Both older adults and carers highly valued the front safety handlebars during Research Phase 1. To prevent obstruction during transfers, the handlebars were integrated into the armrests. However, the operation methods revealed two main challenges: the direction of rotation and the safety lock. The rotation direction impacted the comfort of the older adults and their carers. Rotating from inside to the outside hinders older adults' comfort, as it may touch their abdomens (Figure 36A). Conversely, outer-to-inner rotation could compromise carers' comfort during operation in a small shower room (Figure 36B). Although the design presented to participants in Research Phase 1 used outer-to-inner rotation, both rotation methods were produced in the prototype and tested.

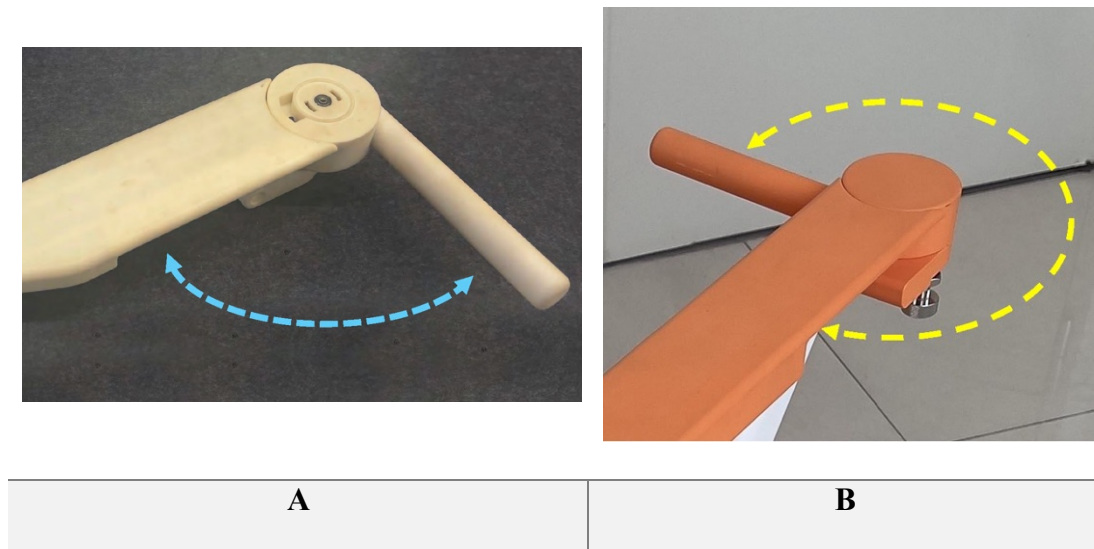


Figure 36. *Front Safety Handlebar Rotation Directions*

The method for operating the lock on the handlebar conflicted with the ergonomically designed control. Initially, a spring-loaded switch (Figure 37) was placed at the bottom of the armrest and tested. The switch is unlocked by pulling the tap, and spring tension locks the pin in place when released. However, this method might limit carers' visibility, challenging the design scheme factors influencing dignity – comfort. The ergonomic design of the control mechanism is essential for a smooth and comfortable assistance process. This locking mechanism required testing the product's comfort during use.



Figure 37. *Front Safety Handlebar Lock Switch*

6.2.3 Rotating Armrest

The goal for the rotating armrest (Figure 38) was to facilitate the safe transfer of older adults between the bed and the shower chair.



Figure 38. *Rotating Armrest: Normal Mode (Left) and Older Adult Transfer Mode (Right)*

This feature was designed to eliminate structural obstacles, ensuring smooth, barrier-free transfers and reducing the risk of falls (factors influencing dignity –

safety). However, this design raised a safety concern. As there was no support for the end of the armrest (Figure 39A), the rotating hinge was required to bear the weight of the older adult (approximately 981 N for a 100 kg user, applied statically at the hinge), especially when sitting or standing. Although the aluminium hinge, machined using computer numerical control technology, limited rotation to 90°, ensuring it provided a sufficient static-bearing margin under this load was challenging.

Therefore, the supporting beam was reinstated, despite the advantages of its removal (Figure 39B). This reinstatement acknowledges safety as the core aspect of objective dignity, as described in Section 1.7.1, ensuring physical safety and an improved sense of security. It emphasises the need to prioritise the protection of older adults over carer usability and design aesthetics in AT development.



A

B

Figure 39. *Initial Rotating Armrest (A) and Its Iteration (B)*

6.2.4 Safety Brake

The safety brake (Figure 40) is crucial for older adults' safety. It provides emotional comfort for carers, allowing them to focus on assistance.

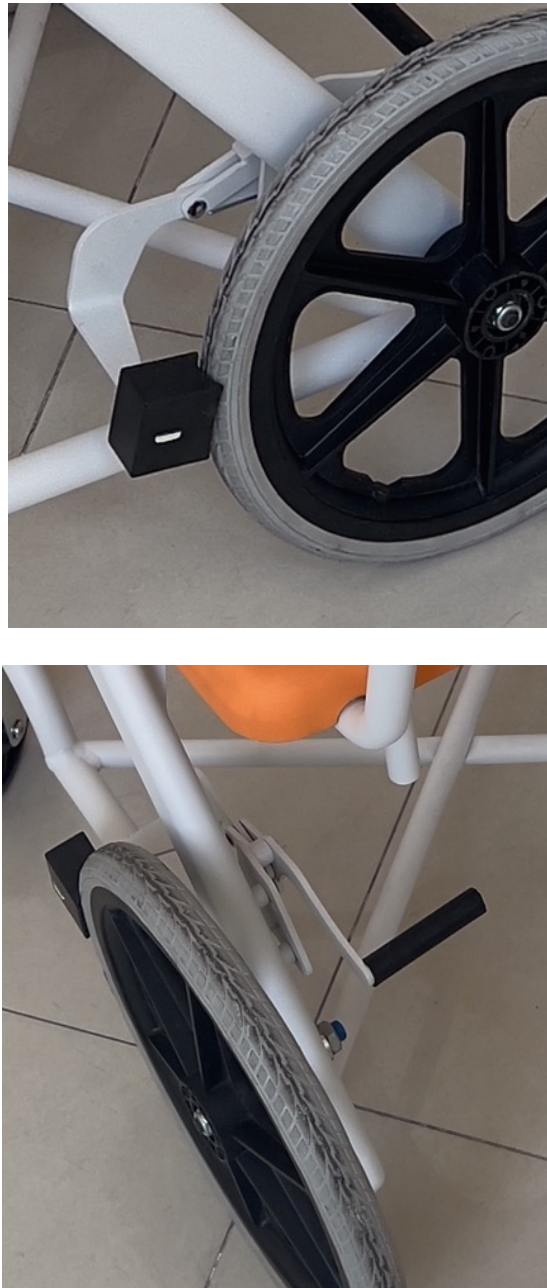
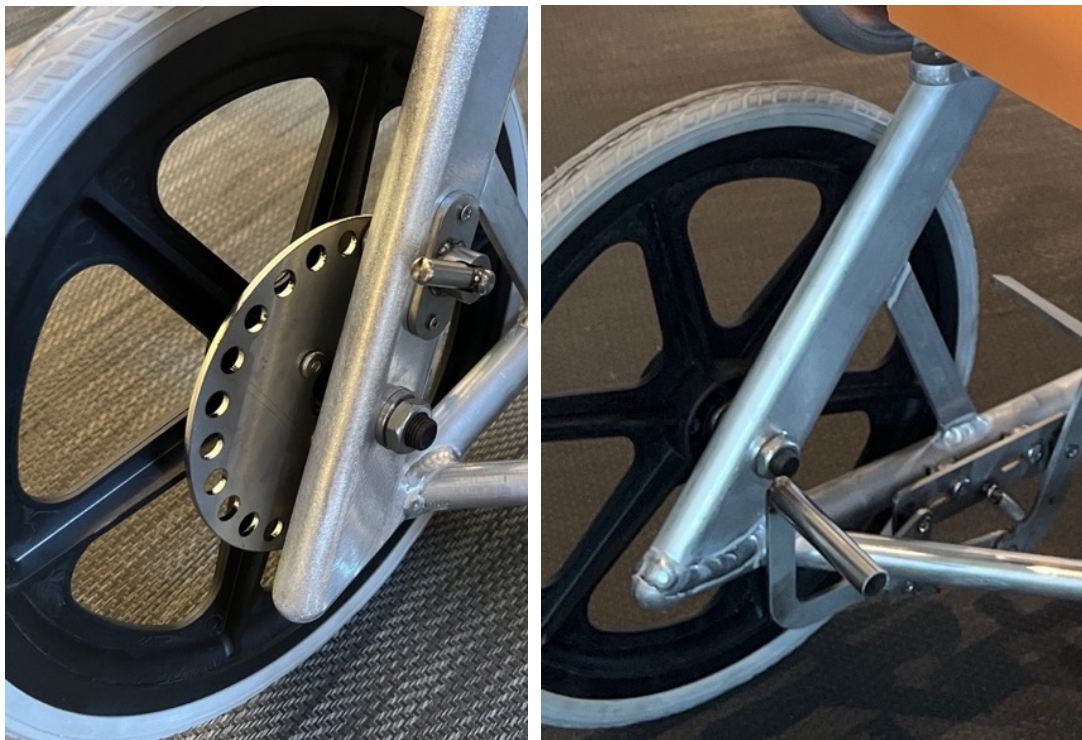


Figure 40. *Safety Brake: Brake Pad (Left) and Pedal (Right)*

At first, a perforated disc with a pin was used (Figure 41A). Locking the wheels by inserting the pin into the hole provided a more robust mechanism than conventional wheelchairs, which rely on friction between the brake blade and wheel rubber. Nevertheless, the distance between the holes posed a significant challenge, undermining the design's attention to emotional and psychological safety. When the shower chair stopped, it shifted slightly to align with the hole for the pin, so it could not stop precisely at the desired position, potentially making older adults feel insecure and reducing carers' confidence. Therefore, the conventional wheelchair braking method (Figure 41B), using a metal blade or plastic stopper, was employed. However, despite its proven functionality, the metal blade raised aesthetic concerns and created a hazardous look, reducing emotional safety.



A

B

Figure 41. *Iterations of Safety Brake Design: Perforated Disc (A) and Metal Blade*

(B)

The final design combined a metal blade with a rubber brake, as shown in Figure 40 (left). The oversized rubber brake pad emphasises safety and durability, hiding the metal blade to achieve a softer appearance. This approach balances proven mechanical solutions with pleasing aesthetics, addressing safety concerns while maintaining functionality and comfort.

6.2.5 Foldable Footrest

A foldable footrest is a critical design feature for transferring older adults between the bed and the shower chair. The front wheel and the footrest share a linkage block, which simplifies the connection to the main structure (Figure 42A) and maintains access for cleaning older adults' lower limbs. Additionally, the footrest can be folded beneath the seat and completely concealed (Figure 42B), thereby reducing the shower chair's overall size and facilitating carers' manoeuvrability in and out of the older adult's room.

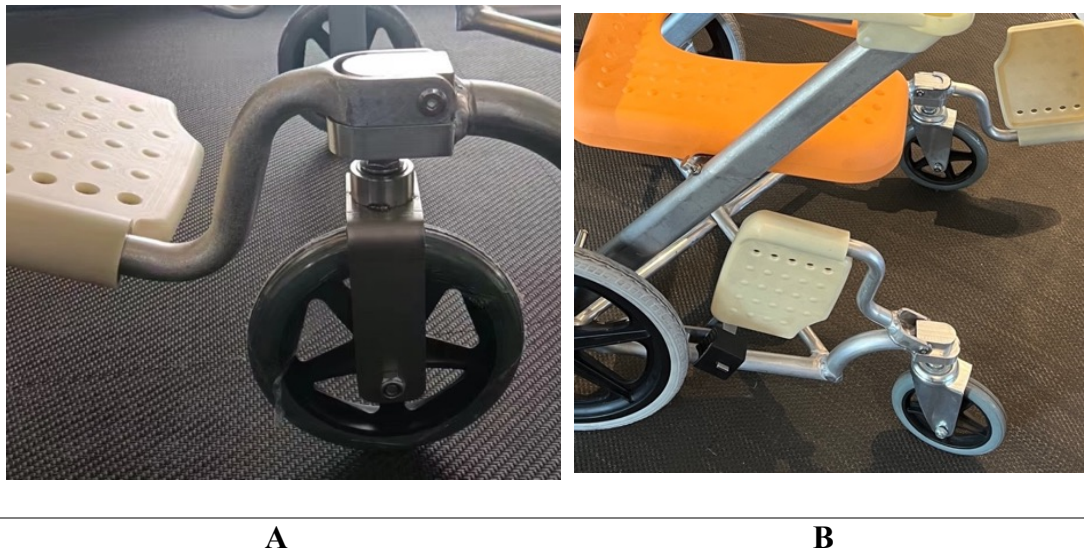


Figure 42. *Foldable Footrest*

6.3 Stage 3: Non-Metal Components Refinement

The shower chair's design includes several key non-metal components—the seat, backrest, armrests, and footrest pedals—that directly interface with the user. The commode bucket was excluded from the design based on the carers' feedback in Research Phase 1, which indicated infrequent use during short (under 10-minute) assisted showers. Optimising the size, placement, and materials of these remaining components is essential to ensure user safety and comfort. These components were refined throughout the prototype's development.

6.3.1 Seat and Backrest

The primary focus of seat and backrest design was seating comfort for older adults. Although the commode bucket is not part of this project, the commode opening is included, as it allows for enhanced cleaning access with the shower head during showering, ensuring efficient hygiene. Design exploration focused on size and ergonomic factors, especially for the lower edge of the backrest. Prototypes were initially tested as 3D CAD models and produced through 3D printing (Figure 43A).

Following validation of size and shape, components were manufactured using PU foam (Figure 43B). This material was chosen for its water resistance, durability, comfort and lightness. Furthermore, 2 mm aluminium alloy plates were included within both the seat and backrest to provide structural reinforcement, ensuring safety and long-term durability without compromising the foam's inherent softness and comfort. The protruded hemisphere texture, which carers were unable to assess for its effectiveness in preventing slips in Research Phase 1, was incorporated.

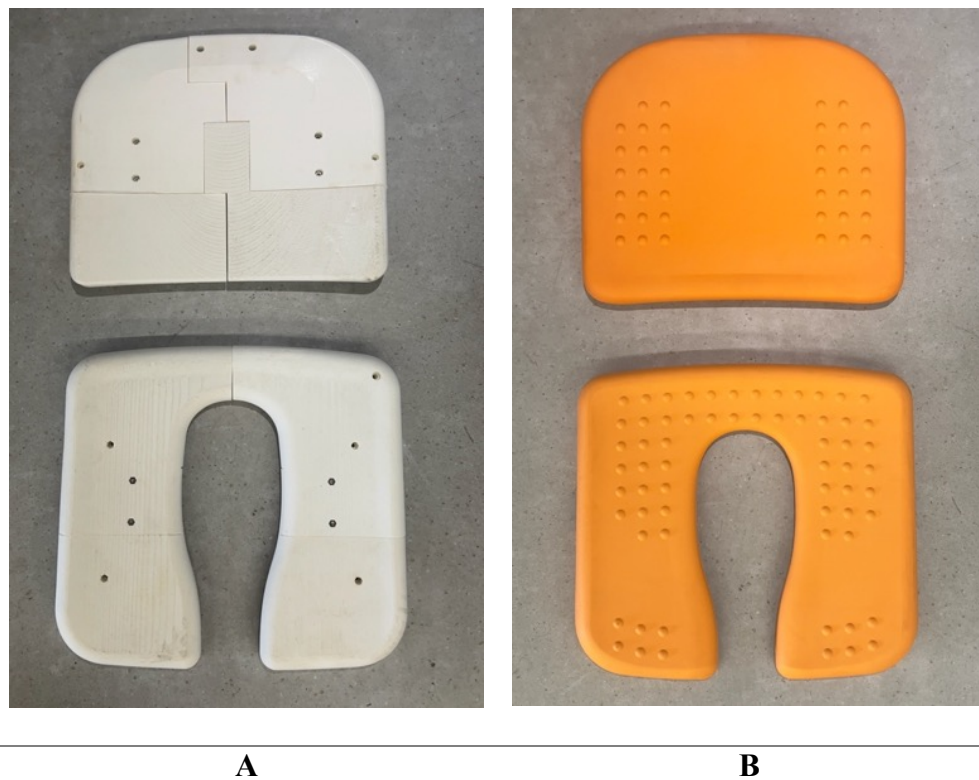


Figure 43. *Iteration of Seat and Backrest: 3D Printed (A) and Polyurethane Foam (B)*

6.3.2 Armrests

The integration of a rotating front safety handlebar significantly influenced the armrest design. Iterations focused on optimising the handlebar's rotation direction and mechanism, with prototypes fabricated and tested through 3D printing (Figure 44). The design also explored the use of plastics, such as nylon, acrylonitrile butadiene styrene, and polycarbonate (excluding the aluminium structural rod), to reduce the chair's overall mass (Figure 45A) and address ergonomic concerns, discussed in Sections 2.3.2 and 2.3.3. A linear static stress analysis was conducted in SolidWorks Simulation using finite element analysis (FEA) to determine if the PC shroud alone could support an acceptable user-applied grip load without the aluminium structural rod (Figure 45B). The model represented only the armrest

shroud; the aluminium skeletal frame, which bears the main bending and shear forces during sitting and transfer, was not included in this sub-model and was tested separately through physical prototype testing and manufacturer validation (Section 6.1.1). The shroud was fixed at its mounting points and loaded with a downward force on the upper grip surface equivalent to a 100 kg user's weight (about 981 N, using $g \approx 9.81 \text{ m/s}^2$). This force was applied as a distributed pressure across the hand-contact area rather than as a point load. The 100 kg value was chosen as a conservative reference for the occupant load: it exceeds the body weight of the older adult participants in this study and provides a margin above their typical weight for the grip-load scenario. This figure is an assumption for this component-level analysis rather than a value based on a formal anthropometric standard. Verification against recognised load requirements and safety factors was obtained separately through the authorised institution's certification testing against applicable Chinese product-safety standards, as detailed in Section 6.6.1.

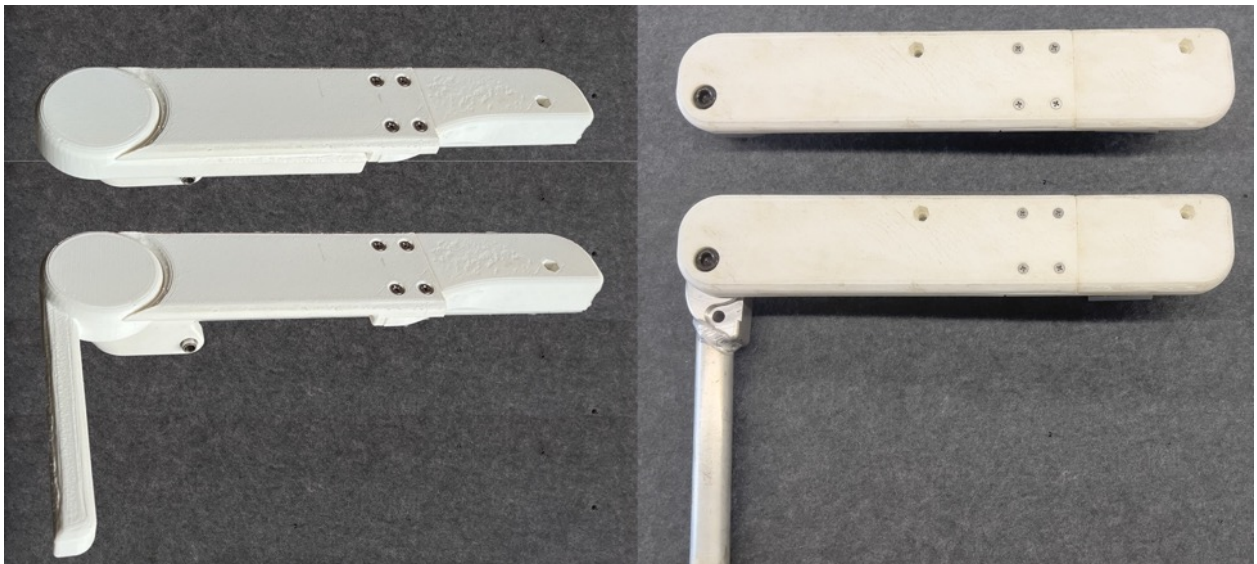
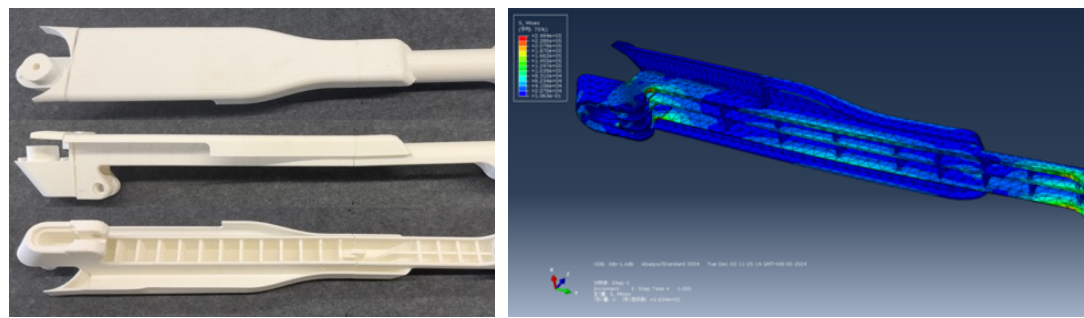


Figure 44. *3D Printed Armrests for Handlebar Rotation Test*



A

B

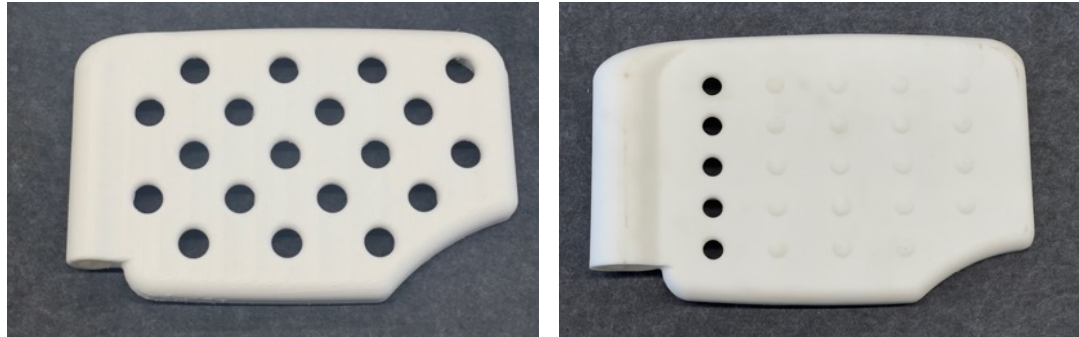
Figure 45. *Armrest Design Excluding Aluminium Support (A) and Durability Simulation (B)*

The analysis showed that the PC shroud could withstand the applied load within its yield limit, but the safety margin was just sufficient under the dynamic, eccentric loading conditions expected in use, such as during transfer or when lateral pulling forces are applied to the grip. Since the simulation did not account for long-term fatigue or combined loads on the shroud and armrest assembly, a steel reinforcement rod was added inside the shroud in the final prototype. Therefore, the FEA should be viewed as a component-level feasibility assessment of the shroud material, not a structural validation of the full armrest assembly or chair. Full-assembly validation was confirmed through the manufacturer's physical load testing before user testing, as described in Section 6.1.1.

6.3.3 Footrest Pedals

The footrest design prioritised seamless integration with the shower chair's overall aesthetic. Initial designs incorporated holes to facilitate water drainage during showers (Figure 46A). However, given that an older adult's foot would rest on the holes, this feature was removed. The final design adopted the same protruded

hemisphere texture as the seat and backrest (Figure 46B), ensuring consistency in design details and slip resistance. PC was selected as the material due to its beneficial characteristics, as mentioned regarding the armrests (Section 6.3.2).



A

B

Figure 46. *Iteration of Footrest Pedal Design: Initial Design (A) and Final Design (B)*

6.3.4 Section Summary

This section described the iterative development of the Research Phase 2 shower chair prototype, highlighting the key design decisions informed by user feedback and design schemes in Research Phase 1. The process emphasised balancing safety, functionality and aesthetics through material selection, structural enhancements, and component-level design. Although each design iteration considered dignity-related experiences, safety was prioritised. The completed prototype was presented to participants at the same elder care facility for evaluation of its functionality and aesthetics. The following section discusses their feedback on the design's perceived quality and impact on dignity.

6.4 Stage 4: Function and Aesthetics Evaluation

Before formal user testing, the shower chair prototype (Figure 47) was assessed at AiDaKang elder care facility, which also participated in Research Phase

1 (see the “Evaluation” section of Volume 2 for visual documentation of participants’ involvement). Due to ongoing safety inspections and ethics approval processes, direct use and testing by participants were not permitted at this stage. Instead, I demonstrated each feature and design element, and participants provided verbal observational feedback. This approach aimed to gather preliminary insights into the design’s features, aesthetics and potential to improve the showering experience. All participants had sufficient communication skills to participate actively in meaningful discussions.



Figure 47. *Dignity-Conscious Shower Chair Prototype*

6.4.1 Carers’ Feedback

The carers (aged 46–60 years) with experience ranging from 4 months to 10 years (Table 14) provided their insights.

Participant	Sex	Age	Length of experience
CG7	Female	53	6 months
CG8	Female	46	1 year
CG9	Female	47	10 years
CG10	Female	51	4 months
CG11	Female	60	1 year

Table 14. *Demographics of Carer Participants in Research Phase 2, Stage 4*

Overall Design and Aesthetic Evaluation. The carers generally expressed positive initial impressions. CG7 stated, *‘This is a new shower chair. It looks much better than the current one.’* Similarly, CG9 remarked, *‘It looks excellent; much prettier than the shower chairs I found online.’* These comments suggest that the shower chair’s aesthetic design is an improvement, potentially reducing clinical associations and feelings of dependence, thereby enhancing self-esteem (Gallagher’s subjective dignity; DP4). However, these initial responses are insufficient to fully validate the design’s effectiveness in promoting dignity, as Gallagher’s framework requires a comprehensive assessment that considers both objective and subjective aspects.

Feature-Specific Evaluation

- **Opened lower bottom:** This feature received mixed reviews. While some raised concerns about possible conflicts with toileting, others highlighted potential benefits in terms of autonomy and hygiene. CG7’s comment, *‘Some older adults want to wash their own lower bodies; the open space allows them to do so’*, is particularly relevant in terms of autonomy, as well as providing a sense of purpose and achievement (Nolan et al.’s framework).

CG9 also found this feature convenient for washing the older adults' private parts, potentially reducing carer burden.

- **Folding armrest:** Overall, participants gave positive feedback regarding improved safety and ease of transfer. CG8 emphasised the folding armrest's importance for safely transferring heavier older adults. At the same time, CG11 appreciated its potential to reduce carer fatigue and allow direct transfer from the shower chair to the bed. However, CG10 cautioned, *'There were too many steps to fold the armrests, which is complicated'*, highlighting the need for simplification to ensure usability across different carer skill levels. This critique indicates a potential usability challenge that may particularly affect carers with limited training or physical ability.
- **Rotating backrest:** This feature was critically assessed for its potential limitations. CG9 remarked, *'It can wash more areas of the back'*, indicating the possibility of enhanced cleaning, improved effectiveness, and greater comfort. However, she also cautioned that time constraints might lead carers to bypass the feature: *'If I were to use this shower chair, when time is tight, I might bend the older adult's waist a little bit and put my hands behind their back to clean it.'* Participants also raised concerns about the need for two-handed operation, which could compromise safety. Although the design was intended for one-handed use, the prototype's fit and finish required a two-handed demonstration.
- **Front safety handlebar:** This feature was consistently praised for its fall-prevention mechanism, which promoted a sense of security, autonomy, and self-efficacy. CG7 considered this feature the top priority, emphasising 'safety first'. However, as the rotation direction was from the inside to the

outside, participants suggested that the handles be shortened to prevent them from hitting the older adult's stomach, indicating a need for dimensional adjustments. This suggestion was addressed in the prototype revision.

- **Footrest:** Carers generally responded positively regarding the pedal's comfort and slip resistance. However, CG7 noted a reach-distance concern: older adults with shorter lower limbs might not be able to fully rest their feet on the pedals. The impact on subjective dignity is indirect and would only occur if unstable foot support led to feelings of insecurity during showering. This was not directly tested in this study and is proposed as a hypothesis for future research.

The carers' feedback (Table 15) reveals a complex interplay between functionality, safety and user dignity. Addressing these issues is crucial to meeting the needs of both carers and older adults and promoting a more dignified, comfortable showering experience.

Feature	CG7	CG8	CG9	CG10	CG11
Opened lower bottom	Saves carer effort during washing.	Concern (inferred): Opening may cause discomfort for older adults during extended sitting.	Convenient for washing older adults' private areas.	Concern: Design may be unsuitable if the older adult defecates during the shower.	Helps the carer wash the older adult's private areas.
Folding armrest	Reduces transfer risk by preventing the older adult from gripping surrounding objects.	Prevents the older adult from grabbing handles at random, which is dangerous during transfer.	Shortens transfer distance, which is convenient for carers.	Concern: Too many steps to fold; operation is complicated.	Reduces carer effort; enables direct transfer to the bed.
Rotating backrest	Expands the washable area of the back.	Expands the washable area of the back.	Expands washable area; improves comfort for the older adult (attributed inference).	Concern: Difficult for novice carers to operate.	Expands the washable area of the back.
Front safety handle	Very good, but safety relies solely on the safety handle.	General positive response; no specific observation recorded.	Very good, but safety relies solely on the safety handle.	Indicates preference for a handle over a no-handle alternative.	Reports that handles help older adults feel safe (attributed inference).

Footrest	Appears comfortable; raised dots provide slip resistance. Concern: Shorter-legged older adults may not be able to reach the pedal.	General positive response; no specific observation recorded.	Design-property observation only (folds and stows under the seat). Not a use observation.	General positive response; no specific observation recorded.	Noted slip resistance and softness; 'safe' and 'comfortable,' not further specified.
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Table 15. *Summary of Carers' Feedback*

6.4.2 Older Adults' Feedback

The participant group included four older adults (one male and three females) with varying ages and lengths of stay in elder care facilities (Table 16), who shared their experiences with the prototype.

Participant	Sex	Age	Length of residency
CR7	Female	70	Uncertain
CR8	Male	73	Uncertain
CR9	Female	76	1 year
CR10	Female	83	4 months

Table 16. *Demographics of Older Adult Participants in Research Phase 2, Stage 4*

Overall Design and Aesthetic Evaluation. Older adults' initial responses to the shower chair's overall appearance varied. While CR10 found the design 'excellent' in terms of size and composition, CR9 noted that the armrests and seat

cushion were ‘a bit high’, suggesting a lack of adjustability that fails to meet the diverse physical needs of older adults.

Feature-Specific Evaluation.

- **Opened lower bottom:** Unlike the carers, who offered mixed reviews, most older adults did not notice or provide specific feedback on this feature. While CR7 found the feature aesthetically pleasing, stating, *‘It is nicer looking, and lighter’*, limited input from the other older adults suggests that its main benefit lies in caregiving, which may indirectly affect their experience.
- **Folding armrest:** Feedback on the armrests was mixed. While CR10 found them convenient for carer assistance, CR9 expressed safety concerns, noting the need for additional support due to mobility issues. In contrast, CR7 stated, *‘I do not feel any benefit; they are used in this way anyway.’* Although the feature aims to ensure a safe transfer, this may mostly benefit carers, having similar implications as the ‘opened lower bottom’ feature.
- **Rotating backrest:** The backrest feature received positive responses. CR7 and CR8 noted that the backrest makes cleaning and drying easier. Additionally, CR9 stated that it allows for more flushing, highlighting the comforting (massage) effect of familiar pre-institutional shower routines and emphasising their importance and personal preferences. This observation aligns with continuity theory and a sense of control.
- **Front safety handlebars:** Most of the older adults recognised this feature’s advantages for their safety. CR9 and CR10 stated, *‘The handlebars feel very secure and make me feel at ease; it is safe to sit on*

it.’ This feedback suggests that the handle’s intuitive design effectively addresses both objective and subjective aspects of safety, promoting a sense of purpose and security that surpasses traditional restraints.

- **Seat:** Significant issues arose with the seat design. Both CR7 and CR9 found the opening too narrow, causing discomfort and toileting difficulties. CR8 suggested widening the seat to improve comfort. Although important, this recommendation may conflict with the chair’s intended compact size and the comfort of smaller users. This feedback highlights the importance of adjustability and personalisation in providing person-centred care.

The summary of the older adults’ feedback (Table 17) highlights key insights. While features such as the folding backrest and front safety handlebars received positive reviews for ease of use, concerns arose about the seat design, safety, and the impact on user dignity.

Features	CR7	CR8	CR9	CR10
Opened lower bottom	Aesthetic preference ('nicer looking and lighter').	No specific feedback recorded.	No specific feedback recorded.	No specific feedback recorded.
Folding armrest	Reports no personal benefit ('used in this way anyway').	Easier transfer.	Concern: Feels unsafe; reports needing additional support due to mobility issues.	Reports convenience, attributing benefit to the carer rather than to self ('convenient for the carer to move me') — inverted attribution.
Rotating backrest	Easier to reach and wash the back.	Positive response ('Good'); no specific observation recorded.	Enables more thorough flushing; linked by the participant to pre-institutional shower routine.	General positive response; no specific observation recorded.
Front safety handle	'Feels safe while having rely on the safety handle'; syntactically unclear.	Easier transfer.	States that safety handles are required.	Reports feeling safer with the handle than without.
Seat	Seat opening too narrow; reported discomfort during use.	Suggested widening the seat to improve comfort.	Seat opening too narrow; reported discomfort during toileting.	No specific feedback recorded.

Table 17. *Summary of Older Adults' Feedback*

6.4.3 Comparison of Carers' and Older Adults' Feedback

The evaluation of the prototype highlights differing viewpoints among carers and older adults (Table 18). The carers emphasised practicality that improves safety

and efficiency, whereas the older adults were more concerned with comfort, dignity and personal preferences. The challenge lies in balancing these potentially conflicting needs to design a solution that benefits both stakeholders, ensuring a respectful and comfortable showering experience for older adults while also addressing carers' practical concerns.

Feature	Carers	Older adults
Opened lower bottom	Majority view: Saves carer effort and facilitates access to private areas (CG7, CG9, CG11). Two concerns raised: Inferred discomfort during extended sitting (CG8); incompatibility with defecation during showering (CG10).	One aesthetic preference recorded ('nicer looking and lighter', CR7). Three participants (CR8–CR10) gave no specific feedback, suggesting the feature primarily benefits carers.
Folding armrest	Majority view: Supports safer transfer by constraining older adults' spontaneous gripping and by shortening transfer distance (CG7, CG8, CG9, CG11). One usability concern: Operation requires too many steps (CG10).	Mixed. One reported that the feature feels unsafe (CR9); one reported no personal benefit (CR7); one framed the convenience as a benefit to the carer rather than to self (CR10, inverted attribution); one reported easier transfer (CR8).
Rotating backrest	All five carers noted that this feature expands the washable area of the back. One usability concern: Difficult for novice carers to operate (CG10).	Generally positive: Three participants reported improved washing or flushing access (CR7, CR8, CR9), with CR9 linking the feature to pre-institutional shower routines. Two entries (CR8, CR10) were general positive responses without specific observations.
Front safety handle	Positive views across all five participants (CG7–CG11).	Positive views across all four participants. CR10 reported feeling safer with the handle than without; CR9 and CR8 reported specific benefits. CR7's cell contains a syntactically ambiguous phrase requiring transcript verification.
Seat	Not separately evaluated by carers at this stage.	Material concerns: Seat opening too narrow (CR7, CR9); one participant suggested widening (CR8). CR10 gave no specific feedback. Findings indicate a need for wider anthropometric coverage or for user-selectable seat sizing.

Footrest	Positive on comfort and slip resistance (raised dots, CG7–CG11). One reach-distance concern: Shorter-legged residents may not reach the pedal (CG7). One entry (CG9) is a design-property observation about stowage rather than a use observation.	No substantive older-adult feedback on the footrest was recorded at this stage.
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Table 18. *Comparison of Carers' and Older Adults' Feedback*

To bridge this gap and refine the prototype towards a more dignified and user-centred design, the following recommendations should be implemented:

For Carers

- **Optimise ergonomics without compromising safety:** While carer comfort and safety are essential, design changes should not compromise usability or safety. Simplify the folding armrest and rotating backrest mechanisms to ensure ease of use and improve durability.
- **Dimensional adjustability:** Adjust the dimensions of the safety handles and brake pedals to accommodate a broader range of user sizes.

For Older Adults

- **Redesign the seat:** Increase seat width and optimise the seat opening shape to accommodate a broader range of body sizes, improving comfort.
- **Re-evaluate armrest design:** Modify the armrest design to provide greater support and stability.

These recommendations prioritise adjustability and personalisation, ensuring that the final prototype equally emphasises ergonomic enhancements and simplified operation. The following section illustrates the final stage of prototype refinements.

6.5 Stage 5: Final Prototype Refinement

The final refinement stage focused on enhancing safety, usability and aesthetic appeal based on feedback from Stage 4. The CAD designs were updated and manufactured to produce a final prototype for user testing. The front safety handlebar locking mechanism was improved by replacing the spring-loaded switch (Figure 37) with a magnet-embedded switch (Figure 48). This modification simplifies operation, enabling intuitive locking and unlocking through magnetic proximity. Furthermore, the switch was relocated from the bottom to the side of the armrest to improve visibility and accessibility. To better accommodate shower room dimensions, the handlebar's rotation direction was reversed from outer-to-inner to inner-to-outer. Finally, the handlebar length was shortened by 11 mm to prevent collisions with older adults' abdomens during rotation. These changes collectively enhance safety, comfort and ease of use.

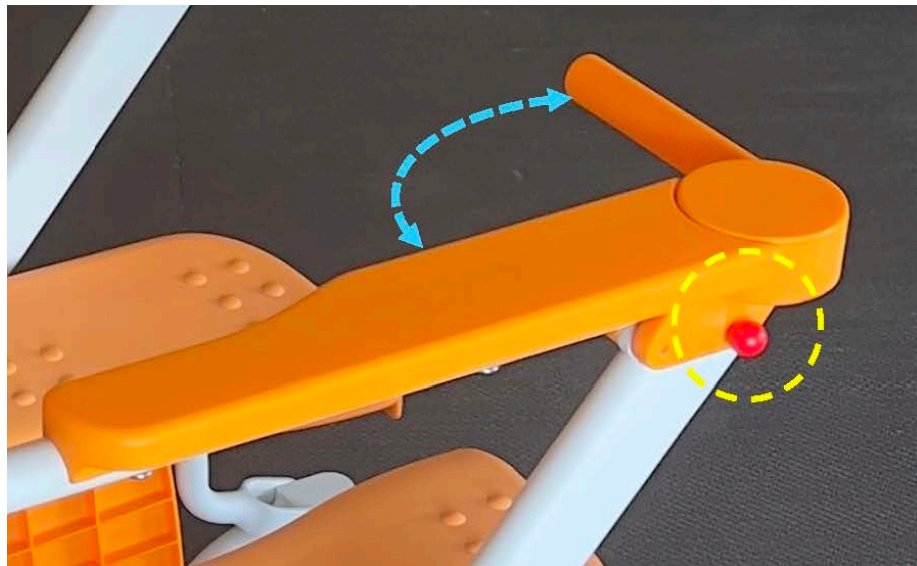


Figure 48. *Final Front Safety Handlebar with a Magnet-Embedded Switch*

Armrest refinement focused on improving structural safety. The overhang length was reduced, and the safety handlebar module was relocated to the top of the diagonal structure bar (Figure 49) to ensure robust support for older adults' weight.



Figure 49. *Final Armrest Design with Shortened Front Overhang*

The box-shaped brake pad was modified to feature rounded corners and a central groove, enhancing both braking performance and aesthetic coherence with the rear wheel. The previously exposed metal connector (Figure 40, left) was concealed within the rubber pad to further improve safety (Figure 50).

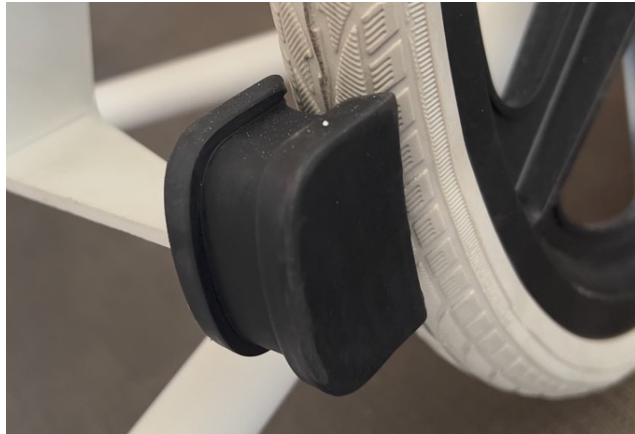


Figure 50. *Final Brake Pad with Middle Groove*

Finally, the prototype was manufactured for user testing (see the ‘Finalisation’ section of Volume 2 for the final shower chair prototype) in two colours, orange and green (Figure 51), to provide users with a choice. The two colours were selected to complement the elder care facility’s existing interior, which uses white and orange. Orange was chosen to match the interior, while green was selected to create a deliberate contrast. By providing an option, the study aimed to examine the impact of participatory colour selection on users’ senses and experiences of dignity.



Figure 51. *The Two Colour Choices for the Shower Chair*

6.6 Prototype User Testing

6.6.1 Safety Certification for User Testing

Before beginning user testing, the shower chair prototype underwent a comprehensive safety certification process conducted by Shenzhen Jingli'an Testing Co., Ltd., a government-authorised institution in China. The assessment covered 17 safety criteria, all of which complied with Shenzhen standards. After the inspection was completed and all requirements were met, the necessary safety certification was obtained (Appendix K). This certification was submitted to the elder care facility, AiDaKang, China (the gatekeeper, which also participated in the function and aesthetics evaluation, Research Phase 2, Stage 4), which facilitated participant

recruitment, ensured compliance, and obtained informed consent for user testing.

The user testing in Research Phase 2 also received ethics approval from both the LJMU UREC (reference: 25/LSA/007) and the Southern University of Science and Technology (approval number: 20230303).

6.6.2 Participant Recruitment and Test Method

The prototype user test was conducted at the elder care facility that participated in Research Phase 1. Participants were recruited by the facility, acting as a gatekeeper. A total of six female carers (aged 44–60 years) and five (one male, four females) older adults (aged 78–98 years) volunteered to test the prototype (Table 19; see the ‘Evaluation’ section of Volume 2 for visual documentation of participants’ involvement).

The test method emphasised the number of assists rather than the test duration. This approach aimed to capture genuine user insights by minimising the influence of familiarity with design features on initial impressions. The carers were instructed to use the prototypes during 40 shower-assistance sessions (approximately four days, assuming an average of ten sessions per day). The older adults were asked to use it for ten showers, reflecting their typical showering frequency. To ensure safety, the use of each design feature was thoroughly demonstrated to participants. The carers were also instructed to ask the older adults about colour preferences.

Older adult	Age	Sex	Length of residency	Carer	Age	Sex	Length of experience
CR11	98	Female	2 years	CG12	49	Female	11 months
CR12	89	Male	1 months	CG13	44	Female	1 week
CR13	82	Female	5 months	CG14	52	Female	1 year
CR14	78	Female	10 months	CG15	48	Female	1 month
CR15	80	Female	1 year	CG16	52	Female	4 months
				CG17	60	Female	2 years

Table 19. *Demographics of Participants in User Testing in Research Phase 2*

The interview questionnaires were designed to evaluate the qualitative experience of dignity with AT from a relational perspective. They focused on how interactions with the shower chair affected dignity for both carers and older adults. Follow-up interviews were conducted with each participant after the test period to gather qualitative data. The following chapter presents the results of the user testing, including participants' critical feedback.

6.7 Chapter Summary

This chapter described the transition from the initial theoretical design and user feedback from Research Phase 1 to the production stages of the shower chair prototype. Although the process was primarily guided by safety and functionality, prototype development revealed significant tensions between the ideal design approach and the practical limitations of materials, structural considerations and manufacturing processes. A linear static stress analysis was conducted in SolidWorks as a component-level feasibility check on the armrest shroud, with full-assembly validation deferred to the manufacturer's physical load testing. This

tension necessitated iterative changes to the prototype, ultimately improving its structure, weight and aesthetics to ensure practicality for real-world use.

A reflection on the sequence of design decisions outlined in this chapter is necessary. The improvements—such as material selection, joint geometry, wheelbase, handlebar lock, and other components—generally resulted from iterative prototyping rather than from initially complete specifications. After each prototype's construction, functional issues were identified, including noticeable rocking of the initial T-shaped joint, corrosion of an unpainted steel structure during manual fabrication, and instability of the unlocked folding-backrest handlebar. These issues were subsequently addressed and resolved in the following iteration, as is typical of practice-based design research. On the other hand, a methodological downside must be acknowledged: several of the identified limitations might have been anticipated through a more rigorous product design specification before fabrication, allowing issues to be addressed early. This chapter not only documents a series of design improvements but also explores the trade-offs involved in a design-research process that emphasises learning through practical creation rather than upfront specifications. The impact of this methodological approach on the validity and transferability of the design insights is discussed further in Section 9.2.

The prototype was evaluated by carers and older adults, with emphasis on both functionality and aesthetics. The participants' feedback informed the final adjustments before user testing. The required safety certification and ethics approval were obtained for the prototype. Participant recruitment was managed through a gatekeeper, maintaining an organised and ethical process. The following chapter will present the results of the user testing phase, including participants' critical feedback and an analysis of the outcomes.

Chapter 7: Results – Evaluation of the Prototype

7.0 Introduction

This chapter presents an analysis of the qualitative user testing results for the shower chair prototype. The analysis was structured using an evaluation framework based on the design schemes outlined in Section 5.4. The design schemes served two roles: linking the study’s theoretical foundations with the practical prototype design and providing the evaluation framework for this chapter. They organised key considerations—such as user needs, practical constraints, and theoretical ideas—into areas for investigation. The evaluation examined the following:

- Experienced dignity: The holistic sense of dignity expressed by participants during the shower experience.
- Factors influencing dignity – safety: How specific design elements contributed to or detracted from feelings of safety.
- Factors influencing dignity – comfort: How design decisions impacted both physical and emotional comfort during the shower experience.

During the user testing session, participants evaluated the prototype’s usability, safety, impact on dignity, and overall effectiveness (see the ‘Dignity-Conscious Shower Chair’ section of Volume 2 for a video demonstrating features). The findings revealed a complex interaction of factors, setting the stage for a deeper discussion on the tensions and trade-offs inherent in AT design.

7.1 Carers’ Evaluation

Six carers (CG12–CG17) evaluated the shower chair prototype. Their feedback highlighted key practical considerations and relational aspects of providing shower assistance. However, their focus on efficiency and practicality raised

questions about which needs should be prioritised in the design process. A detailed summary of this feedback is provided in the summary table in Appendix L.

7.1.1 Experienced Dignity: Operational Efficiency and Carer Competence

Carers appreciated the chair's manoeuvrability, with CG12, CG14, and CG15 noting its ability to turn within tight bathroom spaces: '*The wheels are flexible and allow me to turn in the limited bathroom space.*' Using Gallagher's (2004) framework, this feedback relates to the practical aspect of the carer's role: a chair that turns easily helps support safe assistance under real conditions. However, this single remark does not indicate that manoeuvrability restored a sense of purpose, achievement, or continuity—these would require specific measures, such as workload assessments (e.g. the NASA-TLX) or a component of a dignity scale. Instead, the carers' comments indicate that the chair's turning capability was sufficient for the bathroom's physical constraints, which likely reduced one source of friction in their work.

The carers also raised concerns regarding the shower chair's compatibility with the existing bathroom infrastructure. They introduced a new shower chair (Figure 52B) in their facility that can be placed over the toilet, which was not available in Research Phase 1. The new shower chair was adopted during the final prototype refinement, Stage 5. They compared it with the prototype's X-shaped support structure (Figure 52A). For example, CG13 noted, '*It affects hygiene and efficiency by making waste management more difficult during showering.*' This feedback suggests that while the design was intended to enhance carers' objective dignity (reduced physical strain) through improved cleaning access, its impact on subjective dignity (feelings of competence and ease) is contingent on contextual factors, such as shower room layout. In practice, the X-shaped structure hindered

carers' comfort and productivity, negatively affecting their feelings of competence and well-being (Nolan et al.'s sense of significance and achievement).

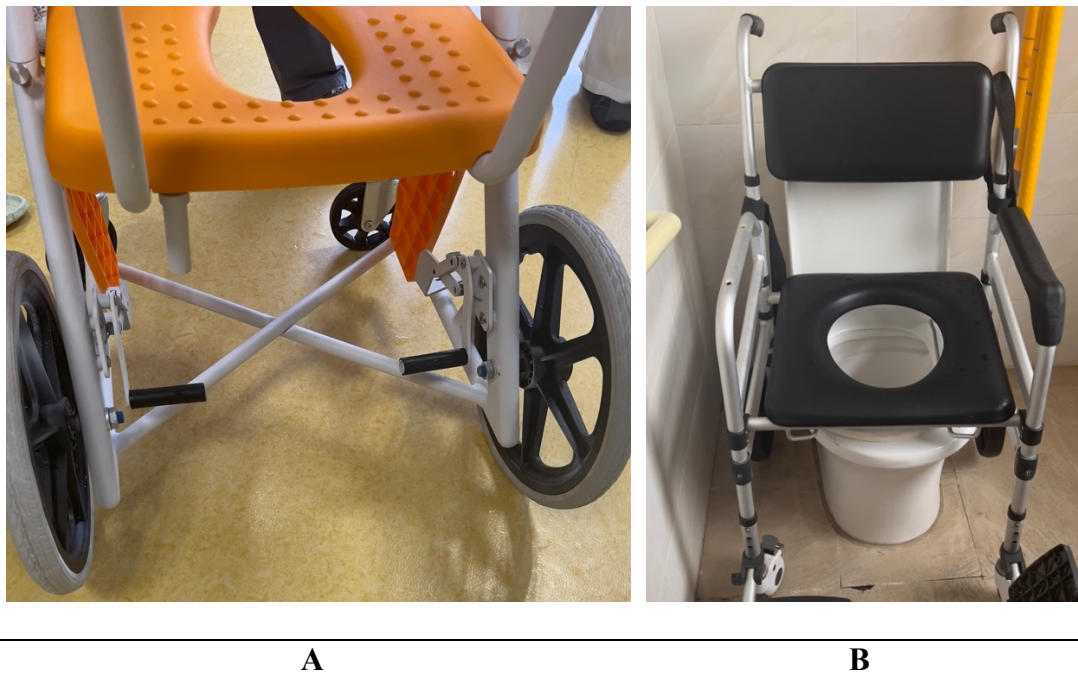


Figure 52. *The X-Shaped Support Structure (A) and the Existing Shower Chair (B)*

It is important to recognise how potential shortcomings in compatibility with existing infrastructure can affect older adults' comfort and overall cleaning outcomes. For instance, placing the shower chair over the toilet can hinder proper cleaning of the backs and wall sides of older adults' bodies. This observation highlights a conflict between carers' comfort, achieved through increased work efficiency (DP2, Section 5.2.3), and the well-being and dignity of older adults (DP3, Section 5.2.3). This tension suggests the need for interplay in design decisions—between 'how it fits into existing routines and environments' and 'how it promotes the well-being of both parties'—and emphasises the importance of balancing these considerations in the development process.

The experienced dignity of carers emerged as a relational construct closely linked to the shower chair prototype's impact on both objective and subjective dimensions. While the structural design aimed to enhance *objective* dignity (by easing tasks), the carers' *subjective* experience was influenced by the existing infrastructural context, which shaped their feelings of competence and agency. This highlights how the effectiveness of a design depends not only on functionality but also on the successful interplay of practical constraints and relational support. This dynamic influences whether the design enhances or diminishes a carer's sense of worth, their sense of security as described by Nolan et al.'s senses, and their capacity to implement care approaches that support each older adult's unique needs and established routines, as outlined by continuity theory (Atchley, 1989).

7.1.2 Factors Influencing Dignity – Safety: The Ergonomics of Care vs the Ethics of Restriction

The safety handlebars received consistent praise. CG14 highlighted their value, stating, *'The safety handle is very good. For older adults who cannot sit independently, leaning forward can be very dangerous. Even if the original shower chair has a safety belt, we are still worried.'* Similarly, CG16 noted the usefulness of the folding armrest during transfers. These comments suggest that carers perceive the handlebars as enhancing safety during high-risk moments, such as unsupported sitting and transfers. However, such statements do not provide direct evidence of a decrease in falls or injuries since this study did not collect data on those outcomes.

Within Gallagher's framework, this feedback relates to the objective aspect, as carers recognise their duty of physical safeguarding. In Nolan et al.'s framework, it primarily concerns security—the category that includes both fall prevention and perceived protection. There are no claims about carers' personal sense of purpose or

achievement, since the data do not address those aspects. Robust and dependable safety features contribute to both physical security (objective dignity) and emotional comfort (subjective dignity).

Despite the positives, the carers raised concerns about usability, locking mechanisms, and the operability of the backrest. Although the safety features addressed objective dignity and provided a sense of security, problems with usability posed risks. The challenges involved in their operation undermine carers' sense of self-efficacy and conflict with the design's intended purpose (DP3, Section 5.2.3), negatively affecting subjective dignity. CG12 stated, '*It was too loose to rotate or stuck, which could cause injuries to the older adults' hands*', and CG16 reported an incident during which the backrest unexpectedly unlocked, causing an older adult to fall backwards. Usability challenges in these areas can adversely affect the well-being of older adults. Therefore, designs that promote objective safety should also ensure usability, contributing to a subjective sense of security across varied carer skill levels. Although the quality of prototype production might have contributed to these issues, these insights highlight the importance of thorough testing and continuous improvement, which emerged as a limitation of the research.

Although their design meets the fundamental needs outlined by Gallagher, the safety features, such as safety handlebars and folding armrests, are undermined by usability issues. This observation demonstrates the interconnectedness of Nolan et al.'s focus and the need for safety. Even when improved safety is an intended design impact, a lack of usability reveals a failure to incorporate all essential theoretical elements. This disconnect challenges how the new product can be integrated into existing care routines. Design choices that undermine caregiving practicality can lead to relational tensions, such as an increased risk of older adult injury from non-

intuitive operation and can diminish users' sense of dignity through feelings of decreased control. Therefore, effective AT design must incorporate elements of safety, usability, and continuity, while continually enhancing user knowledge and experience.

7.1.3 Factors Influencing Dignity – Comfort: Recognising the Unseen Burdens

The principles outlined in Section 5.2.3 guided the design of features to enhance carers' comfort and well-being. However, feedback from carers revealed that operational issues often overshadowed these experiential features. The carers raised three key points. First, the X-shaped support structure, designed to increase frame stability and ease cleaning, became a new primary concern, perceived as increasing workload due to its incompatibility with the existing bathroom setup. Second, colour also emerged as a factor influencing workload, with one carer (CG17) noting, *'Black colour is good, as it is stain-resistant and easy to clean.'* It should be noted that a darker colour might hide contamination rather than truly represent a more hygienic or stain-resistant surface. Therefore, CG17's preference reflects a preference for a clean, easy-to-clean appearance. This distinction should be considered when interpreting colour as a factor affecting the cleaning workload. Third, although carers appreciated the foldable armrest in principle, they found that its operation was time-consuming (CG12: *'The process of opening the armrests is a waste of time, and I rarely use this function'*) and reported limited usability (CG17: *'We can only use it for thin older adults'*).

Interpreted narrowly, these remarks imply that features offering experiential benefits rather than time savings are often overlooked in practice. The time constraints of institutional care routines align with earlier reports of institutional barriers to person-centred practice (Section 2.4.5). More definitive statements about

emotional comfort, workload, or stress would require measurement tools that this study did not employ, as discussed in Section 4.7.

The design implication is specific: in a time-sensitive context, an experiential feature needs a higher minimum cost–benefit ratio than a functional one. It should either save time, match the baseline speed, or provide a noticeable functional advantage that justifies its time investment. Features that do not meet this criterion will be ignored during use, regardless of their potential to enhance subjective dignity.

7.2 Older Adults’ Evaluation

The responses from older adults (CR11–CR15) were primarily positive. However, the older adults’ concerns and preferences varied according to personal experiences and the specific characteristics relevant to their individual needs and circumstances. A detailed overview of their feedback is provided in the summary table in Appendix M.

7.2.1 Experienced Dignity: Aesthetics as Affirmation

Unlike the carers, the older adults initially focused on aesthetics, especially colour. CR1 remarked, *‘The colour is better than black. The green shower chair looks more comfortable.’* Narrowly interpreted, this comment links colour to perceived comfort rather than to an emotional state. This suggests that aesthetic choices were important to the older adults and that they preferred non-clinical colours. This aligns with Jaglarz’s (2024) view on the importance of colour in environments for older adults but does not, by itself, prove a dignity effect.

Within Gallagher’s framework, colour preference is positioned in the subjective dimension of dignity, relating to felt experience rather than intrinsic worth. According to Nolan et al.’s senses framework, it likely connects to a sense of belonging, as less clinical appearances may reduce feelings of ‘otherness’ in

institutional settings. However, this preference is not linked to continuity theory here, as maintaining a continuous sense of self over time is a separate issue that would require either biographical data linking current preferences to past practices or a comparison of long-term preferences. Neither type of data was collected in this study.

This colour preference also revealed a relational tension that extends beyond personal taste: carers appreciated black for its low maintenance, while older adults preferred colour for its emotional and identity significance. In this setting, aesthetic choices become the intersection of two valid but opposing considerations—carer efficiency and older adult self-image—necessitating a relationally-aware design approach rather than favouring one preference over the other.

CR3's statement—'*With this chair, I do not need support from a carer and can hold the handles with both hands*'—makes a stronger claim because it relates to self-performed action, not just perception. Gallagher's objective dimension, focusing on autonomy and bodily agency, is relevant here: the design shifts physical effort in showering from the carer to the older adult, representing a tangible change in the care dynamic, not simply a preference. CR4's remark about the foldable backrest, '*The back could be opened so I could wash my own back*', illustrates the same idea. These statements support designing for autonomy but do not establish a connection to the continuity of pre-institutional bathing identity, which would again require biographical data.

Together, the three findings of this section represent different levels of evidence. Preferences for colour relate to perceptions linked to subjective dignity—such as a sense of belonging—but there is no clear evidence that they affect dignity itself. The disagreement between carers and older adults regarding colour highlights

a relational tension that future designs should aim to mediate rather than eliminate.

The most compelling evidence of dignity-related outcomes comes from the self-initiated actions made possible by the safety handles and foldable backrest, which demonstrate a clear shift in who holds agency during the showering process.

Therefore, ‘aesthetics as affirmation’ should be understood narrowly—as the initial surface where older adults express their preferences—while the real work regarding dignity is achieved through the chair’s enabling features, within the methodological constraints previously described.

7.2.2 Factors Influencing Dignity – Safety: The Subjectivity of Security

Regarding safety, the main issue was understanding the connection between objective safety—reducing physical harm—and perceived security, aligned with DP1 (Section 5.2.3). Two participant remarks highlight this. CR14 stated, *‘The shower chair was secure, and the handlebars kept me safe’*, and CR11 added, *‘The safety handlebar makes me feel more at ease when sitting... The original shower chair relied on the carer... but the new chair can protect my safety.’*

Two assumptions can be drawn from these remarks. The more specific assumption, which the data directly supports, is that older adults perceived the handlebars as decreasing their need to depend on a carer for physical support during showers, and they viewed this positively. The broader conclusion—that this feature enhances autonomy or reduces actual fall incidence—is not supported by this study’s data. Confirming this would require a validated autonomy measure (such as a self-determination scale) and outcome data (fall counts), which were not collected.

Within the analytical framework, the participants’ feedback mainly addresses Nolan et al.’s sense of security; within Gallagher’s framework, it lies along the objective–subjective boundary—objectively, the handlebars physically decrease a

risk (falls from unsupported sitting); subjectively, older adults felt safer. This finding is most accurately described as a perception-based outcome supported by physical plausibility, rather than as an objective safety enhancement, as outlined by Section 4.7.

7.2.3 Factors Influencing Dignity – Comfort: The Embodied Experience of Well-Being

Feedback on comfort was mixed. The cushion received positive comments, *‘The shower chair is very comfortable to sit on, and the cushion is very comfortable’* (CR11), but two specific fit issues were highlighted in the data. CR14 stated, *‘The hole of the seat is a bit narrow, and I feel my buttocks are pinched when I sit on it,’* and CR15 added, *‘The seat and armrests of the shower chair are high... not very comfortable for me.’*

These remarks highlight a specific, actionable design issue: the existing seat aperture and the seat and armrest heights do not align with the anthropometric measurements of the sampled older adult population. This is primarily an ergonomic challenge, not a matter of dignity, and can be best addressed by either (a) expanding the percentile range of the fixed dimensions or (b) adding adjustability to the seat width and height. Additionally, the conflict between the higher seat height preferred by carers (to align with the toilet) and the lower seat height preferred by older adults (for a sense of security) reveals a genuine design tension. These insights underscore the need for adjustable features (Howard et al., 2025) instead of a fixed height that compromises between the two preferences.

The connection between subjective dignity and fit issues is indirect: difficulties during intimate care may gradually diminish felt respect—Gallagher’s subjective aspect—but a single interview cannot prove this decline. The argument

here is based on ergonomics; the dignity claim remains a hypothesis requiring further study, with repeated assessments using a validated tool such as the Patient Dignity Inventory (Chochinov et al., 2008).

Comfort is a more subjective aspect of safety that promotes autonomy and agency, reflecting Gallagher's subjective dignity, Nolan et al.'s emphasis on an individual's sense of security and belonging, and the maintenance of continuity in personal preferences. Ultimately, comfort is not merely a physical attribute but also a crucial element of relational connection, necessitating customisable technology for personalised care and emotional connection with carers.

7.3 Comparative Analysis of Carers' and Older Adults' Feedback

This section synthesises the evaluations from carers and older adults into a comparative analysis organised around three themes: safety (Section 7.3.1), comfort (Section 7.3.2), and the gap between design intent and implementation (Section 7.3.3). Using Gallagher's dual dimensions of dignity, Nolan et al.'s senses framework, and continuity theory—which explicitly includes biographical material—the analysis highlights areas of agreement and divergence between stakeholder accounts. It also points out where an apparent divergence indicates a design challenge that can be addressed during use rather than being an unavoidable stakeholder conflict. Table 20 provides a summary of this comparison.

Theme	Carers' perspective	Older adults' perspective	Analysis
Safety and security (DP1)	Prioritise practicality and efficiency for safety; less focus on subjective feelings.	Prioritise feeling secure over task efficiency; objective safety is insufficient without subjective security.	Carer focus aligns with objective safety but neglects the subjective sense of security. Older adults highlight the need to balance practical safety with feelings of security, showing where AT often falls short.
Independence & control (DP2)	Value autonomy-supporting features if usability is not compromised; efficiency dictates design.	User-friendly controls empower independence; independence is valuable if safety is maintained.	Carers' efficiency-driven approach conflicts with older adults' need for <i>actual</i> control. Features supporting independence are contingent on usability.
Comfort beyond physical (DP3)	Prioritise straightforward implementation, minimising emphasis on the long-term effects on subjective well-being.	Well-being is rooted in a sense of autonomy; relational comfort extends beyond merely receiving assistance.	Carers prioritise short-term practicality, whereas older adults value comfort and relational connection. AT should enhance relational comfort, not merely physical ease.
Design for self-esteem and dignity (DP4)	Aesthetics are considered secondary to the ease of cleaning and maintenance.	Aesthetics impact self-perception: prefer designs that reduce clinical appearance and promote perceptions of normalcy and self-esteem.	Carers emphasise practicality, whereas older adults value aesthetics that promote emotional well-being. Design solutions should aim to balance these competing needs.
Key tension	Practical efficiency vs safety.	Autonomy vs comfort.	Prioritising specific needs and addressing them with features is more feasible because balancing the aims of different features cannot resolve stakeholder conflicts.

Table 20. *Summary of Analysis: Carers' and Older Adults' Feedback*

7.3.1 Safety: Shared Priorities - Multifaceted and Relational

Both older adults and carers recognised safety as a priority, but they interpreted it differently. For older adults, safety focuses on personal feelings of security and the ability to support themselves with safety handlebars during sitting and transfers. For carers, safety means preventing falls, minimising injury risks to both them and older adults, and ensuring predictable transfer mechanics.

Together, these two views focus on the same type of feature, such as handlebars and folding armrests, but from different motivational perspectives. They diverge when usability issues arise, like complex locking mechanisms. The analytical implication is that 'safety' in AT design is not a single objective but rather a collection of related sub-objectives—such as fall prevention, perceived security, ergonomic transfer, and carer injury prevention—that can be achieved through various design strategies. These sub-objectives should be explicitly considered and balanced.

Within Gallagher's framework, the shared emphasis on safety highlights the objective aspect for both parties. In Nolan et al.'s framework, it primarily concerns older adults' sense of security; claims about carers' sense of purpose or achievement depend on features such as handlebars and folding armrests being usable in time-constrained conditions—a requirement that carers in this study often mentioned.

7.3.2 The Comfort Dilemma: Individual Needs vs Practical Limitations

A tension emerged between older adults' preference for features that enhance comfort and identity—such as colour, seat fit, and personalisation—and carers' focus on operational features, such as ease of cleaning, speed, and predictability. This is

not merely a dignity versus efficiency debate, despite how it might appear: carers' efficiency concerns are rooted in their obligations (timely shower provision across multiple older adults), while older adults' comfort concerns have operational implications—uncomfortable older adults tend to resist procedures, which can increase carers' workload. Therefore, while prioritising the comfort of older adults is essential in AT design, the comfort of carers is equally important, as it promotes an attentive care approach (DP3, Section 5.2.3).

The design implication is therefore not about selecting one stakeholder over another. Instead, it involves identifying features where the trade-offs can be fine-tuned during use, such as customisation options, removable cushions, or colour choices, and those that must be fixed during the design phase—such as structural geometry and core kinematics. For the latter, the reasoning behind decisions should be well documented, although documentation was mostly lacking for the current prototype, except for the decision regarding the diagonal beam.

The claim that older adults' comfort preferences served as meaningful links to the past is not fully supported by the data from this study. Continuity theory is most appropriately applied when biographical information is available, such as when a participant connects a current preference to a past practice. Without such biographical material, 'comfort preference' is a more precise term, and continuity theory is only relevant in the few instances in the chapter where biographical details are explicitly documented.

7.3.3 Design Intent and Implementation Reality

The prototype aimed to provide three main benefits: easier access for cleaning, safer bed-to-shower transfers, and increased user comfort. User testing showed that these goals were only partly achieved, and that, in each case, the gap

between design intent and actual use was mediated by the carer. Carers determine when to activate adjustable features, how to explain their use, whether to spend time unlocking mechanisms, and how to position the chair within the bathroom's constraints.

This observation is somewhat modest—based directly on the carers' quotes—but it carries important methodological implications. The carer is not merely a secondary user or operator of technology meant for a primary user; instead, the carer is the key decision-maker at every stage of use, and the technology's impact on the older adult happens through the carer. Therefore, design should consider the carer as an equal user, and the design process should test features to evaluate how easily carers can learn and adopt them, alongside their technical specifications. The integrated framework described in Section 1.7 (Gallagher, Nolan et al., Atchley) can be used for this evaluation because it prompts designers to analyse a feature's effects on both parties simultaneously, considering objective and subjective impacts and relational dynamics. Chapters 5–7 support the claim that this dual approach is essential; where the three frameworks are selectively applied (rather than all three applied to every quote), they justify their relevance. Chapter 8 discusses refining this framework based on the findings presented in this chapter.

7.4 Chapter Summary

This chapter presented the findings from carers' and older adults' evaluation of the shower chair prototype, organised around the themes of experienced dignity, factors influencing dignity – safety and factors influencing dignity –comfort. Findings were interpreted through the integrated Gallagher–Nolan–Atchley lens, with claims presented as participants' perceptions and reported experiences rather than as measured outcomes, in line with the limitation noted in Section 4.7. The

analysis suggests a tension between carers' needs (efficiency and safety) and older adults' desires (comfort and autonomy). The relational nature of dignity emerged as central, with carers' roles significantly influencing older adults' experiences.

Evidence varied in strength: aesthetic preferences indicated subjective dignity perceptions, while self-initiated actions enabled by features such as the safety handles and foldable backrest provided the strongest indication of a shift in agency during the showering process. The findings also exposed the limitations of relying solely on intended design outcomes, leading to unintended consequences and highlighting a gap between design intent and real-world use. For instance, the X-shaped structure, designed to enhance durability and safety, proved incompatible with existing shower rooms, hindering efficient waste management, thereby affecting both carer efficiency and, potentially, older adults' well-being. The following chapter discusses these implications in relation to current research, explores the influence of design choices on relational dynamics, and outlines recommendations for future research and practice for more dignified and practical solutions.

Chapter 8: Discussion

8.0 Introduction

This research, centred on the design of a dignity-conscious shower chair, aimed to address an important gap in AT development: the inadequate consideration of dignity, particularly within the complex relational context of elder care. User testing of an assistive shower chair prototype revealed a complex interplay of factors influencing the dignity experiences of both older adults and carers. While the prototype was perceived by some participants as supporting aspects of dignity across its objective (safety and functionality) and subjective (aesthetics and personalisation) dimensions, the fundamental challenge of effecting meaningful change in the lived experience of dignity requires further exploration. This chapter synthesises the study's findings with existing scholarly literature, ultimately demonstrating how the research advances both theoretical understanding and practical application.

8.1 Re-Evaluating Theoretical Frameworks Through Empirical Insights

This research aimed to base its design interventions on established theoretical frameworks to bridge the gap between abstract concepts of dignity and the practical realities of elder care. The prototype evaluation provided a clearer understanding of these theories, highlighting both their strengths and limitations in guiding design decisions.

8.1.1 Gallagher's Dual Dimensions of Dignity: Beyond the Interplay

Gallagher's (2004) framework, which distinguishes between the objective (inherent human worth) and subjective (personal experience) dimensions of dignity, provided a critical foundation for this research. The findings, synthesised from focus groups and user testing, followed Gallagher's model, recognising 'interplay' between the two dimensions as fundamental to dignity. However, they also revealed

the framework's limitations in guiding practical design decisions, particularly when considering the reciprocal interactions between older adults and carers. This research indicates that implementation of dignity in complex care environments requires a more nuanced, context-sensitive approach.

The limitation related to the trade-offs and tensions between the objective and subjective dimensions of dignity in design decisions. For instance, while the safety guardrail on Shower Chair C (Section 5.2.2) was intended to enhance objective safety, the carers perceived it as an obstacle hindering the efficiency of washing. This tension illustrates how a feature designed to enhance objective dignity can unintentionally undermine subjective dignity by increasing carer burden and emotional strain. This conflict between objective and subjective considerations reveals the limitations of Gallagher's framework in addressing the relational embeddedness of needs. The research findings (Section 7.1.1) show that a carer's well-being and their capacity to provide quality, dignified care are inextricably linked to their perception of control and effectiveness in performing tasks. For example, the prototype's X-shaped support frame, intended to enhance structural durability, instead obstructed waste management when positioned over the toilet, so that a feature meant to improve carers' objective ease diminished their felt competence in practice (CG13, Section 7.1.1). While Gallagher's framework provides a substantial basis for understanding an individual's fundamental needs related to agency and dignity, it does not fully encompass how these needs are relationally embedded in AT design decisions that consider the dignity of all stakeholders.

Furthermore, this tension builds upon Gallagher's framework by demonstrating that effective, dignity-conscious design must move beyond a

simplistic dichotomy to mediate the relationship between objective and subjective needs. This idea is supported by Hoenig et al. (2003), who found that using assistive robots to automate care tasks can lead to a loss of human connection and emotional bond. They emphasised that, in the absence of human touch, the use of AT contradicts ethical principles and user preferences, thereby highlighting the value of relationships in caregiving. Applying this understanding to Gallagher's framework suggests that the concept of 'interplay' should not be limited to the dual dimensions of dignity and must also encompass actively 'mediating' relational contexts, including the evaluation of how a dignity-conscious AT design approach fosters interactions both between individuals and between individuals and AT. This relational aspect of dignity has emerged as a key finding in the research, emphasising the necessity of moving beyond a purely individualistic perspective on dignity, as implicit in Gallagher's framework. For instance, the findings (Sections 5.2.2, 7.1.2, and 7.2.2) indicate that AT design influences power dynamics in care relationships, affecting the capacity of both older adults and carers to express their agency and maintain self-worth. For example, an older adult mentioned being able to wash without needing a carer, by gripping the chair's handles (CR3, Section 7.2.1), while another felt that the new handlebars reduced her dependence on the carer for safety (CR11, Section 7.2.2), indicating changes in who has control during showering. On the other hand, these same safety features could undermine dignity for both parties when usability issues arise, such as an unexpectedly unlocked backrest that caused an older adult to fall backwards (CG16, Section 7.1.2).

Therefore, the concept of 'dignity-consciousness' in future AT design should expand from balancing objective and subjective dignity to actively mediating the care relationships between these dimensions, fostering a sense of shared agency,

mutual respect, and relational well-being. It requires design approaches that are not only user-centred but also relationship-centred, recognising the inherent interconnectedness of dignity in the context of elder care.

8.1.2 Nolan et al.'s Senses Framework: Contextualising and Prioritising Sensibilities

Nolan et al.'s (2006) senses framework offered a practical guide for understanding and promoting subjective dignity, identifying six key senses: security, belonging, continuity, purpose, achievement, and significance. Although all six senses resonated with participants, simply aiming to equalise them may not be feasible or even desirable. The findings revealed a potential hierarchy or prioritisation of senses—security was consistently the most emphasised (as detailed in the Research Stage 2 findings, Section 5.2). This challenges the notion of a universally balanced design approach that seeks to satisfy all senses equally, emphasising the importance of engaging the most important senses with care. However, this prioritisation is not absolute but ‘contextual’, as the senses are interrelated rather than perceived independently. While Nolan et al.'s framework provides a systemic understanding of these senses’ contribution to subjective dignity, this research highlights that its application in AT design requires an understanding of the interrelationships among them. For instance, a sense of belonging positively affects a sense of continuity and purpose by ensuring that older adults feel integrated and respected, enabling them to maintain their personal preferences (as discussed in introductory focus group findings, Section 5.1.2). A sense of purpose promotes a sense of achievement and security by inspiring older adults and carers to pursue and attain goals and ensure safety.

It is also essential to recognise the limitations of the framework in fully capturing the lived experience of dignity when defining design objectives. As each sense holds value and supports the others, specifying design decisions within the framework becomes difficult. For example, although participants consistently emphasised the feeling of comfort, even referencing the prototype's green colour (Section 7.2.1), Nolan et al.'s senses framework does not explicitly include this aspect. Instead, comfort emerged as a consequence of addressing the six key senses. Even the security-related outcome was described as a sense of comfort. As Holmberg and Godsken (2022) noted, despite the connection between dignity and bodily care, it is also important to consider needs that may not always be fully addressed. Nolan et al.'s focus may not cover all aspects, as some feelings are not specified within the framework. This observation highlights the need for more careful evaluation of the key elements involved.

While Nolan's framework is effective for assessing an individual's subjective feelings, its application may be limited if the broader social and cultural context of elder care is not considered. For instance, the significance and prioritisation of each sense may differ across cultural settings and care environments. The findings suggest that the application of Nolan et al.'s senses framework in AT design requires more than simply 'checking off' individual senses. It requires an iterative, contextual approach, in which the designer actively engages with stakeholders to understand their needs and priorities. The objective should be to identify the dominant sensibilities within a specific context, understand their interrelationships, and design interventions that synergistically enhance these prioritised elements.

8.1.3 Continuity Theory: Adapting and Preserving Identity

Continuity theory (Atchley, 1989) highlights the importance of adaptive choices rooted in familiar past experiences to maintain identity and stability, thereby facilitating effective change management in care settings. The findings generally support this core notion. However, they also highlight the challenges of translating this theory into AT design for elder care. A key limitation identified in the research is the risk of misinterpreting or oversimplifying the concept of ‘familiarity’. Merely incorporating familiar elements is insufficient if the elements do not deeply connect with the individual’s core values and preferences. For example, bringing previous personal belongings into the facility, despite its current implementation in the United States under the Nursing Home Reform Act (Turnham, 2008; Section 2.4.5), does not fully address a sense of self-identity, even if it supports the maintenance of emotional attachment.

Furthermore, while continuity theory emphasises maintaining previous routines for older adults, the practical realities of elder care facilities present challenges to the implementation of individualised practices. This feasibility issue was exemplified through a rotating backrest design. While the design aimed to provide older adults with a comforting (massage) effect like familiar pre-institutional shower routines (Sections 5.2.1 and 6.4.2), carers reported that time constraints and workload pressures made it difficult to use the feature fully (Section 7.1.2). This finding highlights the limitations of focusing solely on individual continuity, without considering the relational context of elder care. As AT is integrated into caregiving routines, it is crucial to understand how continuity for older adults interacts with the needs and preferences of carers. While continuity is important, its application in AT

design for elder care must be carefully balanced with the tangible operational constraints within care facilities.

Therefore, to effectively implement continuity theory in AT design for elder care, it is essential to move beyond a simplistic emphasis on superficial familiarity and previous routines. Instead, the research suggests the need for a nuanced approach, in which the designer actively engages with both older adults and carers to understand their evolving needs and preferences, and the design aims to foster a sense of continuity that recognises personal integrity, self-expression, and relational cohesion.

8.2 Situating the Findings: A Comparison with Existing Research

To illustrate the contribution of this research, its findings are contextualised within prior empirical studies on dignity in elder care and AT. This section advances beyond a general discussion of supporting literature by engaging in a more critical discourse, emphasising areas of convergence and divergence, along with distinctive contributions.

8.2.1 Balancing Competing Needs: Drawing Parallels with Person-centred Care

A key tension revealed in this research—and widely noted in the elder care literature—is the conflict between carers’ priorities (efficiency and safety) and older adults’ values (comfort and autonomy; Chochinov, 2002; Enzo et al., 2019). While person-centred care emphasises individual needs and preferences as key to quality of life (Ahmed & Shalaby, 2014), the findings (the user-centred shower chair evaluation in Section 5.2.2 and the prototype evaluation in Chapter 7) highlight the importance of relational aspects in maintaining this balance in the use of AT.

Although some existing studies emphasise the crucial role of the relational dynamic in delivering high-quality care by enhancing interactions (Er et al., 2018; Palm et al., 2020), the findings extend the focus to relational ‘impact’, which encompasses both

synergy and conflict. Specifically, the influence of AT on objective safety is relational; it may affect an older adult's capacity for independence. Similarly, a feature intended to enhance subjective comfort can create an objective safety risk.

This research also demonstrated the effectiveness of a design approach that explores relational aspects by involving users throughout the process. This finding aligns with Salem and Ghassan (2019, Section 1.2.3), who highlighted the importance of integrating user feedback into healthcare design to achieve effective, inclusive outcomes.

8.2.2 Redefining Usability: Moving Beyond Efficiency

While AT design has traditionally prioritised usability in terms of efficiency, speed, and ease of use, this study's findings highlight the need to broaden this focus to include relational, emotional, and contextual dimensions (as discussed in Section 5.2.2). The carers' tendency to prioritise features that reduce their workload, even when these features compromise older adults' comfort or autonomy (as outlined in Sections 5.2.2 and 7.1.2), demonstrates the limitations of a purely task-oriented approach. This finding supports a broader conceptualisation of usability in care settings, recognising that 'user-friendliness' extends beyond the individual user to encompass the entire care ecosystem. It also reflects Hoenig et al.'s (2003) emphasis on human connection and emotional bonds, which create a positive impact while enhancing the autonomy essential to mental and emotional well-being.

This more comprehensive perspective illustrates the importance of adjustable features—whose ergonomic characteristics and customisation options can improve comfort and independence (Howard et al., 2025; Spinelli et al., 2019)—rather than universal, one-size-fits-all solutions. This design-led approach, as Standoli (2022) asserts (Section 1.2.3) promotes accessible and inclusive outcomes by prioritising

social, economic, ethical, and political considerations. These approaches align technical features, such as adjustability, with relational and emotional needs across different care settings.

8.2.3 The Power of Aesthetics: Counteracting Stigma and Promoting Self-Worth

This research highlights aesthetics as a crucial component of dignity-conscious design (Section 5.4), building on previous studies that identify them as opportunities to promote well-being, social interaction, and active lifestyles (Jovanovic et al., 2021). It illustrates how aesthetics can reduce stereotypes of frailty and loss of independence (Fotteler et al., 2021; Spinelli et al., 2019) and make AT feel more life-enhancing than medicalised. However, the findings indicate a need for further development to tailor aesthetic choices, including colour options that promote well-being (Jaglarz, 2024), to the specific preferences and cultural backgrounds of older adults. Universally appealing designs cannot adequately support individual identities (as noted in the analysis of seat and backrest designs, Section 5.3.2) within a shared living environment. By integrating aesthetic elements that uphold dignity, AT design reinforces users' feelings of control and self-esteem.

8.3 Revisiting Research Objectives: Achieving and Evidencing Dignity

The five objectives outlined in Section 1.6 structured this research as a continuous process: identifying the factors that shape dignity during shower assistance (Objective 1), synthesising them into dignity-conscious design principles (Objective 2), translating those principles into a prototype through iterative participatory design (Objective 3), evaluating the effectiveness of the prototype in use (Objective 4), and refining the principles and framework based on empirical findings (Objective 5). For clarity, the following subsections organise these

objectives. Section 8.3.1 reflects findings about the relational complexities of dignity (Objectives 1 and 2), and Section 8.3.2 examines how the principles were implemented and tested in practice (Objectives 3 and 4). Objective 5, focused on refining the design principles and the conceptual model, is addressed in Section 8.4 and in the research claims of Chapter 9. Table 21 summarises the outcomes and ongoing tensions related to each objective.

8.3.1 Unveiling the Relational Complexities of Dignity

Objectives 1 and 2 (Section 1.6) focus on identifying the physical, emotional, and relational factors that influence experiences of dignity during shower assistance in Chinese institutional elder care. They also synthesise these factors into a set of dignity-conscious design principles, based on Gallagher's dual dimensions of dignity, Nolan et al.'s Senses Framework, and Atchley's Continuity Theory as analytical lenses.

Dignity as a Relational Achievement. The research expanded in scope beyond merely identifying individual needs (e.g. safety for older adults and efficiency for carers) to exploring the intricate relational dynamics that shape the experience of dignity. This approach aligns with the ethical considerations outlined in the United Nations' Universal Declaration of Human Rights (Baillie, 2008) and with global policies that uphold these principles through their commitments to human rights (Cohn, 2011). Recognising dignity as inherently relational challenges a simplistic view of it as an individual attribute. Nevertheless, focusing solely on the relational dimension of dignity presents ethical risks. Analysis of this relational aspect should be grounded in an understanding of the limitations inherent in older adults' self-perceptions (as discussed in Section 5.2.2).

Although fostering positive interactions and recognising the interconnectedness of needs is important, it is equally crucial to acknowledge that existing power imbalances and vulnerabilities within the care relationship can be exacerbated. Older adults already face dependence due to limited capacity and resources, and this dependence has relational consequences (Hughes, 2005). Therefore, a delicate balance must be maintained between relational sensitivity and respect for the individual rights, needs and preferences of older adults in care.

This research emphasises the importance of examining dignity not only through individual experiences but through understanding how these experiences are formed and negotiated within the carer–older adult relationship. Neglecting to address pre-existing power imbalances and resource disparities could lead to an AT design approach primarily centred on relationality, which could inadvertently reinforce or exacerbate these inequalities.

This observation highlights the core challenge of designing for dignity: shifting from a purely user-centred approach, which prioritises individual needs and functionality, to a relationship-centred approach that actively considers and supports the dignity of all stakeholders involved in the care process. This change requires a paradigm shift in AT design, moving from viewing older adults as the primary beneficiaries (users) and carers as secondary users (Barili et al., 2020) to viewing carers as the key agents shaping the care environment and influencing older adults' dignity.

8.3.2 Towards a Dignity-Conscious Design: A Transformation Driven by User Feedback

Objectives 3 and 4 (Section 1.6) focus on transforming the dignity-conscious design principles into an assistive shower chair prototype through iterative

participatory design cycles with carers and older adults. The evaluation assesses the prototype's effectiveness by examining how well the principles are reflected in participants' lived experiences of dignity.

Dignity as a Contextual Negotiation. The evolution of the shower chair design from its preliminary, theoretically informed concept to the final prototype demonstrated a significant transformation driven by user feedback (Figure 53). Through the iterative process, a core principle of PD (as noted by Orpwood et al., 2007), the findings highlight the importance of shifting focus from exclusively technical or functional aspects to a design that considers relational and contextual design solutions. A deeper analysis revealed how user feedback challenged initial assumptions, reshaped design priorities and ultimately led to a more nuanced understanding of dignity in the specific context of shower assistance.



Figure 53. *Design Transformation from the Preliminary Shower Chair Design (Left) to the Dignity-Conscious Shower Chair Prototype (Right)*

Challenging initial assumptions. The initial design, based on the literature and theoretical frameworks, revealed limitations when tested in real-world elder care environments. For example, the optimistic assumption that the adjustable-height feature would improve carer ergonomics and visibility met resistance from older adults, as it compromised their sense of security. This observation supports Spinelli et al.'s (2019) argument about the disconnect between design intentions and user experiences, highlighting that good intentions and robust theory are insufficient to ensure positive outcomes.

Reshaping design priorities. User feedback led to a reprioritisation of design elements. The emphasis shifted from complex mechanical solutions to simpler, more intuitive features promoting both physical safety and emotional comfort. However, the findings indicate that absolute prioritisation is infeasible due to the reciprocal nature of care assistance. For example, the carers prioritised efficiency and safety, while the older adults valued comfort and autonomy. This observation highlights a crucial insight: features intended to benefit both stakeholders can, in practice, become sources of frustration if not carefully integrated into the realities of caregiving.

Therefore, the prioritisation of features should be negotiable within the contextual and relational care process to ensure appropriate integration.

A deeper insight into dignity. The iterative design process ultimately transformed the final prototype. It shifted the perspective on dignity from a set of predefined attributes (e.g. safety, autonomy, and self-worth) to a fluid, negotiated experience that emerges from ongoing interaction between the individual, the carer and the care environment. For example, the new design did not accommodate the seating preferences of smaller users, leading to

safety and comfort concerns that carers could not address. In various cases with different users, prototype testing observed that certain design features hindered the intended benefit. Nonetheless, testing also identified a specific design that made users feel secure and comfortable, ultimately promoting stakeholders' dignity.

This design transformation highlights the importance of contextualised design that reflects the complexity of human interactions and the multifaceted nature of dignity. It is essential to not only understand users' preferences but also to consider aspects they may overlook. Additionally, ensuring each user's independent needs and preferences does not guarantee the successful implementation of AT design. Consideration must also be given to how accommodating these necessities influences the overall experience of dignity from a relational perspective. This negotiated, relational perspective serves as the refined dignity-conscious design principle introduced in Section 8.5: dignity is negotiated through relationships, which reorganise the four Phase 1 principles (Section 5.2.3).

The outcomes summarised in Table 21 provide an overview of the outcomes in relation to the research objectives, along with the continuing challenges and nuances that emerged throughout the research.

Research objectives	Key outcomes and evidence	Remaining challenges
Objectives 1 & 2: Identify the factors that shape dignity during shower assistance and synthesise them into dignity-conscious design principles.	Shifted focus from individual needs to complex relational dynamics in care. Demonstrated the interplay between objective and subjective dimensions of dignity. Highlighted both the synergistic and conflicting	Need for design solutions that address and mediate pre-existing power imbalances in carer–older adult relationships. Difficulties related to creating practical design solutions.

	potential of AT design on relational impact.	
Objectives 3 & 4: Translate the principles into a prototype through iterative participatory design and evaluate the prototype in use.	Demonstrated that meaningful change in the lived experience of dignity requires more than theoretical foundations. Used a contextual design approach to highlight the importance of relational and cultural aspects, as well as safety, security, and a human-to-human connection.	Need to implement the frameworks outlined in the study across a broader selection of assistive devices and in diverse cultural conditions. Challenges in negotiating diverse perspectives within the contextual and relational care process.
Objective 5: Refine the design principles and the conceptual model based on empirical findings.	Refined the four dignity-conscious design principles (Phase 1): dignity is negotiated through relationships. The revised conceptual model (Figure 54) reflects this, ensuring the principles and the model share a consistent relational logic (Section 8.5).	The restructured principle is an outcome of Phase 2, and its applicability to other assistive devices and cultural contexts still needs testing (Section 9.4).

Table 21. *Summary of Research Objectives and Outcomes*

8.4 Working Definition of Dignity and the Revised Conceptual Model

At the beginning of this project, dignity was defined, following Gallagher (2004) and Nolan et al. (2006), as a dual concept comprising inherent worth (objective dignity) and personal experience—such as feelings of security, belonging, purpose, achievement, and significance (Section 1.7). While informed by theoretical frameworks, this initial definition was not fully centred on users: it framed dignity as a property of the older adult, with the carer seen as an operator of technology rather than as a person whose own dignity could be affected.

The empirical discussion in Chapters 5–7 refined this definition through three shifts. First, dignity was shown to be co-produced within the carer–older adult dyad, rather than existing solely in the older adult; the research emphasised that the carer’s competence, safety, and emotional capacity directly support the older adult’s sense of dignity (Sections 7.1, 7.3). Second, the research found that Nolan et al.’s six senses should be prioritised based on context rather than weighted equally, with security consistently dominant and the others structured around it (Section 8.1.2). Third, the study determined that claims about continuity relied on biographical information that was not always available (Sections 7.3.2, 8.1.3). Thus, the new working definition frames dignity in AT-mediated shower assistance as a relational, context-dependent achievement created through interactions between the older adult, carer, and technology, where objective factors (safety, bodily integrity, rights) and the most valued subjective experiences (primarily security, then belonging and significance) are mutually maintained.

This working definition is grounded in feedback from carers and older adults, emphasising the carer as an equal beneficiary of dignity (Section 8.1.1). It considers dignity as an attainable property that can be achieved through AT design, as discussed in Sections 5.2.3 and 9.4.4. However, it has limitations: (a) it was developed in a Chinese, Confucian-influenced context with mostly female carers, which limits transferability (Section 8.6); (b) it does not clarify how cognitive impairments such as dementia influence the subjective sense of dignity since participants with severe cognitive impairment were excluded (Section 8.6); and (c) it is a preliminary, refinable definition aligned with practice-based research, not a final theoretical claim.

Building on this working definition, the initial conceptual model presented in Section 1.8 was revisited. As the design process demonstrated, the conceptual shower chair design evolved into context-specific designs grounded in stakeholders' lived experiences. Revisiting the model enables the incorporation of insights from user feedback and iterative design regarding the relational nature of dignity (Figure 54).

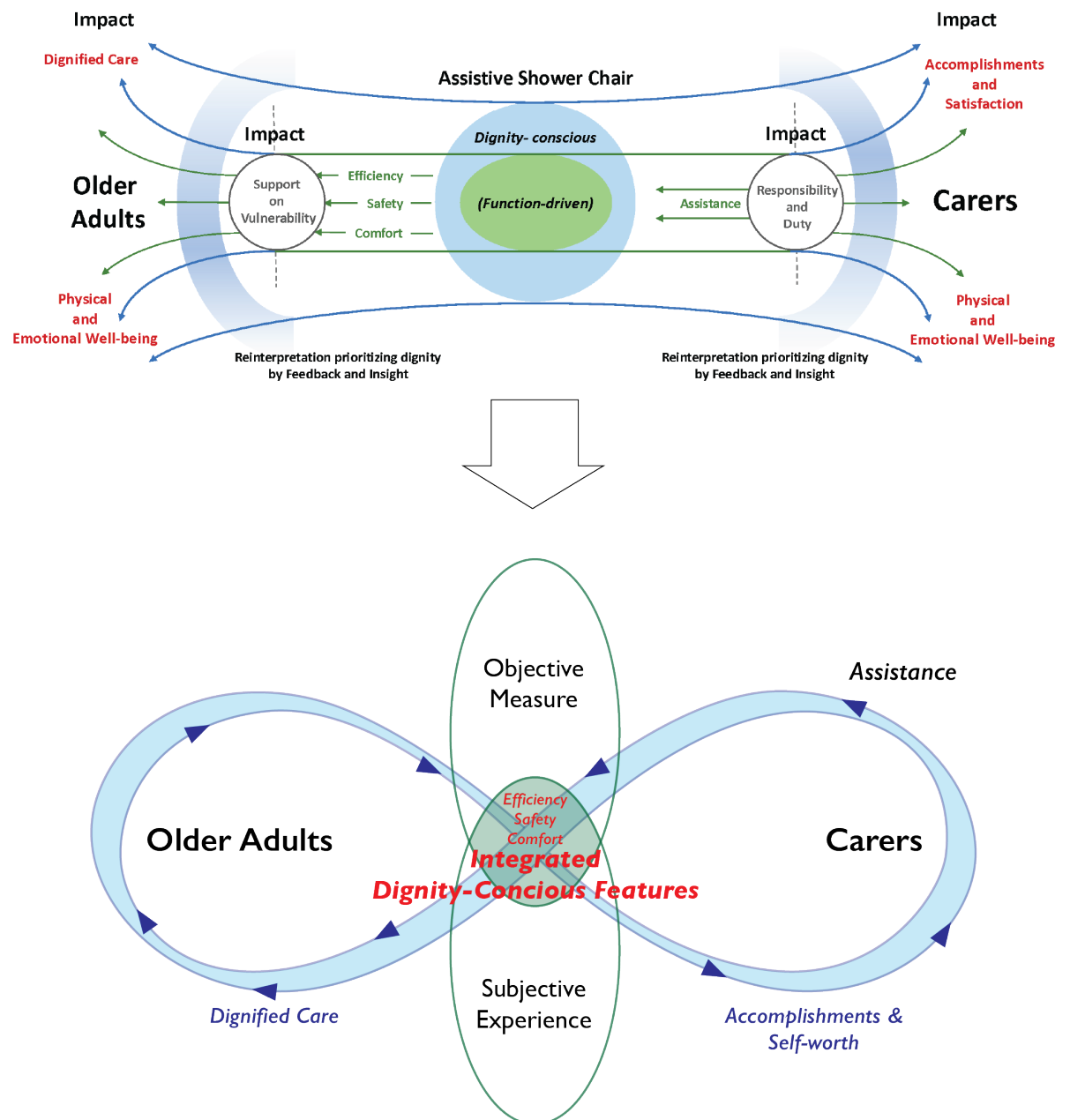


Figure 54. *Revised Conceptual Model: From Linear Interaction to Intertwined Relationality*

- Assistance - Linear flow to intertwined loops:** The data indicated that dignity in caregiving is not a unidirectional process. The well-being of carers directly affects their capacity to deliver dignified care, which subsequently influences the well-being of older adults, establishing a reciprocal relationship.

- **Independent features to integrated design solution:** While the initial model indicated that design features' aims, such as efficiency, safety, and comfort, are independent, the data emphasise that design solutions should integrate them to reduce unexpected trade-offs between features.
- **Discreet Approach to balance of objective measure and subjective experience:** Data showed that dignity cannot be distinguished between objective and subjective experiences. For instance, a sense of security should accompany objective safety, which involves varying degrees of an individual's perception.
- **Older adults and carers loops:** The initial model suggests that the role of AT lies between older adults and carers, with the impact separated rather than circular. The data emphasises the relational effects of care support among these groups, indicating that no single party benefits solely from the use of AT. It highlights the importance of relational dynamics and the necessity for all factors to collaborate effectively to enhance each interaction.

This refined framework suggests that dignity is a dynamic and relational achievement. Providing an effective, efficient experience for carers can create a high-quality experience for older adults. Implementing innovative design solutions and modifying current processes can produce more impactful results and foster a more compassionate environment. This not only improves the lives of older adults but also fosters stronger relationships between stakeholders, ensuring that the value continues to grow with integrated design solutions.

8.5 The Refinement of the Dignity-Conscious Design Principles

In Phase 1, the four design principles (DP1–DP4, Section 5.2.3) were identified as theoretically grounded features to be integrated into the shower chair

design. Testing the prototype in Phase 2 showed that each principle is relational: a feature satisfying a principle for one party might affect it for another, and fulfilling a principle alone does not ensure aimed dignity experience in the carer–older adult interaction. As a result of testing, what emerged was not a new attribute but a broader principle (Table 22): dignity is negotiated through relationships. This perspective reflects the shift shown in Figure 54, from linear interaction to interconnected relationality.

Design Principles	Findings from phase 2	Evolved principle (Phase 2)	Aligned with the logic of Figure 54
DP1: Safety is multifaceted	The adjustable height feature enhanced carers' ergonomics and visibility but reduced older adults' perceived security. Since security is subjective (Section 7.2.2) and involves ethical considerations of restriction (Section 7.1.2), this trade-off emerges.	Safety involves a negotiated balance: a feature that is objectively safer might reduce perceived security, and carer's safety can compete with that of the older adult.	Combined objective and subjective aspects; replaced 'linear' with 'intertwined loops'.
DP2: Independence and control	Older adults see independence as agency, carers as assistance without overstepping; this dynamic empowers one while frustrating the other (Section 7.3).	Independence is a negotiated relationship between two definitions, not an attribute to be maximised by a single user.	Shift from 'separated impact' to 'older-adult-carer loops'
DP3: Comfort beyond the physical	The "comfort dilemma"—balancing individual needs with practical limits (Section 7.3.2); the prototype was inadequate for smaller users, and carers could not resolve the issues.	Comfort is a <i>dynamic</i> outcome resulting from the interaction between older adults, their carers, and the environment, shaped by the realities of caregiving.	Shift from 'independent features' to 'integrated solution'

DP4: Design for self-esteem	Aesthetics served as an affirmation (Section 7.2.1) and reduced clinical signals linked with lower self-worth (Section 8.2.3); its impact was perceptual and relational.	Aesthetics are confirmed to be functional, but their impact on dignity is relational, which depends on how the device conveys worth to the user.	Objective and subjective aspects are combined.
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Table 22. *Summary of refined Dignity-Conscious Design Principles*

Each original principle shifts from being a fixed target to becoming a site of negotiation. For example, DP1 (safety as a multifaceted concept) evolved into a negotiated balance when the height-adjustment feature improved carer ergonomics but reduced older adults' felt security (Sections 7.1.2, 7.2.2), illustrating Figure 54's integration of objective measures with subjective experience. Similarly, DP2 (independence and control) has evolved into a negotiation between two perspectives—empowering older adults to have agency and providing non-intrusive support for carers (Section 7.3). This shift reflects the mutual understanding between older adults and carers. DP3 (comfort beyond the physical) shifted from being an individual feature to a relational achievement after the prototype's fixed seating proved unsuitable for smaller users, a problem that carers could not fix (Section 7.3.2). This suggests a move from standalone features to a more integrated approach. Meanwhile, DP4 (design for self-esteem), initially confirmed, was repositioned within the relational domain, with its aesthetic choices serving to affirm worth in social contexts (Sections 7.2.1, 8.2.3).

DP1–DP4 remain but become subsidiary, interpreted as outcomes of negotiation rather than specified in advance. This restructuring aligns with the revised conceptual model and fulfils the refinement expected by Objective 5 (Section 1.6). This result emerged during Phase 2 rather than being established initially; the principles proved to be relational only through practical testing.

8.6 Limitations: Contextualising the Generalisability of Relational Dignity

Several limitations must be acknowledged when interpreting the findings of this research. While qualitative research prioritises depth of understanding over breadth, it is essential to critically evaluate the factors that may impact the transferability and robustness of the findings.

Gender composition of the carer sample. All twelve carers involved in Phase 1 and Phase 2 (CG1–CG6 and CG7–CG16) were female. While this reflects the gendered reality in Chinese institutional settings, it limits the findings in two ways. First, it prevents a comparative analysis of the embodied aspects of intimate care—such as how carers handle their own and older adults’ shyness during showers and how perceptions of dignity are influenced by same-gender or cross-gender interactions. Second, the argument about relational dignity presented in Sections 7.1 and 8.3 may rely partly on a feminised care labour structure rather exclusively on than caregiving itself. Future studies should intentionally include male carers where available and explore how dignity-conscious AT might need to be adjusted for cross-gender intimate care. This is a substantial constraint on the cultural and gendered dimensions of the relational dignity claim.

Cognitive capacity of the older-adult sample. The study excluded older adults with severe cognitive impairments (Section 4.3.2; determined by

facility staff) to ensure valid informed consent and participant's ability to participate verbally in interviews and focus groups. Although this approach is methodologically justified, it limits the applicability of the findings, because Chinese institutional elder care—in line with global practices—serves many older adults with dementia or other cognitive declines. This has three implications. First, the claims about subjective dignity in Chapters 7 and 8 depend on participants who can verbally express their self-perception; for older adults who cannot, concepts like dignity may differ. Second, the relational mediation argument (Section 8.3.1) might be stronger for cognitively impaired older adults, as carers play a larger interpretive role when older adults cannot verbally advocate for themselves; the design implications for AT in these interactions are not addressed by the present data. Third, the dignity-conscious design principles (Section 5.2.3) should be viewed as hypotheses applicable to the dementia population rather than definitive findings.

Contextual specificity and the Confucian ethic. Research Phase 1 was conducted in two elder care facilities in Zhongshan, China, while Research Phase 2 focused on a single facility within the same cultural context, strongly influenced by Confucian values and the concept of filial piety. Consequently, the emphasis on seniority, which reflects social position and creates hierarchical care relationships (Chen & Chung, 2002; Fan, 2007), may have shaped both the design priorities and participants' perceptions of dignity and AT. For example, older adults may have been reluctant to express a desire for autonomy if they perceived it as conflicting with maintaining their reputation, a dynamic also described by Lee (2008). Although the facilities were chosen

to represent a typical urban elder care environment, the cultural and institutional contexts are specific to these settings. Therefore, the findings may not be directly transferable to Western contexts, where individual autonomy and independence are often prioritised over familial interdependence (Wang, 2010). Future research should examine how the dignity-conscious design principles apply across diverse cultural contexts and investigate how cultural values may influence the relationship among AT, dignity and caregiving.

The negotiated role of privacy. A major omission in the research's key findings is the lack of emphasis on 'privacy', despite its prevalence in the elder care literature (Chapter 2). In AT design, user preferences and privacy risks should not be regarded as an afterthought but rather as a fundamental element of the technology (Kolkowska & Kristofferson, 2016). Privacy features, including integrated screens or shields, posed considerable challenges for carers in this research. The carers consistently noted that features increasing workload or complexity were impractical in resource-constrained elder care facilities (Chapters 6 and 7). Thus, in this context, the need for safe, efficient care often outweighed the subjective preference for greater privacy. Nevertheless, rather than disregarding privacy concerns, the research design addressed them implicitly through alternative means. The focus on objective and subjective safety, along with streamlined processes, aimed to reduce the duration of shower assistance, thereby lessening feelings of vulnerability or exposure. Further research is needed to explore alternative, less burdensome methods for promoting privacy in shower assistance.

Methodological constraints of participatory design. Although the PD approach was crucial for revealing the relational aspects of dignity and integrating user feedback into the design, it also presented methodological limitations. Convenience sampling may not have provided a representative sample of the broader population of older adults and carers, potentially leading to a biased understanding of their needs and perspectives. For example, participants with more assertive voices have been shown to overshadow quieter participants, resulting in a biased view of needs and perspectives (Subedi, 2021). Although strategies such as triangulation and member checking were implemented to mitigate this bias, the findings should be interpreted with caution. Furthermore, while responsive to user feedback, the iterative design process was constrained by the limited timeframe for each iteration, potentially restricting the depth of exploration into participants' experiences. Future research should adopt more rigorous sampling strategies and consider longer-term studies to better understand the longitudinal impact of dignity-conscious AT on both older adults and carers.

Prototype quality and smoothness of operation. Although the prototype was professionally manufactured, it was still handmade, and its limited operational smoothness may have affected participants' experiences during use.

8.7 Chapter Summary

The findings clarified that designing for dignity goes beyond physical support, requiring a comprehensive understanding of relational dynamics, power imbalances and the distinctive, often conflicting, needs of both older adults and carers. The effectiveness of AT in promoting dignity depends not only on its

objective functionality and safety but also on its ability to foster subjective well-being, autonomy and social connection. As user testing demonstrated, design decisions intended to enhance one aspect of dignity can inadvertently compromise another, highlighting the importance of a holistic, context-sensitive and deeply collaborative design process. This finding guided the refinement of the initial dignity-conscious design principles from Phase 1, emphasising that dignity is negotiated relationally. Along with the revised conceptual model, these updates fulfil Objective 5.

In addition, this research demonstrated the limitations of applying isolated theoretical frameworks, highlighting the importance of integrating and adapting them to the specific sociocultural context of elder care. It also emphasised the importance of re-evaluating design decisions based on practical implementation and cultural beliefs.

Although the findings offer valuable guidance for future design efforts, it is essential to recognise the limitations associated with convenience sampling, contextual specificity and the quality of the handmade prototype. Future research should focus on: (a) longitudinal studies, (b) testing within diverse cultural contexts and (c) the development of ethical empowerment design solutions that enhance the relational aspect of caregiving. Ultimately, a paradigm shift in AT design is necessary to acknowledge carers' impact and the importance of the relational aspect in preserving dignity. By involving stakeholders and adopting a comprehensive view of well-being, research can promote a future where technology empowers and protects dignity, fostering compassionate, respectful care environments.

Overall, the contributions of this chapter are best described as design insights and principles, along with a revised conceptual model (Section 8.4). This is not a

complete design framework for AT in general but rather a foundation for future work enabled by this thesis.

Chapter 9: Recommendations and Conclusion

9.0 Introduction

This research explored the complex relationship between AT, dignity and caregiving, explicitly focusing on shower assistance in elder care, which is often overlooked. In response to scholarly critiques of the concept of dignity, this research sought to address an important gap. The investigation focused on two main research questions posed in Section 1.5:

- **Research Question 1:** How is dignity upheld or compromised in the relationship between older adults and carers when using AT for shower assistance?
- **Research Question 2:** How can the features of an assistive shower chair be transformed into dignity-conscious solutions that prioritise the stakeholders' dignity, leading to enhanced quality of care?

Through a rigorous process integrating theoretical analysis, iterative PD, and prototype user testing, this project-based research has produced important findings that challenge conventional approaches and propose new directions for the field. It revealed that dignity is both promoted and compromised by the implementation of shower chairs: well-designed chairs increase safety and independence, design impacts the relational aspect of caregiving, and usability issues undermine dignity due to inherent power dynamics in caregiving relationships. The findings indicate that dignity develops through interactions among older adults, carers, and AT such as shower chairs. They highlight that relational dimensions are present throughout the care process. The key aspect is not solely what can be accomplished but also how older adults and carers perceive it.

9.1 Key Contribution to Conceptual Understanding

This research makes a notable conceptual contribution by moving beyond traditional, individualistic understandings of dignity to a more nuanced, relational perspective in the context of AT design for elder care. By integrating Gallagher's dual dimensions of dignity, Nolan et al.'s senses framework, and continuity theory, the research develops a revised conceptual model (Figure 54) and dignity-conscious design principles. These highlight the interconnectedness of objective, subjective, and temporal aspects of dignity in elder care and lay the foundation for a more comprehensive framework to be built in the future. The research makes the following specific contributions to conceptual understanding:

- **Refined and contextualised definition of dignity in AT design:** Moving beyond a purely philosophical approach, this research offers a practical, multi-layered set of design considerations combining objective, subjective, and relational dimensions to understand human dignity within the specific constraints and opportunities of elder care. As demonstrated in Chapter 5 through the analysis of carer interviews, a key finding was the recognition of carers' key role in shaping the dignity of older adults; they are not merely operators but rather mediators responsible for maintaining an ethical environment for older adults.
- **Relational dignity as a key construct:** Challenging traditional views of dignity as an exclusively individual attribute, this research demonstrates, through the analysis of user testing data (Table 8, Section 5.2.3), that dignity is fundamentally relational. For instance, carers' consistent concerns about the shower chair's efficiency and practicality have led to the prioritisation of speed over personalised care, resulting in a less dignified experience (as

described in Section 7.3). The research shows that interactions among older adults, carers, and technology shape dignity.

- **Power imbalances and contextual influences on the application of dignity theories:** As demonstrated in the user-centred evaluation of shower chairs (Section 5.2.2), existing power imbalances in elder care settings—such as the persistent prioritisation of carer efficiency related to time constraints and workload over the comfort and safety of older adults—may influence the expression and experience of dignity. This research highlights the need for interventions to address these dynamics. The use of a co-design method creates new opportunities for research to understand and verify power dynamics in these contexts.

9.2 Methodological Contribution

This research illustrates the value of PD as an appropriate methodology for examining complex, relational experiences, such as dignity, in elder care. The iterative design process, combined with user feedback and theoretical analysis, offers a flexible approach to developing AT that is both practical and dignity-sensitive. The research makes the following contributions to methodology:

- **Effective application of PD in a sensitive context:** The research illustrates the feasibility of implementing PD in the sensitive, challenging context of elder care, particularly in intimate settings such as shower assistance. In particular, by taking a more interactive approach to demonstrate which features the test aimed to assess and then allowing older adults and carers to share their own views, as described in Section 5.3 (Dignity-Conscious Shower Chair Design and Its Iterations), it helped ensure genuine consent for validation of design decisions. The iterative process in this research also

reveals potential ethical challenges in PD. For instance, despite the design's intent to increase ease of transfer with a rotating armrest (Section 6.2.3), this feature also created a durability issue for the load weight of an older adult, posing a potential safety concern that must be resolved through structural reinforcement; this process demonstrates the dynamic, ethically responsive nature of this methodology.

- **Strategic triangulation of data sources:** Combining semi-structured interviews, focus groups, and visual methods like care activity cards and 3D CAD renderings provides a rich, multifaceted understanding of the lived experiences of older adults and carers, enhancing the validity and reliability of the findings. The agreement on the importance of safety, combined with varying valuations of visual representation, as demonstrated by carers and older adults' feedback during the iterative design process (Section 5.3), highlights the benefits of the triangulation method. Specifically, visual methods and tests facilitate communication and reveal nuanced perspectives for both stakeholders, offering a valuable approach for future research in complex and sensitive contexts.
- **Development of an analytical framework synthesis:** This research extended the application of Nolan's six senses framework, which was originally developed for dementia care (Appendix A), to a broader population in elder care, demonstrating its adaptability for capturing the multifaceted subjective experiences central to dignified care. As described in Section 3.4, integrating the six senses framework, Gallagher's dual dimensions of dignity, and continuity theory provides an analytical lens to support co-design and generate design implications. Through this integrated lens, the research

reveals key relational dynamics: ‘comfort’ is intertwined with older adults’ sense of belonging (Section 7.2.1). The findings validate the framework’s potential as an analytical tool, offering a robust methodological foundation for future research on power dynamics and subjective well-being in the complex context of elder care.

Nevertheless, a notable methodological limitation is the lack of a formal, written product design specification (PDS) before fabrication. The dignity-conscious shower chair was developed through an iterative design and prototyping process (as detailed in Chapter 6), rather than a comprehensive initial specification that set performance targets, load conditions, environmental tolerances, material requirements, and acceptance criteria prior to manufacturing. As a result, several functional limitations were identified only after the prototypes were built and handled, including corrosion of the unpainted steel, noticeable rocking at the initial T-shaped joint, and shaking of the unlocked folding-backrest handlebar. These issues were addressed reactively rather than being prevented during the specification stage. This approach is consistent with the participatory, practice-based methods of the broader study and may be particularly well suited to dignity-conscious design, where issues of relational use and felt experience are difficult to anticipate before physical engagement. Nonetheless, future research building on this work would benefit from combining a participatory design approach with a formal PDS developed in collaboration with users and carers. This approach would ensure both technical performance and the necessary dignity-related qualities to effectively integrate relational specification and engineering rigour. Relatedly, since the design was developed iteratively, some contextual usability issues, such as the prototype’s fit with existing shower-room layouts, only became apparent during later evaluations.

Incorporating structured contextual tools, such as user journey mapping of the shower-assistance routine, upfront, could have identified these environmental constraints earlier. Future dignity-conscious designs should use this approach alongside a formal PDS.

9.3 Practical Contribution

This research provides practical insights to enhance the design and implementation of AT in elder care, focusing on the translation of theoretical frameworks into design solutions. It makes the following contributions to practice:

- Tangible embodiment of dignity:** Beyond theoretical exploration and design principles, this research presents a tangible example of practice-based contribution: a dignity-conscious AT. As described in Section 1.10, the final shower chair prototype, detailed in Volume 2, serves as a representation of the practice-based research process, embodying design iterations and a prototype manufacturing process informed by user feedback. The accompanying video demonstration in Volume 2 is not merely supplemental but instead offers a crucial, immersive experience. It illustrates the shower chair's enhanced functionality and usability, along with the aesthetic considerations deliberately chosen to foster a more dignified showering experience for both older adults and carers. This artefact represents a noteworthy contribution to the field, demonstrating how theoretical frameworks can be translated into practical solutions that directly address the complex interplay of dignity and technology within the real-world context of elder care.
- Dignity-conscious design principles for shower chairs and beyond:** This research synthesises essential findings into a set of actionable design

principles, detailed in Section 5.2.3 and refined through user testing in Chapter 7, offering practical guidance for designers developing AT that upholds and promotes human dignity. Phase 2 testing restructured these four design principles, highlighting the relationally negotiated nature of each rather than treating them as fixed targets (Section 8.5). Moving beyond simple functional features, these principles address critical aspects such as safety, independence, control, comfort, and self-esteem. These aspects should be integrated rather than being considered independent design elements, as illustrated by the visualised revised conceptual model presented in Section 8.4. These principles provide a foundation for the development of AT grounded in both functional efficacy and a deep understanding of the psychosocial dynamics of care. The application of these principles facilitates the creation of design solutions that promote agency for both older adults and carers, fostering more dignified and relationally sensitive care environments.

- **Shift towards a relational design approach:** By identifying the limitations of solely feature-driven AT designs, as demonstrated by the nuanced and often conflicting feedback from carers and older adults regarding features such as colour options and rotating backrest (as detailed in Sections 7.1 and 7.2), this research encourages designers and manufacturers to move beyond technological innovation as an ultimate goal. It promotes a relational design-thinking approach that considers the nuanced needs and perspectives of all stakeholders, including the often-overlooked carers who implement and manage AT. This requires a shift from a product-centric to a people-centric approach, emphasising the social and emotional impact of design choices and the creation of supportive ecosystems around AT, rather than isolated

technological solutions. Designers are encouraged to embrace methodologies that explicitly integrate practice-based knowledge (as discussed in Section 3.5).

- **Nuance in user-centredness:** Relying solely on user-centred design may risk overlooking the inherent relational complexities of dignity and introducing cultural biases. Building a nuanced understanding of users involves recognising both their cultural backgrounds and key values, as underscored in Section 2.2. Future research should examine how design solutions aimed at addressing individual preferences function within the broader social context, particularly the influence of Confucian values in China (Section 2.2.2). This integrated approach, considering both cultural context and individual desires/perceptions, will inform ethically and culturally sensitive AT design.
- **Integrate visual cues and intuitive operation:** This research emphasises the need to move beyond an exclusive focus on objective safety considerations to include emotional and relational dimensions in AT design. Clear visual cues must be integrated, and intuitive operation enabled, to enhance both older adults' perceptions of safety and carers' confidence in their ability to provide effective assistance. The importance of these initial user perceptions was demonstrated in the evaluation of shower chairs (Section 5.2.2) and the iterative design process (Section 5.3). For instance, perceptions of safety were heavily influenced by visual cues of sturdiness and stability, even with secured objective safety measures (Section 5.3.1 and Appendix H). Furthermore, the perceived operational clarity of AT, such as mechanisms for adjustable features, affects carers' emotional burden during caregiving (as discussed in Section 7.1). Future AT design must not only ensure technical

efficacy but also carefully consider the psychological and relational impact of visual and operational elements to ensure genuine and sustained improvements in both safety and dignity.

9.4 Implications for Future Research and Practice

The findings of this research have meaningful implications for future research and practice in AT design and elder care. These implications, presented below, suggest a more focused and productive direction, aimed at building a more robust and empirically grounded understanding of dignity-conscious AT.

9.4.1 Beyond Feature-Driven Design: Toward Integrated Relational Ecosystems

- **Current limitation:** Focusing on adding individual features to the current AT often overlooks the broader systemic challenges present in the care environment. As this research has demonstrated, even well-designed features can fail to translate into meaningful improvements in dignity if they are not effectively integrated into the existing routines, physical spaces, and relational dynamics of care (as described in Chapter 7). This finding highlights a critical disconnect between isolated innovation and the holistic needs of the care ecosystem.
- **Future direction:** Explore design strategies that prioritise a holistic understanding of the care relationship and the interconnected needs of older adults and carers, moving beyond feature-centric thinking to a more comprehensive, systems-oriented approach. Key areas for investigation include:
 - *Contextual inquiry research:* Conduct longitudinal, in-depth ethnographic research of shower assistance routines in diverse elder care settings. Focus on identifying specific friction points, such as

difficulties related to transferring older adults with limited mobility (Section 5.1.1); communication gaps, such as conflicting perceptions (Section 7.2.2); unmet emotional needs, such as feelings of vulnerability and lack of control (Section 7.2.1); and existing power dynamics that influence the care experience (Sections 2.2.2 and 5.2.2).

- *Ecosystem design frameworks*: Develop comprehensive design frameworks that position AT within its broader context, including the physical environment (e.g. shower room layout, accessibility) and care procedures (e.g. training protocols, staffing resources). Carer training, specifically in strategies to manage workload and promote emotional well-being (as discussed in Sections 6.4.1 and 7.1), is crucial, as is addressing the influence of these factors on the overall quality of care (as evidenced in Section 7.3). Frameworks should explicitly consider the interdependencies between these elements and their collective impact on the dignity of all stakeholders, informed by the relational considerations discussed throughout this thesis.

9.4.2 A Renewed Focus on Relational Connection: Transcending Physical Support

- **Current limitation:** Many current AT designs appear to operate under an implicit assumption that the primary goal is to provide physical support, which risks marginalising the crucial dimensions of respect and authentic relationality fundamental to dignified care (as highlighted in Section 1.2.2). This research has demonstrated (Chapter 7) that older adults value the emotional support and attentiveness of carers, often prioritising these

relational elements as tangible physical assistance, highlighting the importance of extending design principles beyond a solely functional view.

- **Future direction:** Design features and their underlying mechanisms should be deliberately engineered to foster relational connections and promote positive interactions between older adults and carers. Key areas for investigation include:
 - *Innovative solutions for social interaction*: The field should allocate resources to explore solutions that go beyond the mere physical aspect of caregiving interactions, such as strategies to enhance communication and reduce feelings of isolation among older adults (as discussed in Section 2.4.5). These may encompass integrating features that facilitate authentic social connection (e.g. personalised music playlists that connect to past memories or projected virtual environments showcasing familiar places). Furthermore, it is essential to explore technologies that provide carers with mechanisms for receiving positive feedback and validation, thereby acknowledging their emotional labour, which is often overlooked. Incorporating input mechanisms for older adults to provide feedback on the care experience may foster reciprocal engagement. This approach aligns with Nolan et al.'s senses framework of achievement and belonging (Section 3.4.2).
 - *Ethical considerations of empowerment*: AT design needs a new framework that focuses on actively supporting a more balanced power dynamic, as highlighted by the evaluation of shower chairs (Section 5.2.2). Future research should rigorously assess whether a technology, despite its efficiency benefits, unintentionally compromises core values,

such as cultural respect and individual dignity, within particular caregiving communities. This requires careful consideration of the potential for AT to reinforce existing power imbalances or create new ones, potentially limiting relational agency, as discussed in Section 8.2.

9.4.3 Contextualising Cultural Values and Privacy in Dignity-Conscious Design

- **Current limitation:** The dignity-conscious design approach developed in this research did not sufficiently address the multifaceted nature of privacy, particularly given the constraints of institutional care settings, such as prioritising speed and emphasising carer efficiency (The Negotiated Role of Privacy, Section 8.5). Furthermore, the framework was tested within the specific context of shower chair design in urban Chinese elder care facilities.
- **Future direction:** Future research should prioritise a deeper exploration of privacy as a relational construct within elder care settings and test the applicability of these design principles across diverse ATs and cultural contexts. It should aim to develop a more comprehensive theoretical or conceptual framework by expanding these principles across a wider range of AT and cultural settings, building on the foundation established by this thesis. User testing should emphasise the interplay of objective elements and relational or even human aspects, such as emotional contact. Key areas for investigation include:
 - Explicit examination of cultural values and norms: Acknowledging the inherent constraints of single-cultural case studies, future research must move beyond superficial acknowledgements of cultural difference to critically investigate how specific cultural values and norms fundamentally shape both the lived experience of dignity and the

acceptance, adoption, and effective use of AT in elder care. As this research demonstrates (Section 2.2.2), cultural context considerably shapes perceptions and priorities regarding dignity, requiring researchers to transcend mere identification of these differences and translate them into concrete design requirements and ethical considerations. Future research should employ rigorous cross-cultural methodologies, including comparative analyses of the application of dignity-conscious design principles across diverse cultural settings (Section 8.6), to critically assess whether and how the framework's core principles require modification to achieve ethical and practical validity across cultures. Furthermore, addressing this challenge necessitates the development of validated tools to evaluate and consider diverse cultural values across care settings, advancing beyond simplistic measures of cultural affiliation to capture the nuances of individual adherence and potential conflicts between competing values, such as autonomy and communal responsibility. Through this approach, research can identify and address potential cultural biases and develop culturally sensitive adaptations of dignity-conscious AT design principles, to improve the understanding of power dynamics between carers and older adults and ultimately promote AT designs that empower older adults with dignity and agency across a wide range of cultural contexts.

- *Development of contextualised privacy solutions*: This requires a dual approach. Firstly, robust methods must be developed to evaluate the privacy requirements and preferences of older adults and carers, acknowledging variation in individual values, routines, and

communication styles (Section 2.4.5). These methodologies should incorporate ethnographic observation and comprehensive interviews to reveal tacit understandings of privacy within specific care settings. Secondly, these assessments must inform the design of burden-minimising AT solutions that enhance privacy without increasing carer workload (Table 5, Section 2.4.3) or compromising essential aspects of care, such as safety, accessibility, and efficiency. These solutions may include flexible and adaptable design elements, such as integrated, adjustable screens manufactured from easy-to-clean materials. The focus should be on design features that empower older adults to control the level of assistance and interaction they receive, thereby fostering a sense of agency over their personal space and interactions.

9.4.4 What Designers, Researchers, and Care Managers Can Do Differently

The contribution of this thesis is best assessed by what its readers can accomplish with it. This subsection translates the research findings into practical actions for three audiences whose decisions determine whether dignity-conscious AT is accessible to older adults and carers in institutional settings.

For designers of intimate-care AT. First, prioritise dignity as a core design principle rather than adding it as an ethical layer after defining functions. The dignity trade-offs discussed in Sections 5.2.2 and 7.3 became apparent because dignity was emphasised from the initial brief. If the function had been specified first and then the dignity checked later, these issues might have been hidden. Second, evaluate with both carer and older-adult groups simultaneously, and consider differences in their feedback as key to the design process. For example, the adjustable-height mechanism (Section 5.2.2) and the rotating backrest (Section 7.1.2) were successful

in single-group reviews but unsuccessful when both groups were tested together; testing with only one group can overlook critical relational care problems. Third, treat aesthetic choices as functional rather than purely decorative. The prototype's colour and form choices impacted older adults' perceived dignity (Section 7.2.1) and decreased clinical signals that diminish self-worth (Section 8.2.3). It is important to evaluate aesthetics with the same rigour as ergonomics, rather than treating them as mere finishing elements.

For design researchers. First, when adopting dignity theory from nursing or gerontology, apply the integrated Gallagher–Nolan–Atchley lens (Section 1.7) with the three context-specific limitations outlined in Section 8.1: Gallagher's dichotomy underestimates relational mediation; Nolan's six senses must be prioritised according to context rather than equally weighted; and continuity theory must be balanced against the practical realities of institutional care. Applying the framework without these adjustments risks replicating the mismatch between theoretical intent and lived experience, as documented in this thesis. Second, in cultural settings where verbal disagreement with authority is discouraged, prioritise visual methods (such as 3D CAD visualisations and care activity cards) as primary tools for prompting responses, rather than using them as supplements to interviews. The negative case analysis procedure (Section 4.6) succeeded because the visual artefacts provided participants with a non-confrontational way to express dissent that verbal protocols might not reveal.

For care providers. First, consider AT procurement as a relational decision rather than solely a technical one. A device that performs well on measures of efficiency can still harm carer–older adult relationships if its design overlooks the trade-offs discussed in Chapter 7. Including criteria that prioritise carer well-being

and older adult dignity alongside throughput can highlight these costs at purchase time instead of after implementation. Second, understand that even features designed to preserve dignity need operational support to be effective. The rotating backrest was meant to provide a familiar, comforting routine, but carers' time constraints made it impractical to use (Section 7.1.2). Purchasing dignity-conscious AT without adjusting staffing, scheduling, or training risks reproducing the function-driven outcomes the technology was meant to avoid. Third, view carer well-being as essential to older adult dignity, not as a separate issue. Sections 7.1 and 8.3.1 suggest that carers' ability to provide respectful care depends on their sense of control, competence, and emotional health.

Across all three audiences. The recommendations above should be considered alongside the limitations outlined in Section 8.6. Notably, this study excluded older adults with severe cognitive impairment (Section 4.3.2), although they form a significant portion of institutional elder care populations. Therefore, future efforts should focus on testing and refining dignity-conscious design principles (Section 5.2.3) with this group, utilising observational and behavioural reporting methods rather than relying solely on verbal self-reports. Additionally, it is important to explore how the relational mediation claim (Section 8.3.1) might shift when older adults' verbal engagement decreases and carers' interpretive roles increase. Future design of AT for this and other populations could be enhanced by applying the matching person and technology (MPT) model (Scherer et al., 2007), which offers a structured approach for aligning device features with user needs, the environment, and technical specifications. Although MPT was not used as an evaluative tool in this study, it complements the dignity-conscious design principles: while the principles guide what dignity-conscious AT should accomplish, MPT

provides a process for ensuring AT fits the right person in the appropriate context.

Integrating these approaches may help put the principles into practice in procurement and prescribing decisions, and it is recommended as a future step.

9.5 Concluding Remarks

This research makes a substantial contribution to the evolving discourse on AT, human dignity, and caregiving. It demonstrates that ethically grounded, practically effective design principles derived from contextual insights form the foundation for developing a transferable framework for dignity-conscious AT design.

While this research emphasises the importance of ‘balance’ (meeting all needs equally) in addressing complex and diverse needs and values in design decisions, it also recognises that such balance may be unattainable in real-world applications. Instead, configuring or carefully tailoring design elements by ‘prioritising’ certain needs and values within a specific context and situation is a key strategy for creating dignified care solutions. Prioritisation, however, should not be interpreted as a dismissal of foundational needs and values, which must remain integral to any design process aiming to cultivate dignity. The research findings consistently demonstrate the interconnectivity of different senses involved in objective and subjective experiences of dignity within the relationality of older adults and carers. Thus, cultivating a primary action will positively resonate with others. From this perspective, genuine balance in design decisions that foster dignity in elder care settings can be achieved through prioritisation, a process that this research enables through its participatory design approach and frameworks for understanding relational dynamics, rather than treating all elements equally.

While the findings are primarily rooted in a specific cultural and institutional context (a limitation that further research and testing must address), the revised conceptual model (Section 8.4) and refined design principles (Section 8.5) offer a valuable foundation. By showing how participatory methods can embody ethical principles in AT within a specific context, this research contributes to the global conversation on dignity-conscious design, offering a compelling model for humanising technology in compassionate elder care. It provides a foundation for future research and highlights the importance of respecting human rights and dignity in the provision of technological and personal care.

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Appendix A

The Senses Framework and Continuity Theory (Focusing on Shower Chair Design)

The Senses Framework and Shower Chair Design

The senses framework identifies six interconnected senses that are crucial for relationship-centred care and the maintenance of dignity in older adults (Nolan et al., 2006; Table A). While initially developed for dementia care, it offers valuable insights into enhancing relationship-centred care and promoting the well-being of older adults across various care settings (Ryan et al., 2008; Woog et al., 2019). These senses are not isolated but interconnected, mutually reinforcing one another, and are particularly relevant when evaluating the impact of AT (Woog et al., 2019), such as shower chairs, on the quality of care and older adult engagement.

Sense	Attribute
Security	To feel safe
Belonging	To feel like a part of things
Continuity	To experience links and connections
Purpose	To have goals to aspire to
Achievement	To make progress toward goals
Significance	To feel that you matter as a person

Table A. *Six Senses and Their Attributes*

Sense of Security

A sense of security in the shower is essential for dignity. A secure shower environment objectively prevents falls and injuries, fulfilling a fundamental human right. Subjectively, a safe design—incorporating robust materials, a stable structure and anti-slip surfaces (Abley, 2012)—reduces anxiety and promotes feelings of

safety and confidence. For instance, although stability is one of the most crucial aspects of safety, some shower chairs are made from low-quality materials, compromising safety (SolutionBased, 2024). Addressing the fear of falling or scalding through thoughtful design choices enhances physical safety and significantly contributes to emotional comfort and a positive subjective experience. In addition, aesthetically pleasing designs that emphasise durability and reliability, such as strong structures, adequate backrest height and anti-slip surfaces, can foster a stronger sense of trust and security.

Sense of Belonging

A sense of belonging fosters feelings of value and connection within the elder care environment. For older adults using shower chairs, personalised features, colour choices and the ability to incorporate personal items (Swann, 2006) can promote a sense of ownership and belonging, enhancing self-worth. Involving older adults and their carers in the selection and setup of a shower chair can strengthen their sense of participation by enabling them to make choices that reflect their personal preferences and needs, preserving their subjective dignity (Woog et al., 2019). For carers, a design that simplifies the caregiving process reduces physical strain and allows for more focused interaction (Swann, 2006). For instance, operating the shower chair with one hand enables carers to maintain physical contact with older adults using their other hand, enhancing the sense of connection and belonging. This attentive care can lead to higher job satisfaction and increased self-worth, which are critical components of objective dignity.

Sense of Continuity

Maintaining routines and preferences supports subjective dignity by providing familiarity and consistency (Watson, 2016; Ryan et al., 2008). Older

adults should retain their personal preferences and routines, even in new settings such as residential care (Chochinov, 2002). For instance, shower chairs can support continuity by incorporating features that reflect older adults' past experiences and comfort, such as preferred water flow, temperature and timing. The design can also accommodate users' existing comfort with mobility and balance, adapting to their individual needs and preferences to create a sense of familiarity and consistency.

Sense of Purpose

Particularly relevant for older adults experiencing cognitive decline, a sense of purpose can arise from engaging in meaningful activities (Ryan et al., 2008). Watson (2016) emphasised the need for individuals with dementia to shift from independence to interdependence, recognising dependency as normal. This principle is crucial in elder care, where older adults often rely on others as their abilities decline. Engaging in meaningful activities significantly enhances their dignity and well-being (Tranvåg et al., 2014). For example, allowing older adults control over adjustable features, such as a safety handle on a shower chair, empowers them to participate actively in their care, reinforcing their sense of agency and capability.

Furthermore, carers' sense of purpose is linked to their belief that they make a positive difference in residents' lives, which increases job satisfaction (Ryan et al., 2008). Efficient and ergonomic design reduces workload, freeing time and energy for more meaningful interactions, thus fostering a sense of purpose in their work.

Sense of Achievement

A sense of achievement refers to the feeling of accomplishment and satisfaction with one's efforts, serving as an essential source of dignity and self-esteem, particularly when facing frailty (Tranvåg et al., 2014). Participating in self-care activities independently, even with assistance, is crucial for maintaining pride

(Scharlach & Lehning, 2012). For instance, older adults may feel proud of managing aspects of their care before carers arrive, fostering a sense of contribution to the carers' efforts and appreciation for their help. In turn, carers may feel that older adults acknowledge and value their efforts.

This example demonstrates that a sense of achievement is reciprocal in the caregiving relationship and beneficial for both parties. For carers, providing quality care while fully utilising their skills (Ryan et al., 2008; Watson, 2016), with the aid of a shower chair, can enhance their sense of accomplishment at work. For instance, positioning control mechanisms within easy reach can reduce physical strain, allowing carers to focus on older adults' specific needs and preferences rather than expending effort overcoming physical challenges posed by the equipment. Therefore, a shower chair design that promotes a sense of achievement can improve carers' job satisfaction and enhance older adults' well-being.

Sense of Significance

A sense of significance involves feeling acknowledged and appreciated as a valuable individual, which enhances self-esteem and dignity (Watson, 2016; Nolan et al., 2006). Recognising an individual's identity and preferences strengthens their dignity and self-worth (Simões & Sapeta, 2019). For instance, involving older adults in personalised activities, such as providing customisable shower chairs that reflect their preferences (Kim et al., 2020), fosters a sense of significance by acknowledging them as valued individuals. When carers value their own efforts, their self-worth increases, which is essential for motivation in challenging roles (Watson, 2016). Recognising one's own importance in the workplace enhances job satisfaction and sense of purpose (Ryan et al., 2008). Additionally, shower chairs designed to improve older adults' comfort during transfers can strengthen their sense of

significance through positive feedback and appreciation. This observation supports the view that dignity arises from meaningful engagement and recognition of individuals' uniqueness and contributions (Chochinov, 2002).

However, ensuring a sense of significance in elder care presents challenges. Barriers such as physical limitations and cognitive impairments must be addressed to make individuals feel valued (Dong et al., 2021). Therefore, carers must be trained to recognise and meet the unique needs of each older adult, fostering an environment of respect and appreciation (Simões & Sapeta, 2019). Nolan et al.'s senses framework, which emphasises interconnectedness, offers a key perspective for designing a dignity-conscious shower chair that not only supports physical safety and comfort but also enhances overall self-worth and well-being.

Continuity Theory and Shower Chair Design

Continuity theory emphasises adaptive choices based on past experiences to preserve identity and stability, enabling effective management of change in care settings (Guedes & Melo, 2019). Maintaining continuity involves preserving familiar routines, preferences and relationships, which helps older adults feel secure and supported (Guedes & Melo, 2019) and facilitates smoother transitions during significant life changes. Thus, a shower chair design that reflects past experiences aligns with continuity theory, easing the transition into new care environment (Giosa et al., 2014). This concept of familiarity also directly relates to the sense of continuity in Nolan et al.'s senses framework.

Continuity theory also holds significance for carers. Understanding how past experiences shape current behaviours enables carers to provide more personalised support, reducing anxiety and uncertainty during transitions and improving satisfaction and quality of life for older adults (Giosa et al., 2014). Guedes and Melo

(2019) described continuity theory as encompassing the interplay between internal and external continuity, highlighting their relation to objective and subjective dignity (Figure A). Internal continuity refers to stable mental frameworks—thoughts, skills and memory—that shape self-identity and our understanding of the world (Guedes & Melo, 2019). This concept is closely related to subjective dignity, which encompasses personal values, preferences and perceptions of self-worth (Tranvåg et al., 2014). For instance, maintaining familiar routines and environments supports internal continuity, enhancing subjective dignity as older adults sustain their established identities and values.

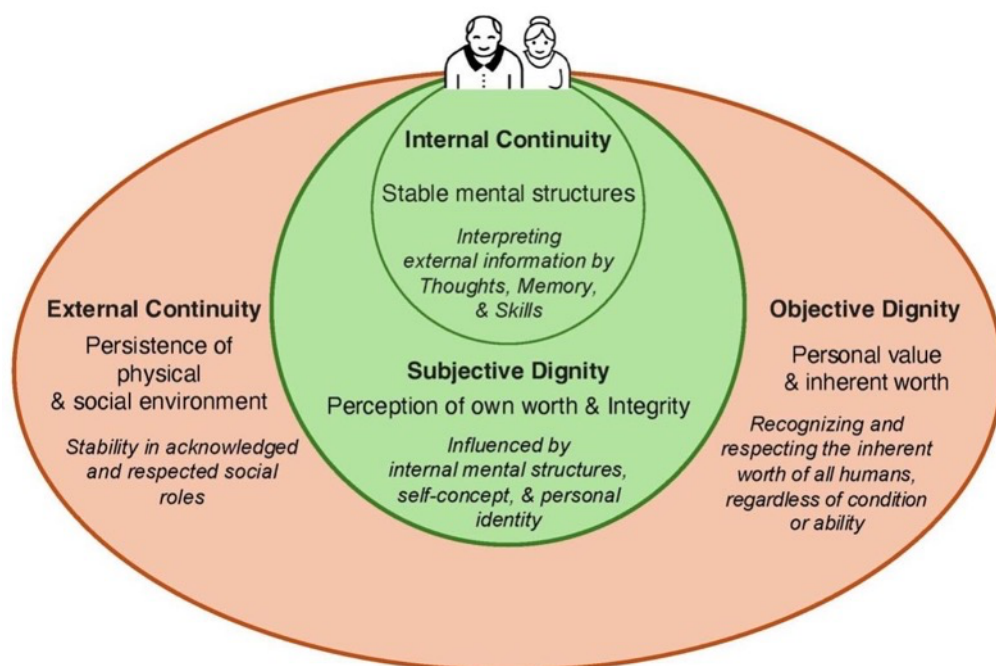


Figure A. *Integration of Continuity and Dual Dimensions of Dignity*

Conversely, external continuity refers to the stability of the physical and social environment, including relationships and roles (Guedes & Melo, 2019). This dimension is closely linked to objective dignity within societal roles that recognise and respect an individual's inherent dignity while upholding personal integrity and

self-respect (Gallagher, 2004). Furthermore, maintaining social connections and participating in meaningful activities contribute to Nolan et al.'s sense of belonging and purpose, which are vital components of both objective and subjective dignity.

The interplay between internal and external continuity is crucial, as they mutually influence each other and affect both objective and subjective dignity, shaping an individual's overall experience of well-being (Gallagher et al., 2008). Therefore, a balanced approach is therefore necessary. Overemphasising external continuity without considering individual preferences is insufficient, just as focusing solely on personal preferences without acknowledging the broader social context can lead to isolation.

This balanced integration is particularly relevant in the design and implementation of assistive shower chairs. By facilitating self-care activities and enhancing self-esteem within care relationships while also maintaining established routines and preferences, shower chairs promote self-efficacy and control. The active involvement of older adults and carers, achieved through customisable features, user-friendliness, safety and visual appeal (Amabili et al., 2023), is essential for aligning shower chair design with continuity and dignity. Grounded in continuity theory, this approach recognises that supporting both internal (mental frameworks and self-identity) and external (physical and social relationships) continuity is vital for effective person-centred care. Therefore, shower chair design should promote engagement, control and self-efficacy, while also honouring personal preferences and facilitating social interaction, all of which are crucial for maintaining dignity.

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Appendix B

Human Ethics Approval (Research Phase 1)

Proportionate Review UREC <PR-UREC@ljmu.ac.uk>

Favourable Ethical Opinion & Approval. UREC Ref: 23/LSA/008

Date: 19 January 2024

Dear Fred

Fred Han, PGR-Examining the Significance of Dignity in the Implementation of Assistive Technology within Care Relationships (Mark Roughley)

UREC opinion: Favourable ethical opinion

UREC reference: 23/LSA/008

UREC decision: Favourable ethical opinion

UREC reference: 23/LSA/008

Research Governance Assessment: Approved – the study may commence.

On behalf of the University Research Ethics Committee (UREC), I am pleased to confirm a favourable ethical opinion for the above study on the basis described in the application form, protocol, supporting documentation and any clarifications received, subject to the conditions specified below.

Conditions of the favourable opinion

- You must ensure the information included in the participant facing documents are always current and informed by ongoing risk assessments and any changes to current practices (<https://www.ljmu.ac.uk/ris/research-ethics-and-governance/research-ethics/university-research-ethics-committee-urec/ethics-application-form-and-templates>)
- Where any substantive amendments are proposed to the protocol or study procedures further ethical opinion must be sought (<https://www.ljmu.ac.uk/ris/research-ethics-and-governance/research-ethics/university-research-ethics-committee-urec/amendments>)
- Any adverse reactions/events which take place during the course of the project are reported to the Committee immediately by emailing FullReviewUREC@ljmu.ac.uk
- Any unforeseen ethical issues arising during the course of the project will be reported to the Committee immediately emailing FullReviewUREC@ljmu.ac.uk

Please note that favourable ethics opinion is given for a period of five years. An application for extension of the ethical opinion must be submitted if the project continues after this date.

Appendix C

Human Ethics Approval (Research Phase 2)

Liverpool John Moores University

From: Proportionate Review UREC <PR-UREC@ljmu.ac.uk>
Subject: Approved with provisos - 25/LSA/007

Date: 2 April 2025

Dear Fred

Han, Fred. PGR, LSA. Examining the Significance of Dignity in the Implementation of Assistive Technology within Care Relationships. (Mark Roughley)

UREC decision: Favourable ethical opinion with provisos

UREC reference: 25/LSA/007

Research Governance Assessment: Approved – the study may commence.

On behalf of the University Research Ethics Committee (UREC), I am pleased to confirm a favourable ethical opinion for the above study on the basis described in the application form, protocol, supporting documentation and any clarifications received, subject to the provisos and conditions specified below.

You or your supervisor (for student projects, the final version of the ethics application must be submitted to UREC by the student's supervisor once they are satisfied that the ethics application has been finalised), are required to submit the final version of the ethics application with the provisos addressed to PR-UREC@ljmu.ac.uk or using the [UREC Research Ethics and Governance Decision Tool](#). Please note, UREC will not check that the provisos have been applied in the final version of the ethics application and will not email any further notifications to the applicant once the final version of the ethics application has been forwarded to UREC. If the applicant does not want to apply the provisos as stated below, the applicant must notify UREC and resubmit the ethics application for further review.

Southern University of Science and Technology (Shenzhen, China)

Southern University of Science and Technology Research Ethics Review Resolution

Resolution number	20250303
Project Name	Examining the Significance of Dignity in the Implementation of Assistive Technology within Care Relationships
Applicant	FRED HAN
Case Number	2025PES303
Application time	April 8, 2025
Has the preliminary review been passed?	☒ Pass ☐ No Pass
Time for meeting or communication review	April 9, 2025
Review resolution	☒ Pass ☐ Need Revise and review ☐ No Pass
Approval opinion from the University's Science and Technology Ethics Committee: Approved. The project will be supervised by the University's Science and Technology Ethics Committee after approval.	



Appendix D

Qualitative Analysis: Introductory Focus Groups

Theme	Code	Description	A	B	Examples	C
Emotional Difficulties : Psychological challenges faced by carers.	Emotional	Feeling emotionally drained or burdened by caregiving.	5	11	"Transferring between bed and wheelchair is the third most emotionally difficult task...may face safety issues" (CG3). "The most challenging part is communication. I am most tired when...I need to guess their meaning" (CG4).	Nolan's Senses Framework (Belonging, Security), Gallagher's Framework (impact of emotional well-being)
	Fear or Worry	Anxieties about the older adult's safety or well-being.	10	18	<i>"When showering, the elderly are at risk of slipping...they should be supported to reduce the risk of falls" (CG1). "Holding elderly for walking...requires physical exertion...otherwise, it is easy to get injured" (CG4).</i>	
	Frustration or Irritation	Feelings of impatience due to the older adult's behaviour or lack of cooperation.	4	15	<i>"Transferring between the bed and wheelchair ... The elderly may not cooperate and may face safety issues if they move around recklessly." "Sometimes, elderly individuals are reluctant</i>	

					to shower and may react aggressively, hitting others" (CG3).	
Stress or Anxiety	Nervousness related to caregiving responsibilities.	8	18	<i>"I prefer to take a shower independently...I am still being watched by the carer nearby" (CR2). "Feeding the elderly is the second most emotionally difficult task. Especially when they do not cooperate to sit up, I feel stressed" (CG3).</i>		
Physical Difficulties : Physical Difficulties : Challenges carers face with effort, strain, or limitations.	Feeding Challenges related to physical effort, strain, or limitations experienced while feeding.	3	6	<i>"There are many requirements for feeding" (CG1).</i>		Nolan's Senses Framework (Security), Gallagher's Framework (impact of physical decline)
	Physical Exertion or Strain	Physical effort, strain, or fatigue experienced by the carer.	6	21	<i>"Holding an elderly person for walking ...requires physical exertion... otherwise, it is easy to get injured." (CG3). "When wiping the body, if the bed is very low, I should bend down. It makes me tired over time." (CG6).</i>	

Risk of Injury	Instances where the carer is at risk of physical injury while providing care.	4	4	"Helping the elderly with toileting is a difficult physical task...to prevent falling." (CG3). "Assisting with washing hair is the second most valuable... a carer helps ensure safety and reduces the risk of falling" (CR1).	
Supporting	Challenges when providing physical support to the older adult during activities.	5	7	"Support walking is the second most physically difficult task, especially when supporting a semi-paralyzed elderly person; they are dragging their leg slowly" (CG1).	
Transferring	Challenges related to moving the older adult between bed-shower-chair.	3	3	"The transfer from bed to wheelchair is the most physically difficult task, especially when taking a shower or engaging in afternoon activities" (CG1).	
Washing /Showering	Issues related to assisting the older adult with washing or showering.	5	11	"Some elderly individuals need more extensive wiping; others dislike face washing and may become upset" (CG1).	
Assistance Needs: Specific tasks for	Eating Assistance required with feeding	1	1	"Due to reduced mobility and pressure sores, I am unable to eat independently" (CR1).	Relates to Gallagher's Framework

which the older adults require assistance from carers.	Mobility	Assistance needed for moving around, including transferring	4	8	<i>"Being supported by the carer makes one feel extremely safe and comfortable" (CR4). "When leg strength is limited, assistance in transferring from bed to wheelchair is essential" (CR1).</i>	k (objective decline impacts the needs of elderly people)
	Personal Care	Assistances that are required for activities related to personal hygiene.	5	8	<i>"I prefer to receive assistance with washing my hair, which is more difficult than taking a shower, because I need to lower my head, hold the high-up shower head" (CR1).</i>	
	Others	Needs that do not fit into the other sub-categories.	5	10	<i>"I depend on carers; without them, I couldn't manage my daily needs" (CR2). "I prefer carers who have been around for a long time to follow my own habits without making unnecessary inquiries" (CR2).</i>	
Preference s for Independence: Activities or tasks older adults prefer to do on their	Mobility	Preferences for independent movement.	3	4	<i>"I prefer to walk independently. I do not want to trouble the carer." (CR2) "Although I can walk on my own without using a wheelchair, the carer is worried about my safety and still wants to help me" (CR5).</i>	Gallagher's Framework (subjective dignity), and Continuity Theory

own, without assistance.	Personal Care	Preferences for performing personal care tasks independently.	5	8	"I prefer to take a shower independently..., but I am still being watched by the carer nearby" (CR3). "When I initially arrived at the nursing home, I bathed alone.... However, after falling once, I needed a carer to assist me with showering" (CR4).	
	Others	Preferences for doing tasks that do not fit into the other sub- categories	3	3	"I do what I can on my own... not to trouble them. I wash myself, go to the bathroom independently" (CR2). "I prefer to eat independently...to avoid troubling carers and because I am capable of doing so" (CR4).	
Carer Appreciation: Expressions of gratitude or recognition from older adults towards carers	Expressed Gratitude	Expressions of thanks or appreciation for specific acts of care.	6	8	"When elderly people are in a good mood, they thank me." (CG4) "Some polite elderly people will also say thank you during meals, and I will be happy to hear it" (CG5).	Nolan's Senses Framework (Significance, Belonging)
	Valued Attitude	Older adults' recognition of the carers' qualities.	7	9	"I think caring for elderly individuals with very limited self-care abilities is challenging" (CR1). "This job is meaningful... opportunity to learn how	

					<i>to care for the elderly"</i> (CG3).	
Others	Negative Experiences with Carers	Instances where older adults experienced inadequate respect or poor care from carers.	2	4	<i>"She refused to assist me with acupuncture and moxibustion, shirked her responsibilities, and made an excuse that she was busy. She didn't think this was her task." "I once complained to nursing home about a carer who was unwilling to help me with the commode and spoke impatiently"(CG2).</i>	Gallagher's Framework (impact on dignity) and Nolan's Senses Framework (Security, Belonging , Continuity)

Note. A: Sources, B: References, and C: Relevant Theoretical Frameworks

Appendix E

Market Research for Choosing Existing Shower Chairs for User Testing

Overview of Assistive Shower Technologies

Various assistive shower technologies are available globally, and their primary function can be broadly categorised as shower assistance. The first group comprises auxiliary transfer devices, which help move older adults or patients from their beds to shower chairs. They are designed to reduce the risk of injury and improve comfort during transfers. Examples include bathing home commode chairs, slide-transfer bath chairs, hoisting chairs and electric lift-transfer chairs (Figure B). Using such devices is essential for reducing carers' workload and ensuring patients' safety during transfers.

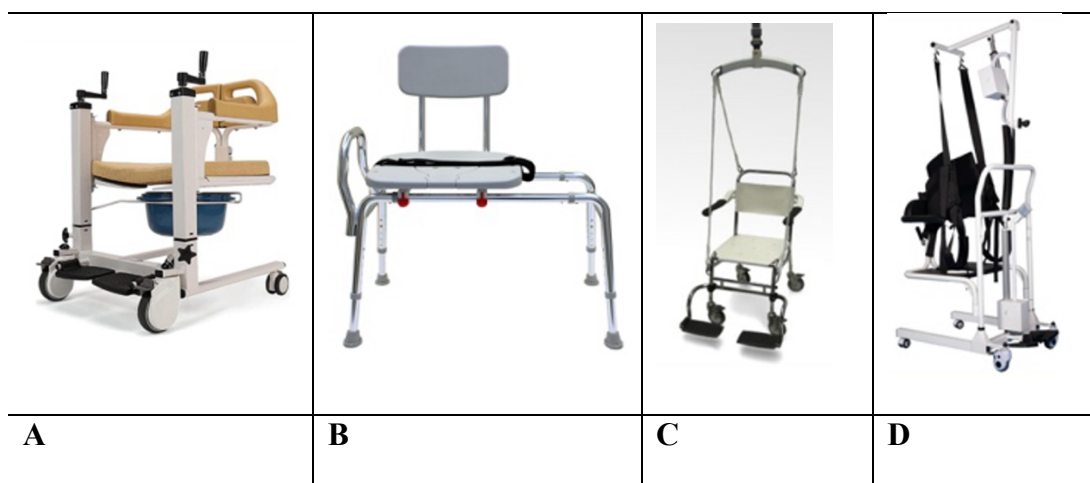


Figure B. *Transfer Function Embedded Shower Chairs (From Left to Right: Bathing Home Commode Chair, Slide-Transfer Bath Chair, Hoisting Chair and Electric Lift-Transfer Chair)*

Note. The images were taken from the following sources: (A)

[https://www.amazon.se/-/en/Transfer-Wheelchair-Portable-Transport-](https://www.amazon.se/-/en/Transfer-Wheelchair-Portable-Transport-Disabled/dp/B0C23LZDM1)

[Disabled/dp/B0C23LZDM1](https://www.amazon.com/DMI-Transfer-Disabled/dp/B0C23LZDM1), (B) [https://www.amazon.com/DMI-Transfer-](https://www.amazon.com/DMI-Transfer-Disabled/dp/B0C23LZDM1)

Aluminum-Eligible-Adjustable/dp/B0BVGWMYCH, (C)

<https://www.ewacmedical.com/products/transfer-equipment/hoist-chair/>, and (D)

[https://www.amazon.com/Gtminan-Electric-Removable-Wheelchair-](https://www.amazon.com/Gtminan-Electric-Removable-Wheelchair-Adjustable/dp/B0DTT9MGFG)

[Adjustable/dp/B0DTT9MGFG](https://www.amazon.com/Gtminan-Electric-Removable-Wheelchair-Adjustable/dp/B0DTT9MGFG).

The second group includes auxiliary bathing devices that assist individuals during showers. These comprise shower benches, bathtub sliding seats, shower wheelchairs and traditional shower chairs (Figure C). Among these, shower stools and shower wheelchairs are the most commonly used assistive devices in homes and assisted living facilities, as they are versatile and easy to use. These devices enhance users' independence and make bathing safer and more comfortable.

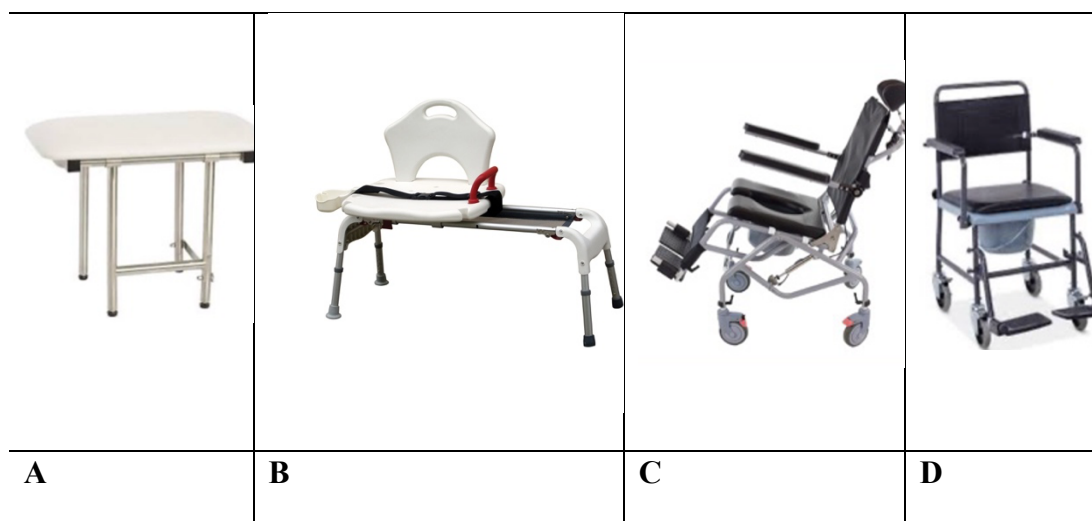


Figure C. *Shower Care Sitting Devices (From Left to Right: Shower Stool, Bathtub Sliding Seat, Tilt-in-Space Reclining Shower Chair and Toilet Commode Bathroom Wheelchair)*

Note. The images were taken from the following sources: (A)

[https://www.amazon.com/-/es/Seachrome-Asiento-plegable-pulgadas-](https://www.amazon.com/-/es/Seachrome-Asiento-plegable-pulgadas-acolchado/dp/B0758PZ4C4)

[acolchado/dp/B0758PZ4C4](https://www.amazon.com/-/es/Seachrome-Asiento-plegable-pulgadas-acolchado/dp/B0758PZ4C4), (B) <https://www.amazon.com.mx/Bathroom-Non-Slip->

Pregnant-Adjustable-Pleasant63/dp/B0CHVDM5HG, (C)

<https://www.platinumhealthllc.com/collections/with-commode>, and (D)

[https://www.amazon.in/Giantex-Medical-Transport-Bathroom-](https://www.amazon.in/Giantex-Medical-Transport-Bathroom-Wheelchair/dp/B07J2BZ4KB)

[Wheelchair/dp/B07J2BZ4KB](https://www.amazon.in/Giantex-Medical-Transport-Bathroom-Wheelchair/dp/B07J2BZ4KB).

Market Research and Price Classification of Shower Chairs

An extensive online market survey was conducted to categorise available shower chairs by price range, features and user preferences. The findings indicate that shower chairs priced below 400 yuan are particularly popular among assisted living homes due to their affordability, simplicity, lightweight design and ease of use with minimal training. These models typically offer basic functionalities suitable for routine daily activities.

Shower wheelchairs priced between 400 and 1,000 yuan are also common. These models generally feature adjustable backrests, foldable frames and additional safety mechanisms such as handbrakes. Their size, similar to that of standard wheelchairs, allows for easier transitions between environments, making them a practical choice for care settings.

More advanced devices priced between 1,000 and 2,500 yuan often incorporate auxiliary transfer functions, enabling users to move seamlessly between beds and shower chairs with minimal assistance. These models tend to prioritise both safety and convenience, offering features such as ergonomic designs and enhanced stability.

Finally, assistive devices costing over 2,500 yuan generally provide enhanced comfort features, including adjustable armrests, footrests and other ergonomic modifications aimed at maximising user comfort and safety.

Selection of Shower Chairs for User Experience Testing

After comparing various products, four distinct types of shower chairs were chosen for further review: two traditional models, a wheelchair-based shower chair and a transfer-function-integrated chair (Figure D). The selection was based on seven key features that are crucial to the devices' functionality and usability: transfer assistance, a reclining seat, removable armrests, adjustable sitting height, adjustable footrests, a handbrake and a foldable structure.

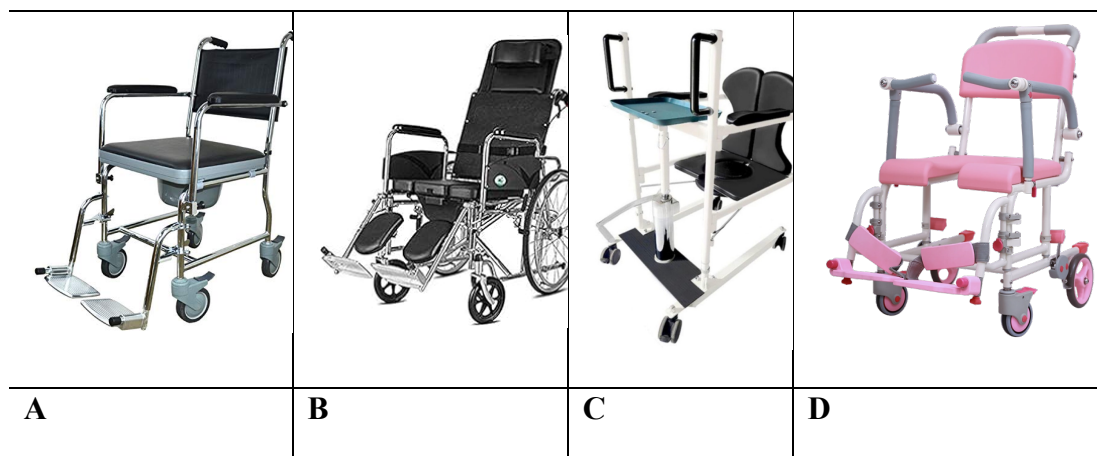


Figure D. *Four Types of Shower Chairs Selected for Review (From Left to Right: Two Traditional Models, a Wheelchair-Based Chair and a Transfer-Function-Embedded Chair)*

Note. The images were taken from the following sources: (A)

<https://www.amazon.com/-/es/elevador-resistente-antideslizante-acolchado-desmontable/dp/B07VVXF8L1>, (B) <https://www.amazon.eg/-/en/b?ie=UTF8&node=85445468031>, (C) <https://www.amazon.com/Hydraulic-Transport-Wheelchair-Detachable-Wheelchairs/dp/B0D5HV6B4Z>, and (D)

<https://www.taobao.com/list/item/624612713168.htm>.

A detailed comparison of these features was conducted, focusing on their benefits to carers and care recipients in terms of comfort, safety and convenience (Figure E). This analysis aimed to identify the most advantageous features that optimise both user experience and carer effort.

Product	Price(元)	Beneficial to	Comfort							Safety							Convenience						
			Transfer Assistance	Recline Seat	Removable Armrest	Adjustable sitting Height	Adjustable Footrest	Handbrake	Foldable Structure	Transfer Assistance	Recline Seat	Removable Armrest	Adjustable sitting Height	Adjustable Footrest	Handbrake	Foldable Structure	Transfer Assistance	Recline Seat	Removable Armrest	Adjustable sitting Height	Adjustable Footrest	Handbrake	Foldable Structure
	<400	Feature	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Caregiver	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Care receiver	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	400-1000	Feature	n/a	YES	YES	n/a	YES	YES	YES	n/a	YES	YES	n/a	YES	YES	YES	n/a	YES	YES	n/a	YES	YES	YES
		Caregiver	-	-	✓	-	✓	✓	✓	-	-	✓	-	✓	✓	✓	-	✓	✓	-	✓	✓	✓
		Care receiver	-	✓	-	✓	✓	-	-	-	-	✓	-	✓	✓	-	-	-	-	-	-	-	-
	1000-2500	Feature	YES	n/a	n/a	YES	n/a	n/a	n/a	YES	n/a	n/a	YES	n/a	n/a	n/a	YES	n/a	n/a	YES	n/a	n/a	n/a
		Caregiver	✓	-	-	✓	-	-	-	✓	-	-	-	-	-	-	✓	-	-	✓	-	-	-
		Care receiver	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>2500	Feature	n/a	n/a	YES	n/a	YES	n/a	YES	n/a	n/a	YES	n/a	YES	n/a	YES	n/a	n/a	YES	n/a	YES	n/a	YES
		Caregiver	-	-	✓	-	✓	-	✓	-	-	✓	-	✓	-	-	-	-	✓	-	✓	-	✓
		Care receiver	-	-	-	-	✓	-	-	-	-	✓	-	✓	-	-	-	-	✓	-	-	-	-

Figure E. Comparisons of Product Features Benefiting Carers and Care Recipients

Final Selection for User Testing

Based on the feature comparison, three specific types of shower chairs were selected for user experience testing in assisted living environments (Figure F). The selection prioritised diversity in design and functionality to thoroughly evaluate their effectiveness and user acceptance. The results from this testing aim to inform future design improvements and support the development of more user-centred assistive shower technologies.



Figure F. Shower Chairs for User Experience Tests

Appendix F

Qualitative Analysis: A User-centred Evaluation of Shower Chairs

Show er Chair	Synthesized Key Theme	Description	A	B	Examples
Show er Chair A	Comfort as Connection	Design Impact on Comfort: how design affects user comfort.	1	6	<i>"Because it is small, I can easily move and change direction...can turn very quickly in the confined space of bathrooms and hallways" (CG2). "This chair is lightweight, and no need to adjust anything" (CG4).</i>
		Ease of Use & Efficiency: how simplicity contributes to efficiency and emotional comfort.	1	5	<i>"I don't need to learn. It is simple to use and don't need to worry" (CG3). "It reduced my time in maneuvering and positioning the chair. So it makes my work workflow smooth and assistance time" (CG5)</i>
		Relational Dynamics &	1	1 1	<i>"When my work is relaxed, I allow them to wipe their own bodies first</i>

	Emotional Comfort: how carer's feelings and attitudes influence older adults.			<i>before helping" (CG4). "When they (carers) are in a good mood, they listen to me" (CR1), "They work softly and become patience" (CR3).</i>
Independence and Control	Carer Control & Influence: how carers' perceptions of older adults' capacities impact on caregiving.	1	2	<i>"When they (elderly) can understand, they listen to me and follow what I ask and Elderly people become cooperative and nice are depended on their mental awareness and upper limb strength" (CR1).</i>
	Negative impact on caregiving: impact on physical, emotional, and efficiency.	1	2	<i>"Using shower chair makes our work easy and smooth" (CR6). "Because the bottom is empty, they (carers) easily clean my back and bottom" (CR3).</i>
	Older Adult Dependence: Dependence on carers and the impact of the carer's attitude.	1	3	<i>"When my work is relaxed, I allow them to wipe their own bodies first before helping. They listen to me" (CG4). "Moving elderly is total up to our strength" (CG3).</i>
Safety and Security	Emotional Security Concerns (Older Adult): feelings related to falling or feeling unstable.	1	7	<i>"Some of them are not strong enough, too rushed, or unsuitable. They are tired and busy. I don't like it" (CR4). "I am scared when they move me if I fall. Sometimes, I bumped into the bedside or shower chair"(CR2).</i>
	Perceived Risk Mitigation (Both): reduced	0	0	<i>nil</i>

		risk of injury or accidents.			
		Physical Safety	1	7	<i>"It is not good for moving an elderly person. It is dangerous when I do it and can get me lower back injuries" (CG6). "I always worry about back injuries when I move them (older adults). I think we (carers) all worry" (CG2).</i>
		Concerns (Carer): Concerns related to moving older adults.			
Show	Comfort as	Design Impact on	1	1	<i>"It was comfortable when I sat on it" (CR4).</i>
er	Connection	Comfort			
Chair		Ease of Use & Efficiency	0	0	<i>nil</i>
B		Relational Dynamics & Emotional Comfort	0	0	<i>nil</i>
	Independence and Control	Carer Control & Influence	0	0	<i>nil</i>
		Negative impact in caregiving	1	1	<i>"This chair is too long and heavy. I scraped against doorframes or water basin" (CG1). "This chair is really bad. Because it covers the elderly body, it was difficult see and reach when I cleaned the buttocks and back" (CG4). "This chair is difficult to clean and clumsy and time-consuming for me to use" (CG2). "This chair made me physically and mentally tired. If I am tired, I am short-tempered" (CG3). "My helpers always rushed when they washed me with this chair"(CR2).</i>
		Older Adult Dependence	1	1	<i>"I feel shame when I am naked. But it is normal in here" (CR3).</i>

	Safety and Security	Emotional Security Concerns (Older Adult)	2	8	<i>"...still worries if slip forward"</i> <i>*Concerns were recurred - Chair A</i>
		Perceived Risk Mitigation (Both)	0	0	<i>nil</i>
		Physical Safety Concerns (Carer)	2	8	<i>"This chair made me physically and mentally tired"</i> <i>*Concerns were recurred - Chair A</i>
Shower Chair C	Comfort as Connection	Design Impact on Comfort	1	13	<i>"This chair is good. It made my work less" (CG3). "Transferring elderly is good because I don't need to use my physical power" (CG1). "Don't need to worry about slipping forward" "I don't need to worry about my back strain and elderly slipping forward," (CG4).</i>
		Ease of Use & Efficiency	1	2	<i>" It is very good for moving elderly"(CG6). "The use became easy and was not very complicated" (CG3).</i>
		Relational Dynamics & Emotional Comfort	1	5	<i>"Less worry of elderly safety during shower" (CG2). "I think they (carers) were more gentle when they asked me what to do" (CR1). "Because the elderly got scared when they sat on it, I had to do two tasks together - comforting a fearful elderly person and washing them" (CG4).</i>
	Independence and Control	Carer Control & Influence	1	5	<i>"This chair is good only for the elderly who can cooperate. For paralysis or severe dementia elderly, this chair has no use" (CG2).</i>

Negative impact in caregiving		2	1	6	<i>"Because the elderly got scared when they sat on it, I had to do two tasks together - comforting a fearful elderly person and washing them" (CG4).</i> <i>"I don't like the front guardrail. It is fixed and makes washing difficult." "preparing need many steps. At the end, I spent more time on this and rushed during the shower" (CG3).</i>
Older Adult Dependence		1	4		<i>"I like the front bar. It is safe because I can hold it" (CR5). "When I was sitting, I felt I was weaker. It was a very serious machine" (CR3).</i>
Safety and Security	Emotional Security Concerns (Older Adult)	1	5		<i>"I was scared when I was moved by the chair. It is too high for me. Especially, I was moved backward. It was scary. I had to hold my helper" (CR6). "It was not comfortable at all...scared" (CR4).</i>
Perceived Risk Mitigation (Both)		1	3		<i>"The front guardrail is good to prevent the elderly from slipping forward. Less worry of elderly safety during shower" (CG2). "I don't need to worry about my back strain and elderly slipping forward" (CG4).</i>
Physical Safety Concerns (Carer)		1	2		<i>"I didn't have to worry about injury. But a longer time is the problem"(CG5).</i>

Note. A: Sources and B: References.

Appendix G

Analysis: A User-Centred Evaluation of Shower Chairs

Shower Chair A: The Complexities of Efficiency, Safety and the Relational Dimensions of Dignity

Recognised for its lightweight construction, ease of manoeuvrability and simplicity of use, Shower Chair A demonstrated a complex balance of advantages and disadvantages. Although carers valued the chair's operational efficiency, persistent concerns about safety, physical strain and the impact on the caregiving relationship emerged as critical factors. Conversely, older adults emphasised their reliance on carers' expertise and attentiveness, revealing a fragmented perception of autonomy and self-esteem influenced by their relationship with carers.

Safety and Security: Relational Implications

Safety emerged as a key concern for both carers and older adults, highlighting a gap between perceived and actual safety in caregiving settings.

Carers' Perspective: Objective Safety and Physical Burden – *Focus on Simplicity*. The carers consistently expressed concerns about the potential for physical exertion and injury during transfers of older adults, especially those with restricted mobility. As a carer, CG6 noted, '*It is not good for moving an older person. It is dangerous when I do. It can get me lower back injuries*'. This view aligns with Gallagher's framework, which acknowledges the objective challenges carers face in elder care, particularly the risk of physical injury. It also reflects Nolan et al.'s sense of security and the subjective dimension of dignity, as anxiety increased with the condition of older adults.

Although the shower chair's design received positive feedback for reducing physical burden, the data does not specify which particular feature contributes to this

advantage, aside from the overall simplicity of the design. Furthermore, the lack of clarity regarding what is detrimental to users indicates that Shower Chair A does not sufficiently promote carer well-being. This issue may persist, potentially leading to burnout and compromised care.

Older Adults' Perspective: Subjective Security and Relational Trust –

Reliance on Carer Attentiveness. The older adults expressed a significant reliance on carers to maintain their sense of security. Many expressed concerns, stating, *'I am scared when they move me if I fall'*. Although no specific incidents were described, most of the older adults felt insecure because they were entirely dependent on their carers' capabilities. This insecurity was evident in CR4's statement: *'When they [carers] help me, I worry if they are strong enough. If not, it is dangerous. I can fall'*. This remark highlights the importance of relational trust, a key aspect of Nolan et al.'s senses framework, which emphasises the necessity of a sense of security and belonging within a care environment. The fear of falling indicates a vulnerability that goes beyond the physical, revealing a desire for reassurance and a secure attachment to the carer. As such, the design's effectiveness lies in establishing a relational connection.

Comparative Analysis. The feedback from carers and older adults addresses safety concerns from both objective (carers' physical well-being) and subjective (older adults' perceptions of safety) dimensions, as well as a sense of security and belonging for both parties. Although Shower Chair A can improve physical comfort during assistance due to its simple functionality, it lacks a dedicated safety feature. Consequently, it also fails to address the emotional reliance on security among older adults. The emphasis on safety and security extends beyond physical tools and the capacity to depend on others for physical support. Therefore, the design of shower

chairs should consider how enhancements to physical safety can positively influence emotional security.

Independence and Control: Balancing Power Dynamics

This theme analyses Shower Chair A from the perspective of balancing power and autonomy within the caregiving relationship, influencing both older adults' sense of self-determination and carers' perceptions of their role.

Carers' Perspective: Navigating Capacity and Maintaining Control – *Influence of Perceived Mental Awareness.* The findings revealed that carers' perceptions of older adults' capacities significantly influence their caregiving approach. CG1 stated, '*Older adults become cooperative and nice depending on their mental awareness and upper limb strength*'. This remark suggests that carers may be more inclined to grant autonomy to older adults they perceive as cognitively and physically capable, while exercising greater control over those with reduced capacity. CG3's statement exemplifies this: '*When my work is relaxed, I allow them to wipe their own bodies first before helping*'. This view demonstrates that the influence of AT design extends beyond ergonomics or efficiency in caregiving; it affects older adults' subjective dignity, sense of control, purpose and achievement, and ultimately, the care relationship, fostering dignified care.

Older Adults' Perspective: Dependence, Power Dynamics and Emotional Well-Being – *Contingent on Carers' Attitude.* The older adults described the underlying power dynamics in the relationship as follows: '*When they are in a good mood, they work softly and become patient*' (CR5), and '*When she [the carer] has more time, she listens to me and talks*' (CR1). The remarks indicate that the relationship between power and reliance is interconnected, impacting the dual dimensions of dignity (autonomy and self-esteem). Therefore, the shift from reliance

to empowerment may result in feelings of vulnerability and a reduced sense of belonging and continuity. Thus, older adults' emotional well-being depends on carers' attitudes and approaches, reflecting the fundamental power dynamics in the relationship.

Comparative Analysis. The balance between carers' perceptions of older adults' capacities and older adults' emotional well-being highlights the complex power dynamics in the care relationship. It also suggests that the impact of AT design extends beyond ergonomics and efficiency to include relational connections and the support of dignified care.

Comfort as Connection

This theme examined how design features impact comfort and efficiency in shower assistance, with the potential to facilitate improved connections and preserve the dignity of older adults. It goes beyond a basic understanding of 'comfort' as merely physical ease, recognising its connection with emotional well-being and relational dynamics.

Carers' Perspective: Ease of Use and Attentive Care – *Enhancing Emotional Comfort for Older Adults*. The data showed that the simple, intuitive design of Shower Chair A enhances efficiency, thereby positively affecting older adults' emotional comfort. Three carers' statements critically exemplify this interconnected influence: '*It is simple and easy for me to use and I don't need to learn*' (CG3); '*When my work is easy ... I can do more for them and become friendlier*' (CG5); and '*When my work becomes smooth, older adults feel comfortable. It makes me feel good too because they like it*' (CG4). These statements suggest that reducing carers' physical burden enhances their emotional comfort, fostering attentive care that supports the emotional well-being of both parties.

Therefore, features that facilitate ease of use not only improve efficiency in caregiving but also positively influence perceived objective dignity by enabling better physical interventions. They also enhance subjective dignity by engaging different senses and fostering a stronger connection with older adults.

Older Adults' Perspective: Relational Connection and Emotional

Comfort. The data indicated that older adults' emotional comfort is associated with carers' feelings, consistent with carers' previous perspectives. CR1 stated, '*When she [the carer] has more time, she listens to me and talks*'. The reduced work-related burdens enable carers to engage more willingly in communication with older adults. Furthermore, for older adults, the perception of being 'listened to' – feeling heard and understood – aligns with 'being respected', a fundamental principle of dignity. Therefore, the quotation indicates that an enhanced assistive shower chair that offers functional benefits for caregiving tasks influences the dignity of older adults by enhancing social communication. Consequently, design decisions regarding functional features should prioritise this as the ultimate objective, rather than merely emphasising ease of use.

Comparative Analysis. The analysis emphasises the importance of the stance in the development of AT, specifically the shower chair investigated in this study. It extends beyond prioritising design elements such as ease of use as immediate benefits to promoting the dignity of older adults as the ultimate goal by fostering communication, thereby reinforcing relationships.

Shower Chair B: Exacerbating Existing Concerns and Introducing New Burdens

Compared to Shower Chair A, Shower Chair B, which features a lightweight and easy-to-use design, was criticised for its size and complexity. The carers and

older adults also reiterated concerns about anxiety and fear associated with transfers during discussions. While the themes of safety and the relational dynamics of care persisted with Shower Chair A, Shower Chair B introduced new challenges related to increased physical and emotional burdens.

Safety and Security

This section re-examines the theme of safety and security within the relational dimension of care, analysing how Shower Chair B may exacerbate or introduce new challenges in comparison to Shower Chair A.

Carers' Perspective: Objective Safety and Physical Burden –

Exacerbated Burden and Accident Risk. The data from the carers regarding Shower Chair B revealed that the physical burden and worry of injury associated with the transfer of older adults were exacerbated, directly impacting the carers' objective dignity due to increased physical strain and the risk of injury. In previous discussions, manoeuvrability or the use of lightweight materials were considered advantageous. However, Shower Chair B exhibited a contrasting design – bulky and cumbersome – that heightened concerns about the potential for physical strain injuries. CG1 noted, '*This chair is too long and heavy. I scraped against doorframes or water basins*'. These statements not only indicate increased effort but also highlight the potential for accidents among older adults. Dignity issues related to physical burden, previously identified under the same theme in Shower Chair A, are worsened by restricted movement, which negatively impacts the older adults' sense of security due to an increased risk of accidents, even from minor bumps on walls.

Older Adults' Perspective: Subjective Security and Relational Trust –

Increased Anxiety About Falls. Like Shower Chair A, the older adults expressed comparable concerns about safety, highlighting the importance of addressing

subjective dignity in the design of AT. CR4 noted, '*It was comfortable when I sat on it, but I still worry if I slip forward*', addressing their concerns about potential injury. Nevertheless, no specific features or issues related to their physical safety and emotional security were further discussed.

Comparative Analysis. Shower Chair B, which is constructed on a conventional wheelchair frame and equipped with a commode bucket and reclining backrest, did not provide any advantage for shower assistance. Although one older adult recognised the comfort of sitting, the primary concern regarding slipping forward remained. In addition, the chair's size and weight, inherited from the wheelchair structure, contributed to increased physical burden and an increased risk of injury, primarily due to reduced manoeuvrability. The amplified challenges resulted from the design, which did not consider the live context of use and was identified as inappropriate for shower assistance. These challenges demonstrate a failure to adequately address both the objective (carer physical burden) and subjective (older adult fear) dimensions of dignity, suggesting a need for more user-centred design approaches.

Independence and Control

The perspective of this theme suggests that comfort serves as an initiative to foster a positive caregiving relationship. The relational nature of this connection can be influenced by physical and emotional affordances that help focus on the other party. However, Shower Chair B prioritises superficial comfort over usability and relational care, resulting in a significant design flaw.

Carers' Perspective: Diminished Capacity and Emotional Frustration –
Due to Size and Complexity. Like Shower Chair A, the carers' perceptions of older adults' capabilities influenced their caregiving approach. However, the design of

Shower Chair B – particularly its size and complexity – further reduced the carers’ ability to support autonomy and led to greater emotional frustration. CG3 stated, *‘This chair made me physically and mentally tired. If I am tired, I am short-tempered’*. The physical demands of caregiving remain a challenge within the care relationship, highlighting the connection between personal well-being and the ability to provide care. Shower Chair B’s design may have aimed to enhance a specific aspect of assistance compared to Shower Chair A. However, it failed to address the relational nature of care, instead creating a tool focused on task completion. CG2 supported this view, stating, *‘When I used this chair, I could not wash the older people the way I normally did. I could see the older people did not like it either’*. Thus, it introduced additional complexity into caregiving, affecting both parties.

Older Adults’ Perspective: Worsening Power Dynamics and Reduced Autonomy – Carer Prioritising Speed. The cumbersome design of Shower Chair B appeared to exacerbate existing power imbalances in the caregiving relationship, leading to a diminished sense of autonomy for older adults, affecting their sense of belonging (Nolan et al., 2006) and disrupting their established care routines (continuity theory). As evidenced by CR2’s statement, *‘My helpers always rushed when they washed me with this chair’*, and CG6’s description of the difficulty of using the chair, *‘I had to move many times ... It made my work slow and took a longer time’*, this may have led carers to prioritise speed over personalised care, resulting in a less dignified experience.

Comparative Analysis. Although the insights of balancing power and autonomy persisted from Shower Chair A, the analysis reveals that Shower Chair B’s design exacerbates the carers’ burdens, diminishing the opportunity for relational connection. The increased physical and emotional demands placed on carers, as

evidenced by CG3's statement, '*made me physically and mentally tired. If I am tired, I am short-tempered*', likely diminished their ability to exhibit patience and empathy, leading to rushed and less personalised care. In this context, the core issue pertains to care. Consequently, the design neither supports nor facilitates actual care. By hindering the relational dynamics, the design fails to support Nolan et al.'s sense of purpose and achievement (carers) and self-esteem (subjective dignity of older adults), the key components of a dignified care environment.

Comfort as Connection

This theme examined how design features affect comfort and efficiency in shower assistance, potentially facilitating improved connection and thereby preserving the dignity of older adults. Like Shower Chair A, Shower Chair B's design did not facilitate potential connections. Furthermore, some features proved to be obstacles for shower assistance.

Carers' Perspective: Deficiencies in Comfort and Task Efficiency – *Hindering Effective Care.* Shower Chair B showed deficiencies in facilitating carers' comfort and task efficiency. The carers identified multiple, distinct issues – relating to washing, contextual adaptability and maintenance – that hindered effective care. CG4 summarised the issue: '*This chair is really bad. Because it covers the older person's body, it was difficult to see and reach when I cleaned the buttocks and back*'. However, Shower Chair B was the only model to incorporate a soft backrest – an element that one older adult (CR4) found comfortable – that the carers perceived as an obstacle to cleansing certain body parts. Concerns about contextual adaptability also emerged. CG3 noted, '*The foldable (reclining) backrest becomes an obstacle in a small shower room*', indicating that features designed without reference to real-world spatial constraints can hinder usability. Finally,

maintenance-related burdens were emphasised: ‘*This chair is difficult to clean, clumsy and time-consuming for me to use*’ (CG2). In addition to increasing workload, maintenance challenges diminish carer efficiency and may adversely affect the quality of care.

These findings suggest that features in Shower Chair B do not meet operational requirements, affecting both efficiency and comfort in caregiving, which are essential for fostering a sense of purpose and achievement (Nolan et al., 2006) for carers.

Older Adults’ Perspective: Limited Perceived Comfort. Unlike the carers’ perspectives, the older adults provided limited feedback on the features they found either comfortable or discomforting (except for the previously mentioned sitting comfort), revealing a possible disconnect between the objective (designed to promote self-worth) and subjective (user experience of comfort) dimensions of dignity. Consequently, many of these features may not have been perceived positively, and their responses, including ‘*I can see how this is not great*’, did not translate effectively.

Comparative Analysis. The carers emphasised usability, such as visibility, reach, spatial fit and cleanability, and identified that the soft backrest, the reclining mechanism and inadequate maintenance features hindered effective care. Conversely, only the comfort provided by the soft backrest was acknowledged by one older adult, with minimal critique. This divergence results in trade-offs: features that enhance perceived comfort, such as soft materials and adjustability, may compromise hygiene, increase workload and diminish opportunities for carer-older adult relationships in limited care settings.

Shower Chair C: Safety vs Comfort – A Delicate Balance

This section evaluates Shower Chair C, continuing the analysis of safety, independence and comfort, with a focus on understanding the effects on the relational dynamic. Shower Chair C presented a design dilemma in balancing safety and comfort, which affected relational dynamics. It showed that the chair's design could influence power dynamics by emphasising self-esteem, thereby fostering better relationships among all parties involved.

Safety and Security

Safety emerged as a key concern for both the carers and older adults. It reveals a gap between perceived and actual safety in caregiving settings.

Carers' Perspective: Objective Safety and Physical Burden – Trade-offs with Transfer. The data revealed mixed feelings about safety and physical burden. While some carers appreciated the reduced physical strain involved in moving older adults, concerns about the overall care process persisted due to its complexity. CG3 noted, *'This chair is good. It made my work less'*. However, others countered this, stating, *'It is very good for moving older people. But preparing the move takes time and needs many steps. In the end, I spent more time on this and rushed during the shower'*. This difference of opinion highlights a trade-off between the physical effort required to lift older adults and the effort needed to operate the chair.

The front guardrail was a point of contention. Although the carers recognised its safety benefits for older adults, they also noted that it interfered with washing tasks, creating tension between safety (objective dignity) and carers' burden to improve quality of care (sense of purpose and achievement): *'The front guardrail is good for older people's safety, but made my work difficult. I had to move more during the shower. It was difficult to apply force when washing their backs and lower bodies. In the end, I was more tired'* (CG1). This view indicates the need for

adjustable features, such as being fixed in place for safety and removable to improve bathing efficiency.

Older Adults' Perspective: Subjective Security and Relational Trust – *Mixed Reactions to Front Guardrail.* The older adults' experiences with Shower Chair C regarding safety and security varied. The effect of the front guardrail on older adults' perceptions was impactful: *'I like the front bar. It is safe because I can hold it. Don't need to worry about slipping forward'* (CR5). However, some of the older adults expressed feeling scared or uncomfortable. CR6 stated, *'I was scared when I was moved by the chair. It is too high for me. Especially, I was moved backwards. It was scary. I had to hold my helper'*. This disagreement reveals an important insight about the balance between a sense of security and social opportunity. Although Shower Chair C's seating posture enables older adults to face carers while moving, they did not perceive this as an opportunity for communication; instead, they worried about their safety by moving backwards, highlighting the importance of the sense of security in Nolan et al.'s (2006) senses framework. These concerns, similar to those with Shower Chair A, highlight the importance of relational trust and the sense of security in implementing AT.

Comparative Analysis. Like Shower Chairs A and B, Shower Chair C shows a discrepancy between its intended safety features and the actual user experience. Although designed to reduce physical strain, the carers noted that its complexity increased the time required, creating a trade-off. The front guardrail, intended to ensure safety, obstructs showering procedures, revealing a design that lacks adequate user-centred considerations and indicating a potential trade-off between objective and subjective dimensions of dignity.

The older adults' experiences focused more on subjective feelings. While the front guardrail fostered security for some, others expressed fear or discomfort, revealing a disconnect between objective safety and perceived security. The seating posture that offers an opportunity for communication is perceived as a threat to the sense of security.

Therefore, the findings reinforce a key point from the evaluations of Shower Chairs A and B: AT design must transcend functionality, prioritising relational and emotional dimensions of care to promote dignity and well-being.

Independence and Control

Following the established themes in the previous chair analyses, this section explores how Shower Chair C reconfigures power dynamics, influences carer roles and affects the self-esteem and emotional well-being of older adults. By considering both carer and older adult perspectives, this analysis aims to expose the inherent tensions and trade-offs involved in 'independence' enabled by technological intervention.

Carers' Perspective: Navigating Capacity and Maintaining Control –

Usability Contingent on Cognitive Abilities. The carers observed that the chair's usability depended on older adults' physical and cognitive abilities, highlighting its limitations. For instance, CR3 stated, '*This chair is suitable only for older individuals who can cooperate (they need to lift their hips to sit). It is not useful for those with paralysis or severe dementia*'. This view suggests that the shower chair's primary feature, designed to ease physical and emotional burdens, cannot accommodate the diverse needs in care settings. Nevertheless, a statement from CG4 illustrates how AT can influence power dynamics by reconfiguring carers' roles and responsibilities, thereby further affecting older adults' sense of belonging and

comfort: *‘Because older people got scared when they sat on it, I had to do two tasks together: comforting a fearful older person and washing them’*. Although this remark may reflect concern over an increased workload, its implications extend to strengthening the compassionate care relationship.

Older Adults’ Perspective: Dependence, Power Dynamics and Emotional Well-being – *Loss of Self-esteem from Loss of Independence*. From the perspective of the older adults, Shower Chair C altered the power dynamics in caregiving relationships. CR1 noted, *‘I think they [carers] were more gentle when they asked me what to do’*, suggesting that the chair influenced the carer’s approach. This remark may align with the previous quotation discussed regarding Shower Chair A, *‘When my work is easy ... I can do more for them and become friendly’* (CG5).

Nevertheless, the chair’s design significantly influenced older adults’ self-esteem. CR4 stated, *‘I thought I was locked inside. I don’t know if it was good, but uncomfortable’*. CR3 added, *‘When I was sitting, I felt I was weaker. It was a very serious machine’*. These remarks reveal how AT can impact self-esteem and emotional well-being.

Comparative Analysis. Shower Chair C reveals how AT can inadvertently reinforce dependence despite intentions to ease care and reduce tension. One older adult observed that the chair encouraged more gentle interactions and indicated a positive shift in power dynamics. However, unlike the evaluation of Shower Chair A, which showed that carers’ attitudes were the main barrier to the caregiving approach, Shower Chair C’s design makes it inaccessible to those who need it most (older adults with *paralysis or severe dementia*), regardless of their attitude. Moreover, although one carer noted potential for compassionate care (*‘comforting a*

fearful older person and washing them'), the older adults expressed diminished self-esteem (*'I felt I was weaker'* and *'locked inside'*).

Therefore, while Shower Chair C may support carer responsibilities, its impact on older adults' independence remains uncertain. A person-centred approach is essential, emphasising autonomy and emotional well-being.

Comfort as Connection

This theme examines how the design features of Shower Chair C influence comfort, efficiency and the potential for meaningful connections during shower assistance. Shower Chair C demonstrated that design features intended to enhance comfort in shower assistance can present unexpected trade-offs, impacting efficiency, relational quality, and ultimately the dignity of both the carer and the older adult.

Carers' Perspective: Time Constraints and Task Complexity. The carers' descriptions revealed how the design features influence their capacity to engage with older adults during showering. The issues are mainly related to time constraints. Although some of the carers recognised the benefits from the chair's feature, others observed that the increased time required for preparation and manoeuvring detracted from opportunities for meaningful engagement. CG2 explained, *'The time I spent using this is more than with other chairs. And it is difficult with washing them [older adults]'*. CG5 also remarked, *'I didn't have to twist my waist and hold their weight. I didn't have to worry about injury. But a longer time is the problem'*. These statements demonstrate a potential trade-off between objective dignity (self-regarded safety), sense of security and sense of achievement. Consequently, the carers found themselves in a hurry during the shower.

The complexity of the operation, which impacted carers' assistance routines, was also observed. Two carers stated, *'Moving the older adults was good. But I had to change my work habits and learn the skill to do it'* (CG6), and *'After I became comfortable using it, the use became easy and was not very complicated'* (CG2). These views highlight the necessity of features that are both ergonomic and intuitive.

Older Adults' Perspective: Relational Connection and Emotional

Comfort. The data suggest that Shower Chair C had mixed effects on the older adults' emotional comfort and their relational connection with their carers. Although some found the chair to be comforting, expressing feelings such as, *'It's fun to be seated. And I don't need to be scared when they put me in the chair'* (CR2), others experienced feelings of fear, discomfort and restriction due to the front guardrail, stating, *'I thought I was locked inside ... uncomfortable'* (CR4). In essence, the 'safety' features of the chair could be viewed as restrictive and dehumanising rather than comforting and supportive.

Comparative Analysis. Unlike Shower Chair A, where ease of use fostered positive connections, Shower Chair C reveals a comfort-versus-connection trade-off. Although ergonomically beneficial for some carers, increased time demands within a time-constrained care routine detracted from meaningful interaction, demonstrating that intended efficiency hindered relational quality. Familiarisation with the operating method further complicated the routines, emphasising the need for intuitive design, which was less emphasised in Shower Chair A. For the older adults, the front guardrail, intended for safety, was perceived by some as restrictive and dehumanising, undermining potential relational comfort. Thus, the design of Shower Chair C hindered relational connection despite the features' intended focus on

physical comfort, safety and efficiency in caregiving, revealing a significant flaw that compromised the emotional and social impact.

Concluding Remarks

A user-centred assessment of three shower chairs identified factors affecting dignity, safety and caregiving. Although each chair addressed specific needs, the findings highlighted both the benefits and unintended effects of various design features. To translate these insights into practical guidelines, the following section synthesises the findings and formulates a set of dignity-conscious design principles to inform future shower chair development.

Appendix H

Dignity-conscious Shower Chair Design: Initial Design

Design Synopsis

The initial design prioritised practical concerns related to cleaning and aesthetics, while implicitly incorporating principles of safety and dignity. The vertical beam near the footrest, which is found in traditional shower wheelchairs, was replaced with a diagonal beam (Figure G-B). It aimed to enhance access to cleaning by creating a larger, unobstructed opening (Figure G-A) for the lower limbs of older adults, aligning with the principle of making carer tasks easier and more comfortable. Furthermore, the diagonal beam was intended to reduce the chair's 'clinical appearance', potentially decreasing the social stigma associated with dependence and contributing to the user's sense of dignity. Thus, it addresses the principle of designing for self-esteem and dignity by moving away from the appearance of traditional AT.

To address usability and comfort when navigating steps within the care facility, the front and rear wheels were indicated with larger sizes in the drawings. The front wheels were integrated with a footrest that rotates independently, simplifying the design. Furthermore, the armrests were inclined to create a larger front opening for easier bed-to-shower chair transfers (Figure G-C) without adding to the chair's size or mechanical complexity. This feature aimed to balance independence and control for the user while still providing the carer with support, although its effectiveness was later questioned in users' feedback.

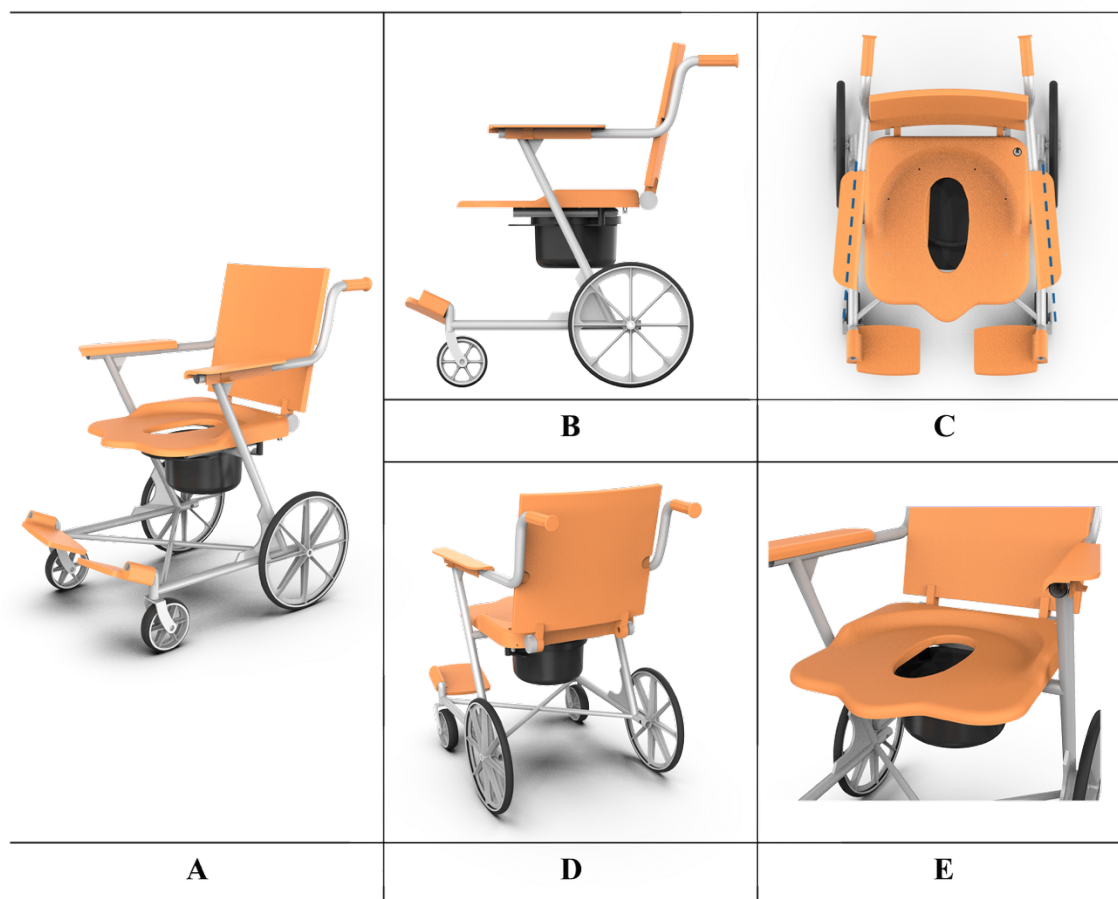


Figure G. *3D CAD Renderings of the Initial Design*

Participant Feedback

The initial design was presented to three older adults (CR2, CR4 and CR5) and five carers. The carers acknowledged the lighter appearance of the diagonal beam structure and recognised its functional benefit in facilitating access for washing (Figure G-A). However, they highlighted the perceived structural weakness, despite assurances of reinforcement. This observation highlights the importance of both objective and subjective safety, where visual cues can significantly impact the user's sense of security.

Feedback regarding the angled armrests (Figure G-C) was unfavourable, raising doubts about their effectiveness in supporting transfers. This finding suggests

that the feature needs refinement to uphold the principle of supported independence effectively, ensuring the shower chair promotes safety and autonomy. The carers also made suggestions, including minimising measurable risks (sharp corners) and enlarging the toilet bucket opening.

The older adults perceived the seat to be uncomfortable (Figure G-E). One older adult (CR5) questioned the material, believing it was made of wood. The protrusion in the middle of the seat (Figure G-C), intended for leg positioning and support, was found to be uncomfortable and unnecessary due to its sharp edge. This finding emphasises the importance of comfort extending beyond the physical, as the seat design failed to provide the necessary support and reassurance.

Regarding aesthetics, unlike the carers, the older adults did not express concerns about structural safety; however, they noted that the chair differed from conventional designs. CR4 perceived the chair as capable of movement, anticipating rocking. Although unintended, this remark suggests a potential opportunity to explore alternative designs that use familiar forms to enhance comfort and reduce anxiety.

The feedback highlighted the need to strengthen both the actual and perceived stability of the diagonal beam. It also emphasised the importance of addressing safety concerns related to sharp corners and a small toilet bucket opening (Figure G-C), optimising seat comfort and refining the armrest design to truly support independence. The following section outlines the iteration of this design, incorporating improvements based on the insights gained.

Appendix I

Dignity-conscious Shower Chair Design: Design Iteration 1

Design Synopsis

This iteration addressed the safety concerns raised in the previous feedback while maintaining the preferred aesthetics (reduced clinical appearance) and enhancing cleaning effectiveness. The primary objective was to balance objective safety, perceived safety and user experience.

The diagonal beam design was retained and reinforced with increased thickness and larger triangular support panels (Figure H-B) to safeguard older adults and address concerns about the structure's perceived weakness. This change demonstrates the key finding: safety is multifaceted, requiring both structural integrity and visual reassurance. The backrest was also redesigned with increased height for better back support and divided into two parts, with a foldable upper part to facilitate carer access and improve cleaning efficacy for the older adult's back. Segmented soft cushion pads were added to the upper panel to enhance sitting comfort and water drainage while maintaining safety (Figure H-D). The lower part remained attached to the seat to ensure the safety of older adults and prevent falls (Figure H-E). This approach aims to optimise both physical comfort and emotional reassurance.

The front safety handlebars (Figure H-F) were added and integrated with the armrest. These rotatable handlebars avoid obstructing the transfer process, ensuring safety and empowering older adults' autonomy by enabling them to manage their safety independently. This change aligns with the design principle of fostering independence and control.

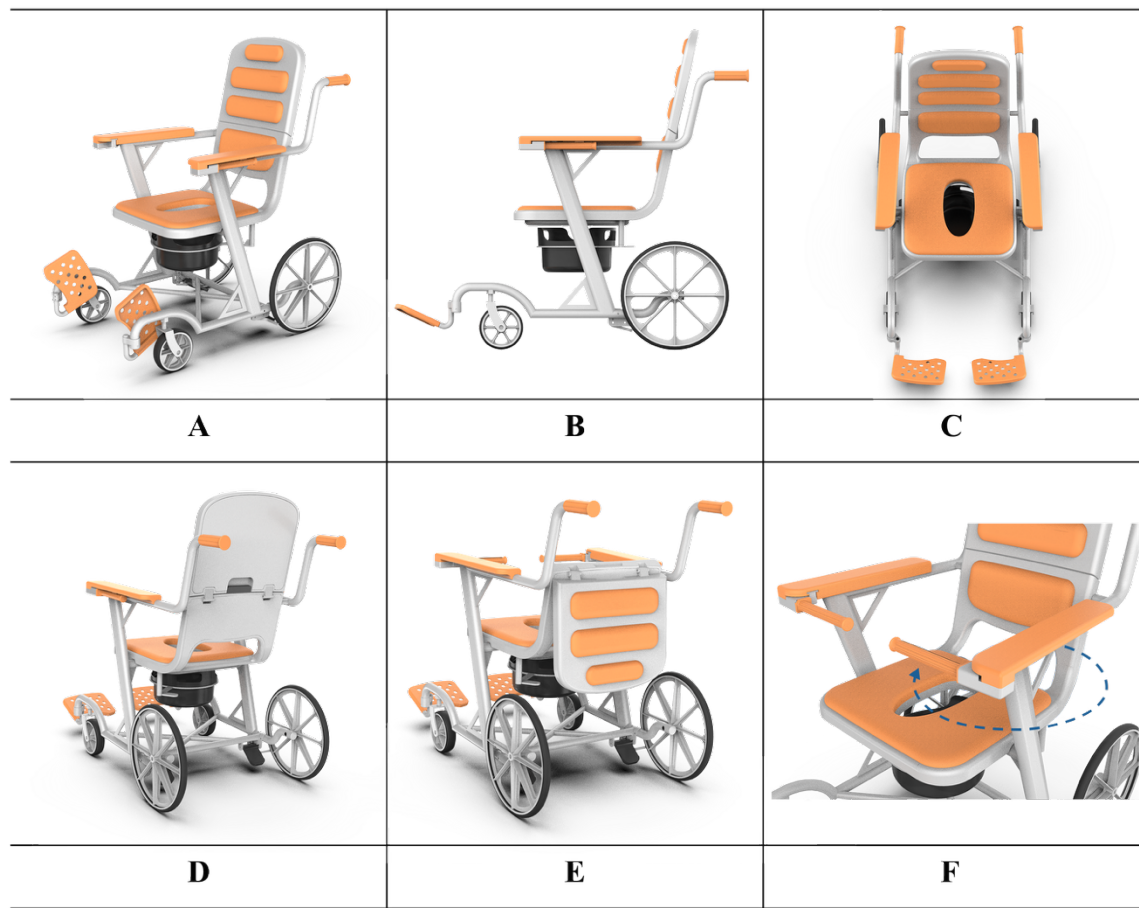


Figure H. *3D CAD Renderings of Design Iteration 1*

Participant Feedback

The updated design was presented to four older adults (CR1, CR2, CR3 and CR4) and six carers, and their feedback was recorded. The reinforced diagonal beam structure was positively received for its improved sturdy appearance (Figure H-A), highlighting how visual cues (visually perceived assurances) can influence trust and confidence in the design.

The carers found the backrest and seat bulky and questioned the practical effectiveness of the segmented cushion pads in providing fast water drainage (Figure H-C). They also noted the closed toilet bucket hole (Figure H-C) and suggested

opening the front end for better access for older adults with shower heads. These concerns about practicality and effectiveness should be considered in future iterations. In contrast, the folding backrest panel (Figure H-E) was favoured by the older adults. CR2 could connect it to experiencing stronger water pressure on her back, similar to a back massage. The feedback on this feature, intended to improve cleaning accessibility, suggests it can foster a sense of comfort by restoring the preferred routine. Nevertheless, the older adults did not notice the improvement in seat thickness, which had been identified as a comfort issue in the initial design.

All participants recognised the benefit of including integrated front safety handlebars (Figure H-F). The carers valued that the handles can be hidden beneath the armrest when not in use (Figure H-F). Nevertheless, they inquired about the mechanisms for rotating the handlebars and folding the backrest, emphasising simplicity and minimal complexity. This finding highlights the importance of ease of use and intuitive design to minimise carer burden.

The feedback highlighted that although this iteration enhanced the shower chair's perceived and actual safety and user comfort, additional refinements are necessary to streamline the design and improve practicality, making it easier for both carers and older adults to operate.

Appendix J

Dignity-conscious Shower Chair Design: Design Iteration 2

Design Synopsis

This second iteration focused on simplifying the overall design while improving usability. This involved shortening the diagonal beam to decrease both the visually perceived weight and the actual weight of the structure (Figure I-B). This design choice aligns with the principles of safety, comfort and ease of use. By shortening the diagonal beam, the armrest could be detached from the structural beam, enabling rotation (Figure I-F) and facilitating barrier-free bed-to-shower chair transfers, reflecting a strategic balance between user independence and the practical constraints of daily care routines.

Based on participants' feedback about the limited benefits of the segmented cushions, the backrest – originally constructed from two different materials in Iteration 1 – was combined with the seat using a single material. However, testing a suitable material such as PU in the physical prototype is essential to ensure tactile comfort. To improve safety, both the seat and backrest feature a protruding hemisphere texture designed to prevent slippage. This approach aims to balance safety and comfort through careful material selection and surface texture; however, the effectiveness of the texture remains to be validated. The central portion of the toilet opening was also modified to improve access for showerhead use, directly addressing carers' feedback.

The carer's push handle was redesigned into a single handlebar (Figure I-D) functioning as a lock-and-unlock switch for rotating the backrest. This one-handed operation is intended to allow carers to maintain contact with the older adult's back

during the procedure, streamlining assistance, enhancing carer comfort and fostering a sense of security for the older adult.

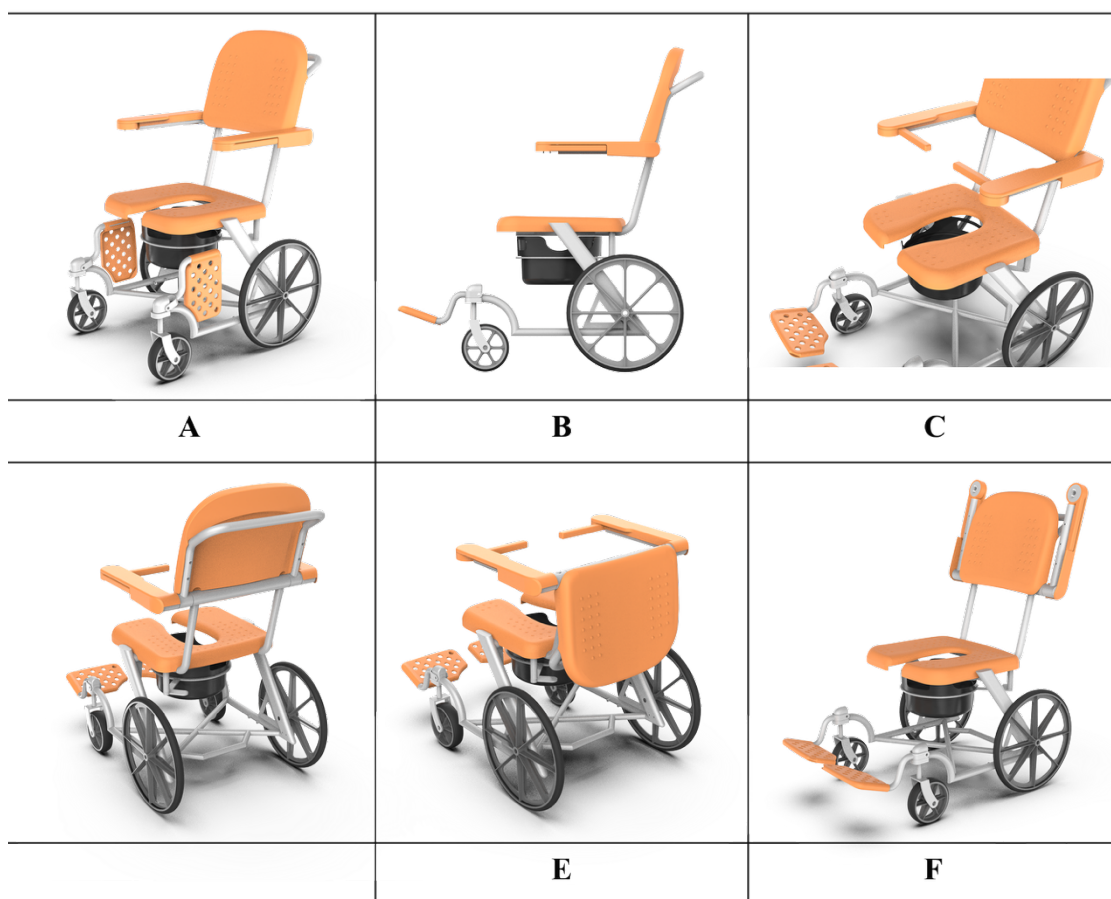


Figure I. *3D CAD Renderings of Design Iteration 2*

Participant Feedback

The modified design was presented to two older adults (CR2 and CR3) and three carers (CG1, CG2 and CG5) and received mixed feedback. The carers noted a lighter appearance from shortening the diagonal beam, perceived as an easy-to-use feature; however, the older adults did not recognise any potential benefit. The front

safety handlebars (Figure I-E) remained regarded as a key safety feature, consistent with the earlier version.

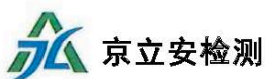
The redesigned backrest and seat were well received for their simplicity and lightweight appearance. Although the protruding hemisphere texture was aesthetically appealing, the carers doubted its effectiveness in preventing slippage (Figure I-C), highlighting the need to validate design features through empirical testing, rather than relying solely on their aesthetic appeal.

The carers noticed improvements in the redesigned push handle (Figure I-D), which could improve navigation and allow backrest folding. However, despite their preference for a one-handed operation design, they were unable to fully comprehend the value of the design objective, which involves maintaining physical contact with the older adult, nor did they understand its benefits. As one carer remarked, *'I cannot understand what you mean from the drawings. We need to use the actual product to find out'*. This statement emphasises the limitations of gathering feedback on features, which are deeply linked with emotional experience and depend on real-world use, highlighting the need for in-situ testing.

The feedback revealed that the second iteration streamlined the design and enhanced usability. However, issues remain with the effectiveness of the anti-slip texture and the intuitive use of the backrest locking mechanism in facilitating connection with older adults. Therefore, testing the prototype and allowing actual interaction to verify its intended safety and effectiveness are essential.

Appendix K

Prototype Safety Certification



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Report number: J25J040711262BR



China's
recognition,
and
international
mutual
recognition
check
TESTING
CNASL18543

Inspection report

Product name: Shower wheelchair

Entrusting unit: Southern University of Science and Technology

Address of the entrustment unit: No.1088, Xueyuan Avenue, Nanshan District, Shenzhen City, Guangdong Province

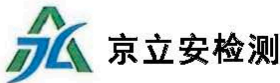
product model: /

Release date: 2025.02.18

深圳市京立安检测有限公司



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Report number: J25J040711262BR

Product name:	Shower wheelchair		
Manufacturer:	Dongguan Weilang Hardware Products Co., LTD		
Manufacturing address:	No.68, Minchang Road, Nanzha Fifth District, Humen Town, Dongguan City, Guangdong Province		
Sample No.:	1#		
Trademark:	/	Date Received:	2024.12.22
Test Category:	consignment	Target Date:	2025.02.18
Sample description: Test sample, shower wheelchair, 1 set of sample number			
test method: GB / T13800-2021 Manual Wheelchair Vehicle			
detection result: See the subsequent page.			
Main inspection:		examine and verify:	 ratify:
			

Sample pictures



Appendix L

Summary Table of the Carers' Feedback on the Shower Chair Prototype

Category	Positive Feedback	Negative Feedback/ Areas for Improvement	Key Insights
Experienced Dignity	Safety handlebars seen as valuable for security and stability (CG3, CG5, CG6); Rotating armrests & seat cushion opening facilitate diaper changing.	Concerns about hard cushion (CG1) and un-accommodating seat dimensions for all body types (CG5); Need for adjustable seat heights and ergonomic design for various toilets.	Adjustability is a MUST to make sure all older adults can feel more comfortable. Intimate hygiene is valuable to their dignity; it allows them to feel like human being. Safety should be on top of our minds. This is what enhances emotional well-being.
Factors Influencing Dignity - Safety	Reliable brakes are vital (CG1, CG3, CG4).	Conflicting views on safety handlebar: potential to hinder movement (CG1); Incident of backrest unexpectedly unlocking and fall risk (CG5); Unstable when the older adults use.	It should be user test and thoroughly tested. All of the parts and design components of the shower-chair need to be evaluated to prevent future safety-risk incidents from occurring.
Factors Influencing Dignity Comfort	Improvement for flexible wheel which eases the workload.	The X-shaped support at the bottom makes it impossible to use with a toilet, as it requires cleaning the excrement stuck on the bottom support structure (CG3); The design needs more simple-design to minimize the workload for carers.	Simplicity is valuable in all means. Easy to clean structure allows everybody to have a peace of mind. High-quality materials such as stain resistant are necessary for a peace of mind. Make it for the environment of the older adults and carers as both are as needed.

Appendix M

Summary Table of the Older Adults' Feedback on the Shower Chair Prototype

Category	Positive Feedback	Negative Feedback/Areas for Improvement	Conflicting Perspectives	Key Insights
Experienced Dignity	Reduced need for carer support (CR3); Easier to assist with diaper changes without moving the older adults (CR3).			Reduces burden on both older adults and carer; Promotes a sense of control and agency for the older adults; Positive caregiving relationship is essential.
	Rotating and hidden footrests appreciated (CR4, CR5); Desire for openable backrest to improve self-sufficiency in personal hygiene. (CR4).			Small design features can greatly influence a user's feeling of independence; Rotating footrests decrease the risk of falls; Highlights the importance of the design respecting and supporting self-sufficiency.
(Aesthetics)	Preference for colours other than black (CR1, CR5); Green is more comfortable (CR1).	Some carers felt that aesthetics was not important in selection of an assistive technology.	Some did not care for colours while others felt that colour was better.	Aesthetic preferences influence user perception and sense of dignity; Aesthetics can humanize assistive technology.
Factors Influencing Dignity - Safety	Handles provide security and stability (CR1, CR3).			The feeling of self-reliance increases the feeling of safety.

	Shift from dependence on carer to a feeling of self-reliance (CR1).			
Factors Influencing Dignity - Comfort	Comfortable Cushion (CR1).	Seat Height and depth were not ideal for everyone and the size of the seat was not a comfortable feature. (CR4, CR5).	Carers needed the chair for toilet usage.	Different designs would benefit older adults and care givers.
