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EDUCATIONAL MANUAL:

INTEGRATING XR TECHNOLOGY FOR GAIT TRAINING AND MOBILITY IMPROVEMENT IN ELDERLY POPULATIONS

ENHANCING THE QUALITY OF LIFE FOR ELDERLY CITIZENS

PROJECT 2024-1-CY01-KA220-VET-000245276

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I. INTRODUCTION

Increasing life expectancy represents, on the one hand, an important achievement but, on the other, also a major challenge for the healthcare systems. Furthermore, a significant obstacle lies in the fact that the decline in brain function sometimes outpaces that of the body. As individuals grow older, the likelihood of experiencing mild cognitive impairment (MCI) or dementia rises, and the decline in brain health accelerates with advancing age. The last statistics suggest that among people reaching 85 years old, approximately one out of every three individuals may develop dementia or MCI, while by the age of 90, this figure increases to around one in two individuals (Fusdahl et al., 2023). Dementia related diseases pose in fact significant challenges to both individuals, caregivers and healthcare systems worldwide.

Given the fact that Europe's population is rapidly aging, the prevalence of dementia is expected to almost double by 2050, increasing to 14,298,671 in the European Union and 18,846,286 in the wider European region, thus, placing immense pressure on healthcare services (Dementia in Europe Yearbook, 2019). Among the most characteristic symptoms of dementia is mild cognitive impairment, which can often manifest itself through gait difficulties and precarious balance, thus increasing the risk of falls among affected individuals. This decline in mobility not only compromises the independence and quality of life of those touched, but also places a considerable burden on caregivers and healthcare systems.

In light of the challenges mentioned above, innovative interventions are essential to address the specific needs of older populations, particularly those in the early stages of dementia.

Extended Reality (XR) technologies, such as augmented reality (AR), virtual reality (VR), and mixed reality (MR), offer a promising avenue to meet these needs, providing immersive and interactive experiences for healthcare professionals (Chuah, 2019).

XR, in particular, presents a unique methodology for gait training, seamlessly blending digital elements with the real world.

This Educational Programme Manual focuses on gait training and fall prevention for individuals with mild dementia and it has the purpose of providing healthcare professionals and caregivers with specialized expertise highly sought after in the field of senior care.

As the population ages and the prevalence of dementia rises, the demand for skilled professionals and caregivers capable of addressing the unique needs of elderly individuals will only continue to grow.

This comprehensive Educational Programme Manual has been first specifically tailored for healthcare graduates and professionals working with elderly populations at risk of and in early stages of dementia, but secondly it also has specific sections designed and dedicated to formal and informal caregivers with tips and recommendations.

By providing targeted training in this area, this Manual enhances the vocational relevance of healthcare professionals and caregivers, making them more efficient and effective.
The manual was conceived and produced paying attention to key aspects such as:

- aligning the content with the latest research, case studies and best practices;
- having a person-centered approach to dementia care;
- ensuring inclusive design principles and accessibility features.

These objectives directly correspond with the overall goals of the GaitXR Erasmus+ project:

1. Empowering healthcare professionals with specialized knowledge in dementia care;
2. Enhancing the quality of care for elderly populations at risk of and in early stages of dementia;
3. Aligning with the overarching goal of promoting a holistic model of dementia care.

This Educational Programme Manual serves as a resource to enhance vocational education curricula, ensuring comprehensive training in dementia care. By equipping healthcare professionals and caregivers with specialized skills in gait and balance improvement for individuals with mild dementia, the manual enhances their vocational relevance and prepares them for roles in senior care. Equipped with evidence-based strategies, professionals and caregivers can proactively address gait training, fall prevention, and rehabilitation protocols, which, in turn, improves the overall quality of life of elderly individuals under their care.

Based on the insights from the needs assessment and designed in an accessible and inclusive manner, this manual contains comprehensive content covering:

- gait assessment and training,
- falls prevention,
- post-fall rehabilitation protocols,
- opportunities offered by new technologies,
- inclusive and person-centered communication,
- holistic approach to dementia care.

The manual underscores the interconnectedness of physical health, cognitive well-being, and overall quality of life. Armed with this holistic perspective, healthcare professionals and caregivers could adopt a comprehensive approach in their care practices. For instance, recognizing the impact of gait training on both physical health and cognitive function allow professionals and caregivers to address multiple dimensions of dementia care simultaneously.

For this purpose, each chapter also includes case studies with projects, initiatives, and experiences from which to draw inspiration and from which to find additional materials on specific topics.

Finally, we would like to synthetically underline that, among the strengths of the Educational Programme Manual, we can include:

- the presence of applied case studies and real-life scenarios;
- modular and flexible materials;

- caregiver-focused content;
- a bridge between digital innovation and clinical fundamentals;
- dedicate focus on motivational and psychological barriers;
- an interdisciplinary coordination and holistic approach.

We hope you will enjoy the contents and inclusive design of this Manual. Happy reading!

1. CONTEXT AND NEED ANALYSIS

Learning outcomes

By the end of this chapter you will be able to:

1. Describe why gait and mobility issues among older adults are a pressing concern in dementia care. You will learn how common gait problems and falls are, how they threaten independence and quality of life, and how they relate to cognitive decline.
2. Recognise the key gaps in current fall-prevention strategies and professional education. You will see that current interventions are considered insufficient and that training is inconsistently applied.
3. Understand why an educational programme manual must be tailored, evidence-based and inclusive. You will discover the implications for curriculum design, including the need for case studies, modular content, caregiver-focused sections and integration of extended reality (XR) tools.

Introduction

The GAIT XR project aims to enhance vocational education on dementia care by integrating extended-reality technologies into training programmes. Before developing such resources, the consortium conducted a needs assessment (Work Package 2). This assessment analysed the knowledge, skills and training gaps among vocational education and training (VET) educators and learners in partner countries. By systematically gathering feedback from practitioners, the project ensures that its educational outputs, particularly the GAIT XR manual and XR tool, address real-world challenges, align with user needs and reflect current evidence.

A participatory needs assessment is essential. It not only helps tailor content but also encourages stakeholder ownership and supports sustainability beyond the project's duration. In this chapter you will

explore the results of the assessment, the prevalence and impact of gait issues in older adults, existing training gaps, and the implications for designing an effective educational programme.

Importance of the needs assessment

Needs assessments provide evidence-based direction for educational programmes. The GAIT XR survey engaged 101 respondents, mainly healthcare professionals such as social and health service assistants (24.8 %), nurses (19.8 %), physiotherapists (11.9 %), occupational therapists (11.9 %) and other allied health professionals. Their input grounds the manual in the realities of geriatric care and ensures that XR innovations complement rather than replace fundamental skills.

The survey underscored why thorough preparation is essential:

- Alignment with real-world practice: Without understanding practitioners' needs, training may be misaligned or impractical.
- Stakeholder engagement: Involving educators, learners and industry professionals fosters ownership and smooth implementation.

Evidence-based design: The assessment sets an evidence-based foundation for developing both the XR training tool and the educational framework.

Prevalence and impact of gait issues in older adults

Survey respondents consistently reported that gait and mobility difficulties are common in adults aged 65 and above. When asked how often older adults present gait problems, 72.3% answered "often" and 12.9% answered "always," while only 13.9% selected "sometimes." These practitioners also emphasised that gait disturbances markedly increase health risks: 84.2% felt that gait issues heightened the risk of falls, hospitalisation or loss of independence either "quite a lot" or "a great deal."

External evidence confirms this perception. The prevalence of gait disorders rises from about 10% in individuals aged 60–69 years to over 60% in those older than 80 years and over 80% in people above 85 years.

Falls are the leading cause of injury in the geriatric population, resulting in millions of emergency room visits, hundreds of thousands of hospitalisations and significant health-care costs. Such injuries often lead to disability, loss of independence and social isolation.

These findings highlight the importance of proactive assessment and early intervention. Gait dysfunction is also a predictor of cognitive decline making it especially relevant in dementia care. Early identification of gait changes can therefore help protect autonomy and quality of life for older adults.

Challenges in gait training

Respondents identified several obstacles when working with adults over 65:

1. Physical limitations (38.8%): Reduced mobility, balance problems, muscle weakness, pain, and fatigue were the most common barriers.
2. Motivation (27.6%): Maintaining engagement and overcoming psychological barriers is critical to sustaining participation.
3. Personalisation (17.3%): Interventions must be tailored to individual needs, health conditions, and preferences.
4. Fear or anxiety: Although mentioned less frequently (1%), fear of falling can impede progress.

These results show that effective gait training requires adaptable, person-centered approaches that address both physical and emotional factors. Training should empower professionals and carers to tailor exercises, motivate participants, and reduce anxiety.

Training and knowledge gaps

The assessment revealed that existing fall-prevention strategies and professional education are viewed as insufficient. When asked whether current interventions for people aged 65 plus are adequate, only 6.9% believed they were “quite a lot” sufficient; 55.4% answered “somewhat,” 27.7% “a little,” and 8.9% “not at all.” Similarly, most respondents felt that education on gait and fall prevention was limited; less than 7% thought

there was “quite a lot” of training, while 34.7% responded “a little” and 12.9% “not at all.”

Implementation of gait training is uneven: only 15.8% reported delivering interventions often and 4.0% always; most do so sometimes (40.6%) or rarely (30.7%). These figures suggest systemic or logistical barriers to consistent practice. Nonetheless, there is a strong appetite for resources: 71% of respondents believed that an evidence-based educational manual focused on gait training and fall prevention would be helpful or extremely helpful.

Educational and training needs

When asked what they most wanted to learn, professionals prioritised practical, clinically relevant content:

- Techniques to prevent falls (22.4%) and fall risk assessment (17%).
- Gait rehabilitation and motor retraining (16.7%).
- Training patients to respond safely to a fall (15.2%) and post-fall rehabilitation protocols (14.4%).
- Multidisciplinary approaches and integration of digital tools or virtual reality (5.5%), indicating that XR technologies, while appealing, are secondary to fundamental topics.

Regarding helpful content in an educational manual, respondents emphasised early identification of gait issues (17.4%), caregiver training (17.1%), patient education and self-management (16.9%), and inclusive approaches for individuals with cognitive impairments (16.6%). Personalized interventions and assistive technology were also valued.

Priority areas for professional training include fall-prevention strategies (24.5%), gait screening tools and assessments (20.5%), person-centred communication during gait training (17.4%), and interdisciplinary coordination (15.5%). These needs underline the importance of foundational competencies before introducing advanced technologies.

Implications for the educational programme

The survey results offer clear guidance for designing the GAIT XR educational programme:

1. Ground content in real-world practice: The manual must reflect typical workflows and challenges faced by professionals in geriatric settings.
2. Avoid one-size-fits-all approaches: Training should be tailored to physical, cognitive and emotional differences among older adults.
3. Emphasise foundational competencies: Before introducing XR tools, ensure users have a solid understanding of gait screening, fall prevention and person-centred communication.
4. Address emotional and motivational factors: Training should include strategies to build confidence, reduce fear of falling and foster adherence.
5. Include applied case studies: Real-life scenarios demonstrate the step-by-step application of assessments and interventions.
6. Develop modular and flexible materials: Adaptability allows educators to customize content for home-based, institutional or outpatient settings.
7. Incorporate caregiver-focused content: Given the crucial role of informal carers in dementia care, the manual should offer specific guidance and support for them.
8. Integrate digital innovation with clinical fundamentals: XR features should complement—not replace—core clinical skills.
9. Promote interdisciplinary coordination: Training should encourage collaboration among nurses, physiotherapists, occupational therapists and other professionals.
10. Design for sustainability and scalability: Materials should be easy to translate and adapt across diverse European contexts.

Are you a caregiver? Here are some tips and recommendations.

Informal carers often provide daily support for older adults. The following checklist offers practical tips for carers to help prevent falls and maintain mobility.

Checklist for caregivers:

- **Recognize early signs of gait issues:** Pay attention to changes in walking speed, stride length, or balance. Early detection allows timely intervention.
- **Create a safe environment:** Remove tripping hazards (loose rugs, clutter), ensure good lighting, and install grab bars or handrails in bathrooms and stairways.
- **Encourage physical activity:** Support participation in prescribed exercise programmes that include strength, balance, and flexibility. Regular activity helps prevent deconditioning.
- **Promote proper footwear and assistive devices:** Ensure shoes fit well and are non-slip; use canes or walkers as recommended by professionals.
- **Provide emotional support and motivation:**
- **Provide emotional support and motivation:** Acknowledge fears, celebrate progress, and encourage persistence to overcome psychological barriers.
- Communicate with professionals: Work with physiotherapists, occupational therapists, and nurses to tailor interventions and report changes in gait or balance. Collaborative, person-centered communication improves outcomes.
- Educate yourself: Learn about fall-prevention strategies, safe responses to falls and the use of assistive technologies. Access available training materials and support networks.

This checklist illustrates how carers can translate educational guidance into daily practice, reinforcing the need for caregiver-focused content within the manual.

Conclusions

The GAIT XR needs assessment demonstrates that gait and mobility issues are prevalent among older adults and significantly increase risks of falls, hospitalisation and loss of independence. Professionals frequently encounter physical limitations, motivational challenges and the need for personalised interventions. Despite awareness of these issues, current fall-prevention strategies and training are perceived as insufficient and inconsistently implemented.

There is strong demand for practical, evidence-based resources that cover fall-prevention techniques, gait assessment, rehabilitation, caregiver training and inclusive approaches for people with cognitive impairments. Respondents also emphasised the importance of foundational competencies and person-centred communication before introducing XR tools. By grounding the GAIT XR educational programme in real-world needs, tailoring content to diverse learners and carers, and integrating digital innovations with clinical fundamentals, the project can deliver meaningful improvements in dementia care.

2. MCI AND DEMENTIA CARE: A HOLISTIC APPROACH

What is MCI?

Learning Outcomes

1. **Define Mild Cognitive Impairment (MCI):** Explain what MCI is, including recent diagnostic criteria and the difference between amnestic and non-amnestic subtypes.
2. **Distinguish MCI from Normal Aging and Dementia:** Identify how cognitive changes in MCI differ from typical age-related changes and from dementia, using clear, evidence-based comparisons.
3. **Recognize Symptoms and Risk Factors:** List common early signs of MCI and describe key risk factors (genetic and lifestyle) that increase the likelihood of developing MCI.
4. **Understand Why MCI Matters:** Discuss why early identification of MCI is important, including statistics on progression to dementia, implications for fall risk, planning care, and the emotional impact on individuals and families.

Introduction

Understanding **Mild Cognitive Impairment (MCI)** is crucial in the context of aging and dementia prevention. As populations age, a significant number of older adults develop cognitive changes that are more pronounced than expected in normal aging, yet not severe enough to be classified as dementia. This intermediate state—MCI—is common: roughly 15–20% of people over 65 are estimated to have MCI. Recognizing MCI is important because it can be an optimal window for intervention before more serious decline occurs. In fact, MCI is often regarded as a transitional stage between healthy aging and dementia. By detecting MCI early, you can take steps to address reversible causes, implement lifestyle changes, and plan for the future to potentially slow cognitive decline. Early intervention and monitoring at the MCI stage may help maintain independence longer and even reduce risks such as falls and injuries associated with cognitive impairment.

Definition of MCI

Mild cognitive impairment is defined by a level of cognitive decline that exceeds what is expected for an individual's age and education but **does not significantly interfere with daily functioning**. In other words, the person has measurable problems with memory or other thinking abilities, yet maintains independence in basic activities of daily life. Recent diagnostic guidelines for MCI (sometimes termed "mild neurocognitive disorder") emphasize **(a)** evidence of concern about a change in cognition (from the individual, informant, or clinician), **(b)** objective impairment in one or more cognitive domains (typically 1–1.5 standard deviations below age norms on cognitive tests), and **(c)** essentially normal functional abilities, with no dementia diagnosis. For example, a doctor may diagnose MCI if a patient shows memory and thinking test scores below expected levels yet can still manage their household, medications, and finances independently (perhaps with slightly more effort or the use of reminders).

How MCI Differs from Normal Aging and Dementia

Table 1: Comparison of Normal Aging, Mild Cognitive Impairment, and Dementia (key characteristics and their impact).

Feature	Normal Cognitive Aging	Mild Cognitive Impairment (MCI)	Dementia
Memory	Occasional forgetfulness (e.g., misplacing keys, forgetting a name briefly)	Frequent memory lapses (e.g., forgetting recent conversations or appointments)	Severe memory loss (e.g., forgetting familiar places, important information, or safety tasks)

Learning & Processing Speed	Slightly slower learning and recall	Noticeably slower, requires effort or compensatory strategies	Severely impaired, unable to retain new information effectively
Daily Functioning	Independent, no significant disruption in daily life	Still functionally independent but requires reminders, lists, or calendars	Impaired independence; difficulty managing finances, cooking, hygiene, or safety without help
Other Cognitive Abilities	Mild word-finding difficulty, no major confusion	Problems with planning, decision-making, and following conversations	Major deficits in language, orientation, judgment, and reasoning
Awareness of Deficits	Aware of normal lapses, not concerning	Often aware and may express concern about changes	Awareness decreases over time; may lack insight into impairments
Impact on Life	Minimal, does not interfere with social or occupational functioning	Noticeable effort needed but independence preserved	Significant interference with everyday activities, requires supervision or assistance

As shown above, **MCI is an intermediate state**. It is more than normal aging, the changes are beyond occasional slips, but it is not dementia, since general cognitive function is largely preserved and the person remains self-sufficient. For example, an older adult who sometimes forgets what day it is but recalls it later, or who needs a bit more time to find words, is likely showing normal aging.

If they begin frequently forgetting important information (like recent events or scheduled plans) or start needing to reread instructions due to trouble concentrating, yet are still handling their daily affairs, that pattern is consistent with MCI. On the other hand, if memory and thinking problems become so frequent and serious that the individual cannot keep up with work or social obligations, gets lost while driving in a once-familiar neighborhood, or can no longer prepare meals or dress appropriately without help, these are red flags of dementia-level impairment.

To quantify these differences, clinicians often use cognitive screening tests and functional assessments. Someone with normal aging will score in the expected range for their age and have no functional limitations. In MCI, cognitive test scores are lower (but not as low as dementia), and neuropsychological testing can detect deficits in specific areas while daily function questionnaires/ interviews show intact basic abilities. In dementia, cognitive test scores are much lower and there is clear evidence of functional decline (from informant reports or direct observation of the person's inability to manage routine tasks).

In summary, the boundary between MCI and early dementia can be subtle, and ongoing observation over time is often needed. Notably, primary care physicians report that it is sometimes challenging to know "where MCI ends and dementia begins," underscoring the need for careful evaluation. Key distinguishing features are the degree of daily functional impact and the severity of cognitive deficits. MCI occupies the "gray zone" where cognition is below normal, but daily life is essentially intact.

Symptoms and Risk Factors

Symptoms of MCI:

Amnestic MCI (memory problems)

- Significant short-term memory loss (more than peers)
- Forgets recent conversations, repeats questions
- Misplaces things and cannot remember how to find them
- Difficulty remembering new information (names, plans), but remembers older events

Non-amnestic MCI (other cognitive areas)

- Executive function: Problems with organisation, decision-making, sequencing tasks
- Visuospatial skills: Getting lost, difficulty finding your way around familiar areas
- Language: Difficulty finding words, following conversations

Other signs

- Losing track of conversations
- Increased impulsivity, poorer judgement
- Difficulty multitasking and concentrating
- Changes often noticed by family/friends

Important to know

- MCI does not cause severe confusion/disorientation (signs of dementia)
- Mild disorientation may occur (e.g. uncertainty about the date or brief confusion in unfamiliar places)

Beyond cognitive symptoms, many individuals with MCI experience **mood and behavioral changes**. Research shows that people with MCI commonly have symptoms of **depression, anxiety, or apathy** at higher rates than cognitively healthy older adults. They might feel more withdrawn, frustrated, or irritable, possibly due to awareness of their cognitive difficulties. For example, a person with MCI could become anxious about performing tasks in public for fear of making mistakes, or they might exhibit a low mood and lack of interest in activities they used to enjoy.

These neuropsychiatric symptoms are important to recognize because they can impact quality of life and may even accelerate cognitive decline if left unaddressed. Early counseling or treatment for depression and anxiety in MCI has been suggested to potentially improve outcomes for both cognition and well-being.

Risk Factors for MCI: It is often not one single cause that leads to MCI, but a combination of genetic and lifestyle factors that increase vulnerability to cognitive decline.

- Advancing age is the strongest risk factor, MCI is rare below age 60, and its prevalence rises with each decade in older adulthood.
- Genetics also play a role: carrying the APOE-ε4 gene (the same gene variant that increases risk for late-onset Alzheimer's disease) is associated with a higher likelihood of developing MCI and progressing from MCI to Alzheimer's dementia. However, having this gene is neither necessary nor sufficient, many people with APOE-ε4 never develop impairment, and many MCI patients do not have the gene.
- Modifiable health and lifestyle factors significantly affect MCI risk. Medical conditions like diabetes, hypertension (high blood pressure), high cholesterol, obesity, and cardiovascular disease can harm brain health and have been linked to elevated risk of cognitive impairment. Smoking and excessive alcohol use are additional risk factors, as they contribute to vascular damage and oxidative stress in the brain.

On the other hand, a lack of protective factors can also increase risk: physical inactivity, a diet high in saturated fats and sugars, and low cognitive or social engagement (for example, not regularly challenging the brain or socializing) have all been associated with greater chances of developing MCI. Depression and chronic stress in mid- or late-life are not only symptoms but also potential risk factors; studies indicate that a history of depression or significant psychological distress may predispose an individual to cognitive decline and MCI.

The encouraging news from recent research is that lifestyle improvements can mitigate risk even for those with genetic predispositions. A 2023

cohort study of older adults in China found that participants with unhealthy lifestyle habits (poor diet, physical inactivity, smoking, and heavy alcohol use) had a significantly higher risk of developing MCI than those with healthy habits, and this was true regardless of genetic risk status. In fact, those with high genetic risk (like APOE-ε4 carriers) but a healthy lifestyle had a lower incidence of MCI than those with no genetic risk but an unhealthy lifestyle. This suggests that staying physically active, mentally engaged, and socially connected and managing vascular risk factors (blood pressure, blood sugar, and cholesterol) can meaningfully delay or help prevent cognitive impairment. Additional studies estimate that addressing lifestyle and health factors, such as exercise, diet, not smoking, and treating hearing loss or depression, could prevent a substantial proportion of cognitive decline cases. While MCI itself has no approved medication to cure it, these modifiable factors are powerful tools to reduce risk and potentially slow progression.

Are you a caregiver? Here are some tips and recommendations.

- **You play a key role in observing changes**. Don't hesitate to encourage a loved one to seek professional advice if you notice memory or thinking issues that seem more than normal aging. Early evaluation can identify MCI and open up options for support and prevention.)

- **Learn the terminology and nuances of MCI subtypes**. If your loved one is diagnosed with MCI, ask the clinician what specific domains are affected. For example, is it mainly memory (amnestic MCI) or something else like language or judgment (non-amnestic)? This understanding can help you tailor your support, e.g., memory aids for amnestic MCI, or help with organization and schedules for non-amnestic MCI, and watch for changes relevant to those areas.)

- **Educate yourself on what changes are considered normal** with aging versus those that are not. Don't dismiss frequent repetition of questions, confusion, or noticeable memory lapses as "just getting old." If you notice your family

member is having increasing difficulty performing familiar tasks or is more than a little forgetful, take notes on what you observe. You can gently bring this up with their doctor. On the other hand, try not to panic over every minor lapse; occasional forgetfulness can be benign. The key is to look for consistent patterns or worsening cognitive issues. When in doubt, consult a healthcare professional for a proper assessment of whether it might be MCI.

- **Take note of the risk factors that can be improved**. You can support your loved one by encouraging and facilitating a

brain-healthy lifestyle. This includes regular exercise (even walks or tailored routines for older adults), a balanced diet (for example, the Mediterranean or MIND diet rich in vegetables, whole grains, and healthy fats), controlling cardiovascular risks (help them follow medical advice for blood pressure, diabetes, etc.), and staying mentally and socially active (perhaps engaging them in puzzles, games, learning new skills, or social gatherings). Also be attentive to signs of depression or anxiety; if your relative with MCI seems persistently sad, worried, or apathetic, encourage them to speak with a doctor or counselor. Treating mood issues can improve their daily function and might even slow cognitive decline. By addressing these factors, you not only improve their overall health but may also modify the course of MCI.

- A diagnosis of MCI is a signal to plan and prepare, but not to panic. It's a chance to be proactive. Engage your loved one in discussions about their wishes for the future while they can still voice preferences.

Make sure legal documents (like power of attorney and advanced care directives) are in order. At home, consider safety enhancements to prevent falls or confusion (for example, ensure good lighting and minimize clutter; use pill organizers for medications). Support the person in staying active and involved in hobbies as much as possible, because maintaining routine and purpose is beneficial. Most importantly, provide emotional support, be patient with memory lapses, and encourage rather than take over tasks the person can still do. Many individuals with MCI continue to lead fulfilling lives for years. By understanding that MCI matters as an opportunity for early action, you can help your loved one optimize their health and autonomy, and navigate changes with confidence.

What is Dementia?

Introduction

Dementia is a chronic progressive syndrome characterized by deterioration in cognitive function, beyond the range of what might be expected from normal ageing. It affects memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgement. Consciousness is usually not affected. The symptoms may be accompanied, and sometimes preceded, by changes in emotional control, social behaviour and/or motivation.

Dementia is not a single disease, but a syndrome—a cluster of possible causes and manifestations. The rate of progression can vary widely between individuals and between subtypes. Some people may have a very slowly progressing decline over many years; others may decline more rapidly. There is also a preclinical phase where pathological changes in the brain occur before symptoms are clinically evident. Biomarkers are increasingly being used to detect such early changes.

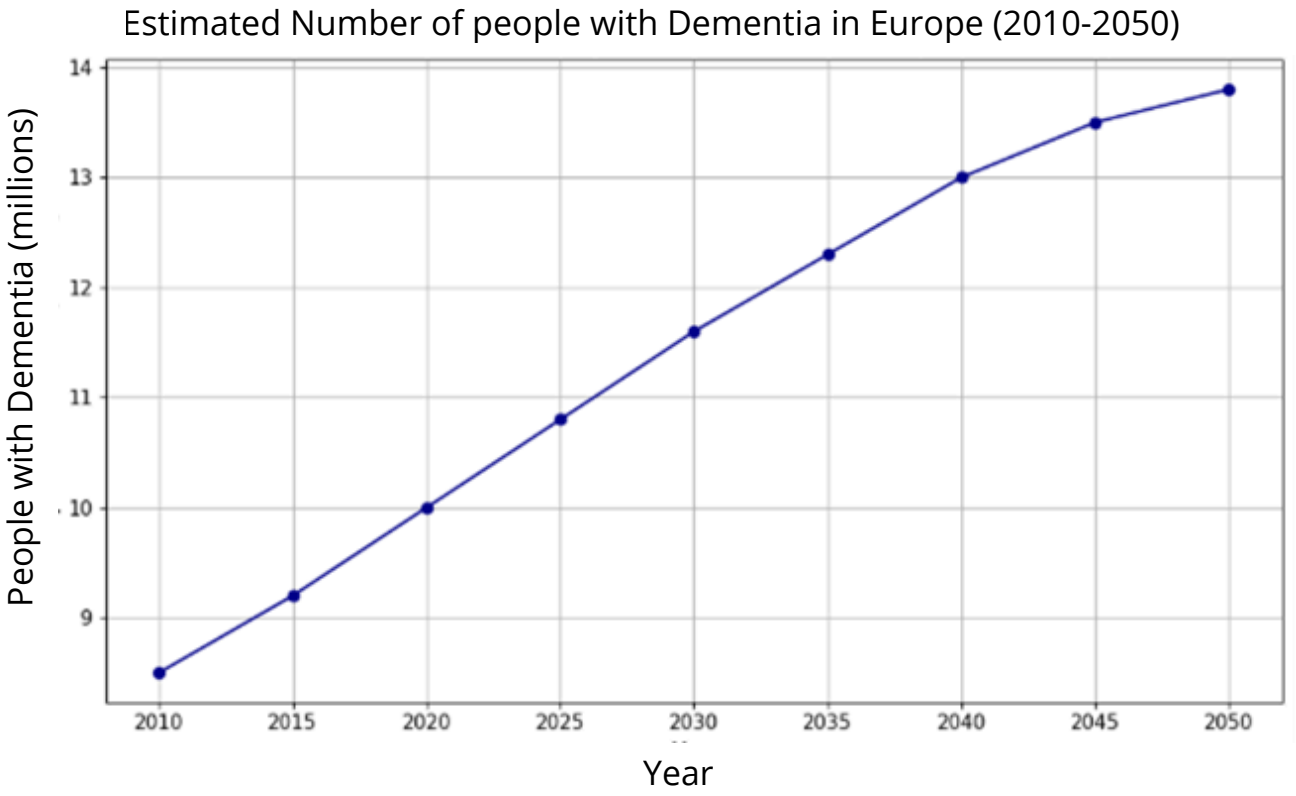
Learning Outcomes

By the end of this chapter, you will be able to:

1. Define dementia and explain how it differs from normal ageing.
2. Identify the main types of dementia and their risk factors.
3. Recognize the diagnostic criteria and clinical guidelines relevant in Denmark and Europe.
4. Describe how dementia progresses and its impact on daily life.
5. Understand the importance of early detection and intervention.

The Background

Epidemiology: According to the World Health Organization (WHO), approximately 55.2 million people worldwide are currently living with dementia, with a significant proportion residing in Europe. Alzheimer Europe and WHO suggest that around 10 million people in Europe are living with dementia in the mid-2020s and the number is expected to increase in the coming decades due to demographic shifts.



Source: Alzheimers Europe

- **Causes and subtypes:** Dementia is a broad umbrella, including Alzheimer's disease (most common), vascular dementia, dementia with Lewy bodies, frontotemporal dementia, among others. Multiple etiologies often coexist. Risk factors in Denmark and Europe include hypertension, obesity, hearing loss, physical inactivity, and others.
- **Additional risk factors** identified in recent Danish studies include hearing loss, physical inactivity, obesity, hypertension. A study "Potential for prevention of dementia in Denmark (Jørgensen et al., 2023)" estimates that about 35.2% of dementia cases in Denmark could be attributed to modifiable risk factors; among these, physical inactivity, hearing loss, hypertension, and obesity had the greatest prevention potential.
- **Impact:** Dementia has significant physical, psychological, social and economic consequences. It affects not just cognitive function but daily activities, independence, quality of life, and places large demands on caregivers and health systems. Awareness may lag, and diagnostic delay is common.

Definition and diagnostic criterias

- Dementia is a clinical diagnosis, based on overall assessment; history, symptoms, physical and neurological examination, cognitive testing, imaging, lab tests. There is no single test that definitively establishes the diagnosis.
- The Danish National Clinical Guideline for diagnosis of mild cognitive impairment (MCI) and dementia (2018) defines dementia via consistent cognitive decline plus impairment in daily functioning.
- Biomarkers (e.g., cerebrospinal fluid amyloid, tau; PET imaging; structural imaging) may be used specially to clarify etiology or subtype, though some are weak or optional recommendations depending on context.
- ” The accuracy of a purely clinical diagnosis (i.e., without biomarkers) is only about 70–80%, even among specialists. Biomarkers can increase accuracy.
- There are evolving guidelines (both European and Danish) that increasingly incorporate biomarkers (amyloid, tau, neurodegeneration) to allow earlier detection and better subtype classification.

Progression and Stages

- Dementia progresses gradually, often from a preclinical or very mild stage, to mild, moderate, and severe dementia. In earlier stages, MCI may be present, where cognitive decline is evident but daily functioning largely preserved.
- As dementia advances: increased dependency in Activities of Daily Living (ADLs), Increased risk of complications (falls, malnutrition, comorbidities), and greater burden on caregivers.
- The functional decline may start with instrumental activities (e.g. managing finances, medications, driving) before basic activities (personal hygiene, feeding) are affected.
- The time course (how rapidly one moves through stages) depends on subtype (e.g., Alzheimer’s tends to have a slower but progressively worsening trajectory; vascular dementia may show
- stepwise declines; frontotemporal dementia may show early behavioural changes).

- Cognitive reserve (education, lifelong cognitive stimulation) can influence symptom onset and rate of decline.

Key takeaways

- Dementia is a syndrome, not a single disease, and its diagnosis requires multifactorial assessment.
- Early detection (including MCI) allows for earlier intervention, risk-factor management, and planning.
- Subtypes and coexisting pathologies matter for prognosis, interventions, and rehabilitation.
- Modifiable risk factors (e.g., physical activity, hearing, hypertension, obesity) account for a substantial share of prevention potential in Denmark (~35%).
- Different subtypes have different prognosis, symptom profiles, and may respond differently to interventions.
- The use of biomarkers can improve diagnostic accuracy and subtype distinction.

Are you a caregiver? Here are some tips and recommendations.

- Provide clear, simple communication, and allow extra time for responses.
- Encourage routines and familiar daily activities to reduce confusion.
- Support independence by offering choices but avoid overwhelming the person with too many options.
- Seek early professional guidance (GP, memory clinic) if cognitive decline is suspected.
- Join caregiver networks or support groups (e.g., Alzheimerforeningen in Denmark) to share experiences and access resources.

The holistic approach to dementia care

Learning Outcomes

1. **Define holistic dementia care** and explain how it differs from purely medical or symptom-focused approaches.
2. **Identify the key dimensions** of holistic care (physical, cognitive, emotional, social, and environmental) and understand their importance for people with dementia.
3. **Explain how an XR-based gait training program** can integrate multiple dimensions of care to improve outcomes for individuals with dementia.
4. **Recognize strategies and interventions** in each dimension (e.g. exercise, cognitive stimulation, emotional support, social engagement, environmental adaptation) and their benefits, especially in the context of XR Gait training.
5. **Appreciate the role of informal caregivers** in a holistic care approach and apply practical tips for family caregivers to support these multiple aspects of care in daily life.

Introduction

In dementia care, taking a holistic approach means looking beyond the medical diagnosis and memory symptoms, and caring for **the whole person**, body, mind, emotions, and social context. You will see how this comprehensive approach addresses the physical health of the individual as well as their cognitive needs, emotional well-being, social connections, and even their living environment. This topic is vital because dementia affects every aspect of a person's life; therefore, effective care must integrate all these dimensions to truly improve quality of life. By treating the individual rather than just the condition, holistic care can promote greater comfort and happiness in daily living. It can also reduce common behavioral challenges (like agitation or confusion) by meeting emotional and social needs, and even **relieve caregiver stress** through better communication and support.

Within the XR Gait Training project, a holistic perspective is especially relevant. This project uses eXtended Reality (XR) technology to deliver gait training exercises to older adults with mild dementia, aiming not only to

improve their walking ability but also to enhance their overall well-being. A holistic approach guides us to design XR gait interventions that simultaneously engage multiple domains: for example, physical movement (walking exercises), cognitive stimulation (interactive virtual environments requiring attention or memory), emotional engagement (enjoyable and motivating activities), and social elements (potentially involving caregivers or group training sessions). In this chapter, we will break down the holistic approach into its key components, physical, cognitive, emotional, social, and environmental, and discuss how each can be addressed in dementia care, with explicit connections to XR gait training. This understanding will help you apply a person-centered, multidisciplinary mindset to dementia care, ensuring that technology-based interventions like XR gait training fit into the bigger picture of supporting the person's whole well-being.

Physical Health and Well-being in Dementia Care

Physical health is a foundational dimension of holistic dementia care. People with dementia often face declining strength, balance, and mobility, which can increase their risk of falls and reduce independence. Addressing physical well-being involves regular exercise, physiotherapy, proper nutrition, and management of other health conditions, all of which can significantly improve a person's daily functioning and safety. Research shows that **regular physical activity can slow cognitive decline and improve the ability to perform daily tasks in people with dementia**. Physical exercises like walking, swimming, dancing, or strength training improve muscle strength and balance, helping to reduce the risk of falls while also enhancing mood and sleep quality. Importantly, when exercise is done in group settings, it provides social interaction that further boosts mental well-being.

In the context of gait training, the **primary physical goal** is to improve walking (gait) and balance. Gait training exercises, whether done traditionally or with XR technology—can help maintain mobility and reduce fall risk for a person with dementia. For instance, a structured 6-week physiotherapy and gait aid training program (including caregiver-supervised practice at home) was shown to significantly improve walking speed, step length, and walking cadence in older adults with dementia.

Most participants learned to use their walkers more safely, leading to more stable gait and potentially fewer falls. This illustrates how targeted physical interventions can enhance safety and independence.

XR technology offers an innovative way to deliver physical exercise by making therapy exercises more engaging and personalized. In XR-based gait training, a person might walk on a treadmill or in place while immersed in a virtual environment (for example, a peaceful park or a city sidewalk). This immersive approach can **increase motivation and enjoyment of exercise**, encouraging the person to be more active. Virtual reality exercise not only improves balance and gait in older adults but also provides additional cognitive benefits compared to regular exercise alone. The interactive 3D environments and real-time feedback in VR can stimulate the brain in ways that traditional exercise does not, effectively turning physical exercise into a cognitive workout as well. For example, an older adult with dementia might practice stepping over virtual obstacles or follow a path in the VR scene, which challenges their attention and planning while they move. Such **dual-task training** (simultaneously physical and cognitive) can improve both domains: research on combined exercise and cognitive training shows better outcomes in cognition (like improved memory and executive function) than exercise alone. In fact, using VR with exercise has shown **greater improvements in both bodily function and cognitive capacity** in seniors compared to general exercise without VR. Therefore, XR gait training aligns perfectly with the holistic ideal; it addresses physical rehabilitation and cognitive stimulation together.

Cognitive Stimulation and Brain Health

The cognitive dimension of holistic care focuses on supporting memory, thinking abilities, communication, and overall brain health. Dementia is characterized by cognitive impairments and difficulties with memory, language, attention, and problem-solving, so stimulating the brain and maintaining mental activity can help slow cognitive decline and keep the person engaged with the world around them. One evidence-based approach is **Cognitive Stimulation Therapy (CST)**, a structured program of group activities and exercises that has been shown to improve cognitive function and quality of life in people with mild to moderate dementia.

In one trial, participants in CST (doing activities like word games, puzzles, or discussions twice a week for 7 weeks) had significantly better cognition compared to a control group. Notably, CST also encourages social interaction during sessions, which combats isolation and has added benefits for mood.

Another powerful method is **reminiscence therapy**, which engages cognitive and emotional areas by stimulating long-term memories, for example, by discussing past experiences, music from the person's youth, or looking at old photos. Reminiscence therapy has been associated with modest improvements in cognition and mood and can reduce agitation in dementia. By tapping into preserved memories, it reinforces the person's sense of identity and can spark meaningful conversations with caregivers or family.

Emotional and Psychological Support

Dementia doesn't only affect memory and thinking; it also has profound emotional effects. People living with dementia often experience frustration, anxiety, depression, confusion, or apathy, stemming from the changes they are going through and the challenges in communicating or performing tasks. Therefore, attending to the **emotional and psychological well-being** of the person is a crucial part of holistic care. This involves creating a supportive, empathetic environment, using interventions that improve mood, and addressing symptoms like anxiety or agitation without immediately resorting to medications whenever possible. Beyond formal therapies, ensuring the person has **daily cognitive engagement** is key; this could include simple puzzles, reading (or listening to audiobooks), playing familiar games, or any mentally stimulating hobby they enjoy. Even involvement in routine tasks (like helping fold laundry or gardening) can provide mental stimulation and a sense of purpose.

Within XR gait training, cognitive stimulation can be naturally integrated. As mentioned earlier, VR-based exercises often require the user to pay attention, react to virtual prompts, or navigate virtual scenarios. This means that while a person is practicing walking in XR, they are also exercising their brain, for example, remembering a route, recognizing virtual objects, or making decisions (stop or go, turn left or right, etc.).

Such **dual-task exercises** can improve executive functions (like planning, attention, and inhibition) in people with dementia. Immersive VR programs for gait often incorporate memory or attention challenges to mimic real-life walking situations (like encountering an obstacle or answering a question while walking), thereby training the brain to handle multiple tasks. A systematic review of VR interventions in Alzheimer's disease found that most studies targeted both **cognitive and physical functions**, and the main finding was that VR interventions helped improve cognitive performance and balance in patients with AD. In other words, the virtual exercises sharpened the mind at the same time as they trained the body.

Moreover, emerging research suggests that VR and other interactive technologies can have direct cognitive benefits beyond what traditional paper-and-pencil exercises yield. For instance, VR cognitive training has shown improvements in specific domains like visuospatial skills and even reduced apathy (loss of initiative) in people with mild cognitive impairment. VR-based reminiscence activities (such as virtually "revisiting" a hometown or a meaningful place) have been demonstrated to increase pleasure and help maintain cognitive performance in older adults. All these findings indicate that using technology in cognitive care is not just a flashy addition; it can genuinely engage neural circuits and possibly slow cognitive decline when used appropriately.

Memory and thinking abilities also benefit from a healthy lifestyle. Physical exercise has cognitive benefits, as exercise increases blood flow to the brain and promotes neuroplasticity (the brain's ability to form new connections). Proper nutrition, especially diets like the **Mediterranean diet** rich in vegetables, healthy fats, and antioxidants, has been linked to better brain health and slower cognitive decline. Good sleep is another often-overlooked factor; poor sleep can worsen confusion and memory, so supporting good sleep hygiene (like maintaining a regular sleep schedule and a calm nighttime routine) is part of holistic cognitive care.

One key principle is to always see **behavior as communication**. When a person with dementia becomes agitated or upset, it may be because

an underlying need is not met or they are overwhelmed by something.

By adopting a compassionate, problem-solving attitude (sometimes described as being a “dementia detective”), caregivers can try to identify triggers of distress, such as pain, loneliness, boredom, or a confusing situation, and address them, rather than just suppressing the behavior. This person-centered approach greatly improves emotional outcomes and can reduce the frequency of challenging behaviors over time.

Non-pharmacological therapies are very effective in boosting mood and reducing anxiety. For example, **music therapy** is widely used: familiar music can evoke positive feelings and memories, even in advanced dementia. Research shows that regular music therapy sessions can reduce agitation and depression and improve overall behavioral symptoms. Singing old songs or listening to a personalized playlist often brings joy and can even enhance communication (someone who struggles to speak may still be able to sing along to a known tune). **Art therapy** (painting, drawing, crafting) provides a creative outlet for emotions and can lessen anxiety and apathy by giving a sense of achievement and self-expression. Other approaches like **pet therapy** (interacting with animals), **aromatherapy**, or simply spending time outdoors in nature have shown calming effects and help alleviate stress for people with dementia.

In recent years, XR technologies have opened new avenues to support emotional well-being. Virtual reality experiences can be designed specifically to reduce stress and spark positive emotions. For instance, an XR application might allow a person with dementia to “visit” a calming beach, a beautiful forest, or a favorite city from their past, all from the safety of their home or care facility. Introducing VR experiences in care facilities where residents took immersive virtual trips to familiar places (like a seaside town they loved in younger years) **triggered positive memories and significantly reduced feelings of isolation or confusion** during and after the sessions. By virtually transporting them to comforting environments, VR can provide a form of escapism and enjoyment that improves mood. Likewise, VR-based

reminiscence therapy has been found to enhance well-being; for example, in a study, elderly patients who engaged in VR reminiscence showed increased pleasure and maintained cognitive function better than those who did not.

Beyond reminiscence, XR can also make exercises more fun and game-like, which increases the user's **motivation and reduces apathy**. Enjoyment is not a trivial matter; when a person looks forward to an activity, it can counteract depression and apathy. One review noted that older adults doing VR exercises often experience increased energy and a sense of tranquility, along with less negative emotion; essentially, they have fun and feel more relaxed afterwards. Additionally, the immersive nature of XR might help distract from pain or discomfort, providing some relief and improving emotional state during therapy.

An important aspect of emotional care is **communication**, how we speak to and interact with people with dementia. Using a calm, reassuring tone, maintaining eye contact, and being patient while they search for words can all help the person feel respected and less anxious. Validating their feelings (even if they are confused about facts) and offering reassurance goes a long way. In a holistic approach, every interaction is seen as an opportunity to provide emotional support. For example, if during an XR gait session the person becomes anxious about the virtual scenario ("This looks dangerous" or "I'm afraid of falling"), the caregiver or trainer should pause, acknowledge the fear, and perhaps adjust the difficulty or offer encouragement: "You're safe, I'm right here with you, and we can stop whenever you want." Handling these moments with empathy strengthens the person's emotional security and trust.

Finally, we cannot forget **mental health** in terms of clinical issues like depression or anxiety disorders, which can co-occur with dementia. A holistic approach means involving appropriate professionals (doctors, psychologists) to evaluate and treat these conditions. Sometimes counseling or medication may be needed for depression or severe

anxiety, these should be integrated into the care plan as part of the whole-person approach, alongside lifestyle and environmental interventions.

Environmental Adaptations and Safety

The environment in which a person with dementia lives and trains is another crucial dimension of holistic care. Dementia can alter how individuals perceive and navigate their surroundings—changes in depth perception, vision, or hearing are common, and confusion can be worsened by complex or unfamiliar settings. Thus, adapting the **physical environment** to be dementia-friendly can greatly enhance independence, reduce anxiety, and prevent accidents. A well-designed environment is actually a form of non-pharmacological intervention: it can cue the person to function better and feel calmer without anyone saying a word.

Key principles of a dementia-friendly environment include **simplicity, safety, and familiarity.** For instance, ensuring good lighting and high contrast can help a person see and recognize objects and hazards (many older adults with dementia have better function in bright, evenly lit rooms with minimal glare). Placing clear signs or pictures on doors (like a bathroom sign or a photo on their bedroom door) supports memory and orientation. Reducing clutter is critical; a cluttered space can be overwhelming and can also increase fall risk. In fact, one study in care homes found that **residents had fewer falls and were less agitated after improvements such as better lighting, reduced clutter, and easier-to-navigate layouts were made**. Simple modifications at home, like removing loose rugs, installing grab bars in the bathroom, and keeping walkways clear, can prevent falls and injuries, addressing the physical safety aspect.

Another aspect is managing **sensory stimulation**. Too much background noise (like a TV blaring or several conversations at once) can confuse and upset someone with dementia. Creating a quieter, calm environment (perhaps using soft music or familiar sounds instead of jarring noise) can help them stay oriented and relaxed. Scent and touch are also considerations: sometimes strong smells or uncomfortable furniture can

cause distress without us realizing it. A holistic approach means we pay attention to these details, perhaps choosing a soothing lavender scent if they enjoy it or providing a variety of textures (like a soft blanket or a “fidget” activity cushion) for sensory engagement.

Familiarity and personalization of the environment are comforting. Keeping personal mementos, family photos, and beloved items around can ground a person in their own life story. In care facilities that embrace holistic care, you often see rooms decorated with a resident’s own furniture and photos, and memory boxes by the door with objects from their past. This isn’t just decoration, it’s a therapeutic tool that can spark recognition and a sense of security.

It’s also worth mentioning **technology in the physical environment**: smart home devices, sensors, and assistive tech can support dementia care. Things like automatic stove shut-off devices, GPS trackers (for those who may wander), or reminder alarms are part of a holistic strategy to keep the person safe while respecting their autonomy.

Finally, **consistency between the training environment and home environment** is important. If a person practices walking and balance in a quiet clinic room, but their home is crowded and chaotic, the benefits might not carry over. Holistic care encourages us to prepare the home to reinforce what’s learned in training. For gait training, that could mean setting up a small exercise space at home or ensuring floors are safe so they can continue to practice walking exercises without hazards.

By thoughtfully adapting the environment, you enable the person with dementia to function at their best and reduce a lot of needless stress, for both of you. A supportive environment is like an unseen caregiver that works 24/7 in the background, making daily life smoother and safer.

Conclusion

In summary, a holistic approach to dementia care means caring for the whole person, attending to their physical health, stimulating their mind, supporting their emotional needs, fostering social connections, and shaping the environment around them for success. In this chapter, you learned that each of these dimensions is interconnected. Physical interventions like gait training can enhance cognitive function and social opportunities; cognitive stimulation and meaningful engagement can uplift mood; emotional support reduces behavioral issues; social involvement strengthens identity and happiness; and a well-designed environment underpins everything by enabling safety and independence. By integrating these aspects, we move beyond just managing symptoms, aiming instead to maximize quality of life and dignity for people living with dementia.

Are you a caregiver? Here are some tips and recommendations

- A holistic approach is also highly relevant for you. It means considering all aspects of your loved one's life, not just their memory problems, but also their physical health, feelings, social
- You can support the physical well-being of a person with dementia by encouraging safe daily movement and exercises. Your encouragement can make exercise a positive, enjoyable routine, rather than a chore. And remember, even small improvements in physical ability are victories that enhance their independence and confidence.
- Try to make cognitive stimulation part of the daily routine. Always celebrate their successes in these tasks, no matter how small.
- Keeping the mind active, in a stress-free and fun way, can help your loved one feel more competent and engaged, which is rewarding for both of you.
- Supporting the emotional well-being of your loved one is one of the most meaningful roles you have. Try to maintain a daily routine that includes moments of enjoyment: maybe a short walk in the garden, listening to music together, or having a cup of tea and chatting (even if the conversation is simple). If you notice certain things that upset them (for example, loud noises or too many people at once) try to minimize those stressors. Conversely, identify what makes them light up (a certain song,

- a favorite dessert, or a visit from a grandchild) and incorporate those into their week. Use touch and affection if they are comfortable with it; a gentle hug or holding their hand can convey reassurance when words fail.
- Take care of your own emotional health too. Don't hesitate to seek support for yourself, whether it's talking to a friend, joining a caregiver support group, or speaking with a counselor. When you are emotionally balanced, you'll be better able to create a positive emotional environment for your loved one.
- Staying socially connected is vital for your loved one and for you. Try to maintain regular social routines. When communication becomes difficult, remember that presence can be more important than words; sitting together, holding hands, or listening to music side by side is still a social connection. Also, involve your loved one in family decision-making and conversations as appropriate, so they don't feel overlooked. Even if they cannot answer everything, being included matters. And do not forget your own social needs: maintain your friendships and support network.
- Connecting with fellow caregivers (through support groups or online forums) can provide camaraderie and practical tips; people in similar situations truly understand what you're going through. In a holistic approach, your well-being is part of the equation too, because a healthy, supported caregiver can provide the best care.
- **You have the power to shape the environment to better suit your loved one's needs.** Start by taking a critical look around the home through their eyes. Are hallways and rooms well-lit, especially at night? Adding nightlights can help prevent disorientation if they get up in the dark. Are frequently used items easy to find? Perhaps label drawers and cupboards with words or pictures (e.g., put a photo of a spoon on the cutlery drawer) so they can independently find things. Fewer obstacles and a clear purpose for each space (dining area for eating, living room for relaxing) help reduce confusion. Create safe walking paths inside the house (remove loose wires, secure carpets) so they can move around confidently. If they use an assistive device like a walker, ensure furniture is arranged to

- to allow it through. You can also set up a memory corner or table with family photos and familiar objects that they can look at and touch; this often brings comfort and can be a conversation starter.
- Keep a routine with the environment, for example, setting the table the same way each meal or keeping personal care items (comb, toothbrush) in a consistent spot in the bathroom—these environmental cues support their memory and independence. Lastly, don't overlook outdoor spaces: if possible, make a safe area outdoors (a bench in the garden, or a porch with a gate) where they can enjoy fresh air without risk of wandering off. Many caregivers find that a secured yard or even a sensory garden (with nice smells and tactile plants) can be a calming retreat for a person with dementia.

Inclusive and person-centered communication

Inclusive and person-centered communication focuses on respecting individual needs and perspectives to ensure everyone feels valued and understood. It involves tailoring communication methods to individual preferences, actively listening to understand their unique context, and fostering a collaborative and respectful environment. This approach is crucial for effective communication in diverse settings, promoting equity, and fostering understanding and belonging.

The following sections outline how these principles can be applied in practice, starting with individuals living with Mild Cognitive Impairment (MCI).

Inclusive and person-centered communication for MCI

Individuals with Mild Cognitive Impairment often face significant challenges, including memory deficits, language impairments, and reduced attention span. These cognitive limitations can substantially hinder their ability to effectively communicate their needs and concerns. In order to make the communication process inclusive and more person-centered for both the individual with MCI and healthcare professionals, we need to adapt communication strategies to ensure clarity, understanding, and respect. This includes using simple language, clear and slow speech, and providing sufficient time for processing and response. Nonverbal cues like eye contact, gestures, and active listening are also crucial.

Verbal communication strategies

Short sentences and simple language

- Use simple and clear language, with a calm and gentle tone
- Avoid using medical jargon and technical terms
- Example: Instead of asking “Do you have any concerns about your medication regimen?” prefer using a simpler phrasing “Do you have any questions about your medicine?”

Speaking slowly and clearly

- Speaking slowly and clearly allows the patient more time to process each word and sentence, reducing the likelihood of misunderstanding
- It can also reduce anxiety and frustration, allowing patients to respond more confidently

Repetition and rephrasing

- By repeating key points and instructions, you can reinforce important information, thereby enhancing the patient's understanding
- By rephrasing the same information using different words you can enhance clarity and aid in comprehension
- Example: After explaining a medication schedule, you might say, "So, you will take this pill every morning," and then, later confirm, "Remember to take this medication every day when you wake up."

Allowing extra time for responses

- You should provide sufficient time for the individual to process questions and provide answers
- You should be patient and allow a comfortable pause before giving a reply, to facilitate more productive exchanges

Nonverbal communication strategies

Nonverbal communication is the exchange of information without the use of words or spoken language. This form of communication primarily relies on body language, including facial expressions, eye contact, gestures, posture, and touch. This form of communication provides a means to express complex emotions and maintain connections between people.

Eye contact

- Maintain appropriate eye contact. It helps in gaining the patient's attention, conveying respect, interest, and empathy and demonstrating active listening
- It can also provide reassurance and a sense of connection
- It is important to avoid intense staring. It might be perceived as confrontational or distressing. Use short and gentle glances

Facial expressions

You should be mindful of your facial expressions, as they can significantly impact the patient's emotional state and willingness to engage in communication. A warm and friendly expression can help in easing anxiety and building trust with the patient.

- Smiling, can create a positive environment and make patients feel more comfortable
- **Avoid** frowning or showing impatience as they can increase stress and confusion in patients

Gestures

Simple and clear gestures can complement verbal communication and can emphasize key points and keep the patient engaged

- Pointing to objects or using hand movements to illustrate actions can be helpful, especially when verbal instructions are misunderstood
- Gestures should be **deliberate and gentle** to avoid startling the patient

Body posture

Maintaining an open and relaxed body posture can create a welcoming atmosphere

- Leaning slightly forward
- Maintaining a comfortable distance and aligning yourself at the person's eye level can help reduce intimidation and promote a sense of connection
- Avoid crossing arms or turning away. It can be interpreted as disinterest or frustration

Appropriate touch

- Simple actions like holding a patient's hand or a light touch on the shoulder can be reassuring and may help calm agitated patients
- You should be mindful of patient boundaries and cultural differences regarding touch, seeking permission and carefully observing the patient's comfort level

Active listening

Active listening is especially important for cognitively impaired individuals, as it helps them feel heard and valued

- Maintaining a comfortable distance and aligning yourself at the person's eye level can help reduce intimidation and promote a sense of connection
- **Avoid** crossing arms or turning away. It can be interpreted as disinterest or frustration

Are you a caregiver? Here are some tips and recommendations.

Good communication is especially important when caring for a loved one with Mild Cognitive Impairment. It's not only about the words you use, but also about how you listen, your tone of voice, your body language, and the patience you show. This section will give you simple, everyday strategies to make conversations clearer, reduce frustration, and create a stronger sense of connection. By using these approaches, you can make your loved one feel more understood and supported, while also making your caregiving role easier and more rewarding.

- Keep it simple: Use short sentences and familiar words.
  - Instead of: "Do you have any concerns about your medication regimen?"
  - Say: "Do you have any questions about your medicine?"
- **Speak slowly and gently:** Give your loved one more time to process what you say.
  - Example: Pause after each sentence instead of speaking continuously.
- Repeat if needed: If they forget, calmly repeat or rephrase the same message.
  - Example: After saying "Take this pill every morning," later add, "Remember, you take it when you wake up."
- Use your body language: Smile, nod, and use hand gestures to support your words.
  - Example: Point to a glass of water while asking, "Would you like some water?"
- Give them space to respond: Don't rush or finish their sentences.
  - Example: If they pause after a question, wait patiently for their reply.
- Stay warm and positive: A gentle tone, eye contact, and a relaxed posture help them feel safe and respected.
  - Example: Sit at their eye level instead of standing over them.
- Use touch carefully: A light touch on the hand or shoulder can be reassuring—but always notice if it makes them uncomfortable.

Inclusive and person-centered communication for Dementia

Inclusive and person-centered communication is a cornerstone of effective dementia care. It emphasizes **respect, empathy, and understanding** of the individual's unique needs, preferences, and cultural background. This approach ensures that communication is not only functional but also affirming and empowering for the individual.

While many strategies used for individuals with Mild Cognitive Impairment (MCI) are also effective in dementia, the more complex and severe symptoms require additional adaptation and sensitivity.

Key Principles:

- **Respect for identity:** Always address individuals by their preferred name and title, and acknowledge their life history and values. For example, using a person's chosen form of address ("Mr. Smith" rather than a first name) can reinforce dignity and familiarity.
- **Active listening:** Allow extended time for responses and avoid interrupting or correcting unnecessarily, even if the person struggles to express themselves. Gentle prompts and patience can reduce frustration and build trust.
- **Simple and clear language:** Use short sentences, plain words, and avoid jargon. Pair verbal instructions with visual or physical cues — for instance, pointing to a glass of water when suggesting, "Would you like a drink?"
- **Non-verbal communication:** Maintain warm eye contact, open body posture, and supportive gestures. Smiling or nodding can help convey reassurance even when verbal comprehension is limited.
- **Cultural and linguistic inclusivity:** Respect language preferences and cultural norms. Use interpreters, translated resources, or culturally relevant examples where needed to support understanding.
- **Accessible materials:** Provide written information in plain language and large print. Where possible, offer alternative formats such as audio recordings or digital versions compatible with screen readers.

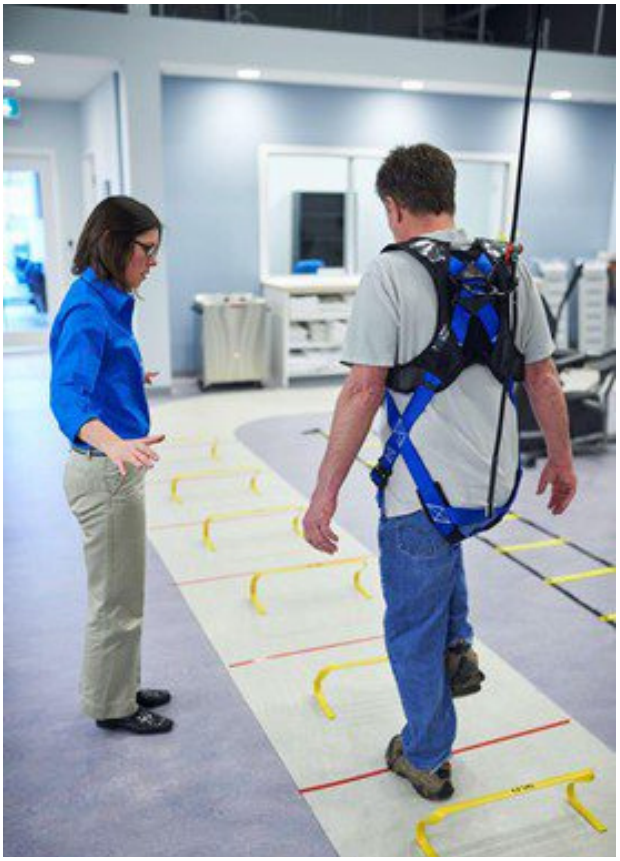
Are you a caregiver? Here are some tips and recommendations.

Caring for someone with dementia can feel challenging at times, especially when communication becomes more difficult. Remember, it's not just about exchanging information, but about creating moments of connection, reassurance, and dignity. By using simple strategies every day, you can make your loved one feel safer, calmer, and more understood. These approaches also make your role as a caregiver easier and more rewarding.

- Keep it simple: Use short, clear sentences and avoid complicated explanations.
  - Say: "Let's have lunch now," instead of "Would you like to go and prepare some food in the kitchen with me?"
- Validate feelings, not just facts: If your loved one says something untrue, don't argue — focus on how they feel.
  - Example: If they say, "I need to go to work," you can answer, "Tell me about your job" rather than correcting them.
- **Use body language:** Smiles, nods, and gentle gestures often communicate more than words.
  - Example: Point to a chair while saying, "Let's sit down together."
- Allow extra time: Don't rush. Give them space to find their words and respond at their own pace.
- Create a calm atmosphere: Reduce background noise, sit at their eye level, and keep your tone gentle.
- Use familiar objects or cues: Showing a cup when asking "Would you like some tea?" can help understanding.
- Offer gentle touch when appropriate: Holding hands or a light touch on the shoulder can be very reassuring — but always watch their comfort and respect personal boundaries.

3. FALL PREVENTION STRATEGIES

Learning outcomes



1. **Identify and assess fall risk factors:** You will be able to recognize factors that increase the likelihood of falls, including physical limitations, environmental hazards and behavioural risks.
2. **Understand environmental hazards:** You will be able to identify potential hazards in domestic and extra-domestic environments, such as clutter, uneven surfaces, and inadequate lighting.
3. Implement injury reduction strategies: You will be able to implement strategies to reduce the risk of falls and injuries, such as promoting safe movement, using assistive devices, and providing appropriate supervision.
4. Communicate effectively about fall risks: You will be able to effectively communicate with patients, families and other professionals about fall risks and preventative measures.
5. Promote a safe environment: You will be able to contribute to a culture of safety, emphasizing the importance of fall prevention.
6. **Evaluate and adapt strategies:** You will be able to evaluate the effectiveness of fall prevention strategies and adapt them based on individual needs and circumstances.
7. **Utilize appropriate resources and tools:** You will be aware of available resources and tools for fall prevention, such as risk assessment tools and educational materials.

Introduction

In order to implement both mental and physical actions aimed at preventing the risk of falls among older adults, it is essential to analyze which factors may hinder or support this goal. This understanding is especially important to provide caregivers, professionals, and older individuals themselves with useful and practical guidance that can be applied in everyday life often through small, mindful adjustments.

In particular, age-related changes, cognitive impairments such as Mild Cognitive Impairment (MCI) or dementia, and environmental challenges can significantly increase the risk of falls. For this reason, a preventive approach must include personalized strategies, continuous observation, and clear communication among all those involved in the care process.

Fall risk factors

People over 65 could be exposed to a greater risk of falling, due to various factors such as **physical impediments** (like reduced muscle mass and strength, decreased flexibility and mobility, impaired balance and coordination, diminished cardiovascular and respiratory function), **risky behaviors** not considered as dangerous (such as compulsive hoarding, climbing on chairs, doing heavy housework, but also reluctance to seek help and social isolation), and **no longer adequate environments** (like presence of stairs, lack of grab bars, inadequate lighting, cluttered pathways, poorly designed bathrooms). Moreover, if we deal with a person with Mild Cognitive Impairment (MCI) or Mild Dementia it is important to remember that a common feature of the various forms of Dementia is the progressive decline in cognitive functions that can involve, in varying combinations, different domains (such as memory, attention, visuospatial functions, executive functions, language) and be associated with a variety of psychobehavioral disorders.

Potential hazards in domestic and extra-domestic environments

Even if seniors are at home and feel safe because they're familiar with it, caution is very important for fall prevention, as physical, mental, and emotional abilities may have changed with age. Therefore, some things

they've always done may no longer be as safe as expected. In fact, conditions like Dementia can impact seniors' ability to manage their daily life, navigate their home safely and recognize potential hazards.

Strategies to reduce the risk of falls

Ask for help and use precautions

From a preventative perspective, it is essential that the person with Mild Dementia or MCI can openly talk to family members, caregivers and professionals about the risk of falling. The person should not feel judged and should not be afraid to ask for help from those around.

Among the precautions a person should take:

- Always turn on the light when there's poor lighting, in particular at night;
- Make sure the bed allows the person to rest feet on the floor;
- Sit the person for a few moments before standing, and make him/her get up slowly;
- Before walking, make sure the person feel confident and that is not dizzy;
- Avoid using rugs and mats in the bedroom and living room; if necessary, use only thin, non-slip rugs in the kitchen and bathroom; use grab bars for the bathroom and shower/tub chairs;
- Position cables and extension cords so they don't obstruct walkways;
- Eliminate barriers and arrange objects and furnishings so they don't create obstacles.

In general, make sure that the person has a clear path while moving, to avoid tripping over furniture (e.g. chairs, wheelchairs, tables), equipment or electrical cables. Pay attention to be more careful if the elderly person lives with pets and young children.

Clothing and aids

Whether you are a professional or a caregiver, make sure that the person:

- Wears comfortable clothing, such as tracksuits and pajamas, that fits properly, and avoid clothing that could cause stumble;

- Wears closed, low-cut shoes with wide, non-slip soles;
- Always wears the glasses and hearing aids prescribed or recommended;
- Keep seniors hands free, making them using a small bag that allows to carry small necessary objects;
- If you realize that the person needs walking aids or environmental adaptations and doesn't have them yet, contact the doctor or healthcare professional who will be able to recommend the most appropriate ones;
- Remind the person to always use the recommended aids, such as a cane or walker, because they help moving around safely and avoiding falls.

Avoid risky activities

Furthermore, some activities that a person has always performed, may now be risky. It is important to always follow the specific instructions of healthcare professionals or doctors about what can and cannot be done to prevent the risk of falling. In particular older people with walking difficulties should NOT:

- Use armchairs and chairs with wheels that can move unexpectedly;
- Climbing ladders or chairs for activities around the house or in the garden;
- Get out of bed or wheelchair without feeling stable;
- Walk without aids or assistance if it is needed;
- Go to the bathroom alone without feeling stable;
- Lean out of bed or reach or bend over to grab distant objects.

Engage in activities and exercise

For seniors with Mild Dementia and/or walking issues, it's essential **to stay as active as possible**, performing daily activities, independently or with the help of someone close to them. Staying fit means choosing activities based on the physical and health status, such as walking, dancing, swimming, and activities in "safe gyms." Regular physical activity keeps seniors stronger, improves balance, ensures independence for longer and reduces the risk of falling. If possible, it is preferable to carry out activities with other people, because it is more stimulating.

Even if seniors are in a hospital, or in a senior care facility (always following the instructions of the healthcare staff and if there are no contraindications), it is important for them to stay as active as possible, participating in daily activities such as moving in bed, getting up, walking, washing, dressing and eating independently, based on their physical condition.

Among non-pharmacological treatments for people with Mild Cognitive Impairment (MCI), cognitive training interventions have proven effective in treating cognitive symptoms, while cognitive rehabilitation appears to be useful both in treating cognitive symptoms and maintaining independence. Participation in art and music therapy has also been shown to improve cognitive symptoms and reduce depressive and anxiety symptoms.

Participation in physical exercise interventions helps maintain independence, as does dance and ballet, which also appear to reduce depressive symptoms. Finally, participation in recreational activities (e.g., card games, board games) improves cognitive deficits and reduces depressive symptoms.

Communication and support in managing fall risk for people with demiantia

People with Dementia often have a complex clinical condition that must be considered in care planning. It is important that the person with Dementia be included in a care and support plan from the moment of diagnosis, to ensure the ability to plan future care. It is helpful to identify a person responsible for coordinating care to avoid communication difficulties between the professionals involved in the care.

Providing adequate information to family members or caregivers about available services and how to access them is crucial. People with Dementia and their family members, or caregivers, should be especially guided and supported in identifying where, from whom, and how to obtain information at every stage of the disease.

It is essential that family members or caregivers, and where possible, the person with Dementia, are involved in support interventions and throughout the decision-making process.

This involves agreeing and reviewing the care and support plan with them, establishing ways and times for updating and documenting changes in care goals and needs.

Caregivers are valuable resources not only for those receiving care, but also for all healthcare professionals, given their direct connection with them. The large amount of time they spend providing care allows them to gain intimate knowledge of the person they care for, enabling them to provide a wealth of potentially useful information. The physical and psychological burden and quality of life perceived by caregivers are important factors to monitor so that early intervention can be made to reduce the former and maintain the latter as high as possible, especially considering that caregivers of people with Dementia are at risk of depressive disorders. Caregivers can request guidance regarding the services they are entitled to and how to access them, such as a formal assessment of their needs, including their mental and physical health, short breaks, and other respite services. The World Health Organization has identified the development of support and training programs for caregivers and family members of people with Dementia as one of the priority actions to address Dementia.

Are you a caregiver? Here are some tips and recommendations.

Due to difficulty in walking, older people are often at risk of falling. Furthermore, falls can have much more serious consequences in older adults than in younger people, primarily resulting in broken femurs. Preventing falls at home often requires a few simple measures:

- Provide good lighting, especially during nights;
- Remove items that could cause tripping, keeping pathways clear and free of obstacles;
- Reduce the risk of slipping: remove rugs, make stairs safer by adding a handrail and kerbs to mark each step, use grab bars especially in the bathroom;
- Make the senior wear appropriate footwear: avoid flip-flops and slippers, preferring closed, lace-up shoes;

However, if, despite these precautions, the older person can still fall. In this case:

- Don't panic - stay calm and assess the situation;
- Check for injuries and/or pain;
- DO NOT let the elderly person get up;
- Call emergency numbers, leave the person on the ground, keep him/her warm with a blanket, and calmly wait for help to arrive.

Finally, after any fall, it is important to contact the family doctor to discuss the incident, determine the possible causes and decide together what are the best procedures to implement.

Conclusions

Fall prevention in older adults requires awareness, practical strategies, and a supportive environment. By identifying risk factors, adapting living spaces, encouraging safe behaviours, and involving caregivers, and healthcare professionals, it is possible to significantly reduce fall risks and promote autonomy and wellbeing in daily life.

A multidisciplinary and person-centred approach is key, especially in the presence of cognitive impairments. Combining physical activity, environmental adjustments, and effective communication helps build a safer, more inclusive care setting where older adults can remain active, independent, and protected from avoidable harm.

4. GAIT ASSESSMENT TOOL

Introduction

Gait disturbances are common in people with mild to moderate dementia, contributing significantly to the risk of falls. Valid reliable assessment of gait is essential both to stratify fall risk, monitor progression, and guide rehabilitation. This chapter presents proposed tools and protocols for gait assessment, particularly in European/Danish settings.

Gait disturbances in dementia are not just slower walking speed but often include increased variability in step length or timing, impaired turning, difficulty with dual-task walking (walking while doing another task), and reduced adaptivity to changes in environment. These disturbances often precede more obvious functional decline and can serve as early indicators of risk. Recent research suggests that gait features such as step parameters extracted during TUG (Timed Up and Go) tests or dual-task versions can discriminate between people with Subjective Cognitive Impairment (SCI), Mild Cognitive Impairment (MCI) and dementia.

Learning Outcomes

By the end of this chapter, you will be able to:

1. Explain why gait assessment is important in people with dementia.
2. Identify validated tools commonly used in Denmark and Europe (e.g., gait speed, TUG, SPPB).
3. Conduct basic gait and balance assessments safely in people with cognitive impairment.
4. Interpret gait assessment results and use them to guide rehabilitation planning.
5. Recognize the limitations of gait assessment tools when applied to individuals with dementia.

Background

- Dementia is associated with impaired physical performance, mobility limitations, and higher incidence of falls. Multiple guidelines (e.g., World Falls Guidelines) emphasise gait and balance assessment as core components of multifactorial fall-risk assessment.
- Early recognition of gait decline allows timely intervention (strength, balance training, environmental modifications).
- Slow gait speed is not only a risk for falls; it also predicts future dementia, mortality, and poorer functional outcomes, even after controlling for cognitive function and brain imaging markers.
- Guidelines such as the World Guidelines for Falls Prevention and Management (2022) give gait speed a high recommendation (GRADE 1A) for predicting falls risk; TUG is also recommended though with slightly less consistent evidence.

Assessment Tools and Measures

Assessment of gait and balance in people living with dementia is a fundamental component of fall-risk evaluation, functional monitoring, and rehabilitation planning. Because cognitive impairment can influence motor performance, particularly tasks requiring attention, sequencing, or divided focus, clinicians must select tools that are both feasible and sensitive to the unique needs of this population. A structured and dementia-appropriate assessment enables the identification of subtle mobility changes, supports early intervention, and enhances the safety and effectiveness of care.

This chapter provides an overview of the most commonly used gait and balance measures in clinical practice—including gait speed, the Timed Up and Go (TUG), the Short Physical Performance Battery (SPPB), the Chair Stand Test, and the Berg Balance Scale (BBS)—highlighting their clinical utility, strengths, and limitations when applied to individuals with cognitive impairment. Complementary approaches such as dual-task assessments and instrumented or wearable-based measures are also introduced, as they can offer additional insights into gait variability, turning, and divided-attention capacity.

In addition to describing the tools themselves, the chapter outlines a standardized assessment protocol designed to promote safety, consistency, and reliability of measurement. Key steps include adequate preparation of the environment, tailored communication and demonstration of tasks, careful selection of appropriate measures, and systematic interpretation of results. Regular reassessment is emphasized to track change over time and to inform individualized rehabilitation strategies.

Together, these tools and procedures provide clinicians with a practical, evidence-based framework for evaluating mobility and fall risk in people with dementia, ensuring that assessments are both meaningful and actionable within everyday clinical practice.

Tool / Measure	Description	Advantages	Limitations / Considerations in Dementia
Gait Speed	Measure of walking speed over a short distance (e.g., 4 m, 6 m).	Simple, quick, validated; recommended in WFG; < 0.8 m/s often indicates higher risk. (PMC)	May be affected by attention, motivation; requires safe environment.
Timed Up and Go (TUG)	Time to stand up from a seated position, walk 3 m, turn, walk back, sit down.	Good test of transitions, turning; widely used.	Cognitive load (e.g., remembering instructions) may affect validity in moderate dementia. Needs supervision.

Short Physical Performance Battery (SPPB)	Battery including gait speed, sit-to-stand, balance; gives composite score.	Broad assessment; can detect subtle impairments; tracks change over time.	Time-consuming; balance components may be difficult for those with more advanced disease.
Chair Stand Test	Repeated sit-to-stand in specified time or number.	Measures lower limb strength; complementary to balance/gait.	May be unsafe if strength is low; risk of fatigue or falls.
Berg Balance Scale (BBS)	14-item scale assessing static and dynamic balance tasks.	Detailed, well-validated in older populations.	Administration requires training; cognitive impairment may affect performance (following multi-step tasks).

Protocol for Assesment

1. **Pre-Assessment Preparation**
   - Ensure safe environment free of trip hazards
   - Use familiar footwear and assistive devices if usually used
   - Explain tests clearly, possibly with demonstration
2. **Baseline Assessment**
   - Record demographic data, dementia subtype, disease stage
   - Assess comorbidities that affect gait (vision, hearing, medications, musculoskeletal issues)
   - Choose at least gait speed + one balance/transitional measure (e.g., TUG)

3. **Test Execution**
    - Gait speed: walk at normal pace, over flat unobstructed path; average of two trials
    - TUG: timed, instruction standardised; ensure clear route, chair stable
    - SPPB / BBS etc., as appropriate
4. **Interpretation**
    - Gait speed < 0.8 m/s as marker of higher risk (per World Falls Guidelines)
    - Compare with normative data for age / country when available
    - Consider variability, walking aids, dual-task performance (if feasible)
5. **Follow-Up / Monitoring**
    - Re-assess periodically (e.g., every 3–6 months) to detect decline or improvement
    - Use results to guide individualized intervention (balance training, physical therapy etc.)

Key Takeaways

- Gait speed and TUG are essential, practical components; more comprehensive tools (SPPB, BBS) when capacity allows.
- Assessments must be adapted to cognitive impairments (clear instructions, safe environment).
- Regular monitoring is crucial.
- Dual-task performance (like dual-task TUG) can uncover deficits not seen in single tasks and may predict conversion from MCI/SCI to dementia.
- Spatiotemporal parameters (step length, variability, turning performance) are promising markers for differentiating cognitive stages.

Are you a caregiver? Here are some tips and recommendations.

- Observe walking and balance regularly at home, noting any changes or increased instability.
- Ensure safe surroundings: remove loose rugs, secure cables, improve lighting.
- Encourage the use of walking aids if prescribed and remind the person to use them consistently.
- Support exercise routines prescribed by physiotherapists; short, frequent sessions are often better tolerated.
- Accompany the person to medical appointments and share observations about mobility changes with healthcare professionals

Conclusions

Gait assessment provides critical insights into fall risk and functional decline in people with dementia. Simple measures such as gait speed and TUG are practical and effective, while more comprehensive tools can be applied when capacity allows. Regular reassessment enables monitoring of changes and adjustment of interventions. For reliable results, assessments must be adapted to cognitive abilities, with clear instructions, demonstrations, and safe environments.

The use of dual-task assessments and instrumented measures can increase sensitivity and predictive ability for fall risk and possible cognitive decline, and interventions targeting gait (speed, stability, turning, dual-task capacity) can reduce fall incidence and improve mobility, even in dementia. Some studies (e.g. dance/tango interventions) show improvements in gait speed and functional mobility.

5. GAIT TRAINING

Training adaptations for individuals with cognitive impairments

Individuals living with cognitive impairments such as Mild Cognitive Impairment (MCI) or dementia may experience challenges with memory, attention, problem-solving, and executive functioning. These difficulties can affect their ability to follow instructions, learn new tasks, and stay engaged during training sessions. For this reason, gait training and fall prevention programs must be adapted to their specific needs to ensure safety, maximize participation, and achieve meaningful outcomes.

This section outlines general training adaptations for individuals with cognitive impairments, emphasizing strategies that enhance safety, participation, and learning. In addition, examples are provided to illustrate how Extended Reality (XR) technologies can be integrated into these practices to further support engagement and effectiveness.

Training Adaptations

1. Simplified and Structured Instructions

- Use short, step-by-step directions with clear demonstrations.
- Example: Instead of “Walk to the end of the hallway and turn left into the therapy room,” say “Let’s walk to that chair” while pointing to the target.

2. Repetition and Consistency

- Conduct regular, repeated practice sessions to reinforce learning.

- Example: Begin each session with the same warm-up routine (sit-to-stand) so it becomes automatic

3. Task-Specific Training

- Prioritize functional movements like sit-to-stand, turning, or walking short distances.
- Example: Practicing rising from a chair safely or walking to the bathroom mirrors real-life tasks.

4. Dual-task Training

- Incorporate cognitive tasks during walking to strengthen executive function.
- Example: Ask the person to count steps out loud or name animals while walking.

5. Cueing Techniques

- Use visual, auditory, or tactile prompts to guide movement.
- Example: Colored tape on the floor for step length, rhythmic clapping or metronome for pacing.

6. Multi-sensory and Multimodal Approaches

- Combine movement with music, dance, Tai Chi, or VR exercises.
- Example: Encourage walking to music or practicing balance through slow Tai Chi postures.

7. Short, Focused Sessions

- Keep training sessions between 15–30 minutes with breaks.
- Example: Divide a longer therapy program into three shorter sessions spread throughout the day.

8. Individualization and Progression

- Adapt difficulty and intensity to the person's stage of impairment and physical ability.
- Example: Start with walking 5 meters with support, progressing gradually to longer distances without assistance.

9. Safe Environment and Supervision

- Provide a quiet, familiar, and hazard-free space with supervision.
- Example: Remove clutter, use handrails, and avoid loud noises or interruptions.

10. Motivation and Engagement

- Use enjoyable, familiar, or meaningful activities to increase adherence.
- Example: Walking in a favorite garden, dancing to familiar music, or integrating culturally meaningful routines.

Are you a caregiver? Here are some tips and recommendations.

Supporting a loved one with MCI or dementia during physical training can feel challenging, especially when memory, attention, or confidence make exercises harder. Remember, you don't need medical training to make a big difference. Small adjustments, patience, and encouragement can help your loved one stay safe, active, and motivated. The following tips give you simple, practical ways to support gait training at home.

Tips for Caregivers: Helping with Gait Training

- **Keep it short and simple:** Practice for 10–15 minutes at a time and focus on one exercise.
  Example: "Let's stand up and sit down five times together."
- **Repeat routines often:** Doing the same exercises every day builds familiarity and confidence.
  Example: Always start with sit-to-stand before moving on to walking.
- **Show, don't just tell:** Demonstrate movements yourself or guide gently with your hand.
  Example: Stand up together rather than only giving instructions.
- **Use cues in the environment:** Simple prompts make exercises clearer. Example: Place colored tape on the floor to guide steps, or point to the chair where they should walk.
- **Turn it into something enjoyable:** Pair exercises with favorite music or make them into a game.
  Example: Walk together to a song with a steady beat, or step on pieces of paper as if they are "stepping stones."
- **Keep the space safe:** Remove clutter, close pets in another room, and make sure the floor is dry and clear.
- **Celebrate small wins:** Give positive feedback after each step.
  Example: "You walked all the way to the chair on your own — that was wonderful!".

Comparative overview

Although Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR) and Extended Reality (XR) share some similarities, each of them provides a different level of immersion, equipment requirements, and potential applications. Understanding these distinctions is essential when choosing the most suitable solution for gait training and rehabilitation.

The table below summarises their main features:

Technology	Description	Level of immersion	Typical devices	Application in gait training
Virtual Reality (VR)	Fully digital environment that replaces the real world.	100% immersive	VR headsets (e.g., Oculus, HTC Vive)	Safe simulation of outdoor walking, balance exercises, and practice of risky scenarios without real danger.
Augmented Reality (AR)	Digital elements are overlaid on the real world.	Low to medium	Smartphones, tablets, AR glasses	Gamification of exercises (e.g., following arrows, collecting virtual objects), training in familiar environments.
Mixed Reality (MR)	Real and digital elements coexist and interact in real time.	Medium to high	MR headsets (e.g., HoloLens)	Interactive training with virtual obstacles or companions that adapt to user's movements.
Extended Reality (XR)	Umbrella term covering VR, AR and MR.	Variable	All of the above	Flexible toolbox: allows professionals to choose the best option for each person's needs.

Conclusions

Immersive technologies such as Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR) and Extended Reality (XR) are no longer confined to the gaming or entertainment industry. They are now entering healthcare and rehabilitation, offering new opportunities to support older adults and people with cognitive impairments in safe, engaging, and effective ways.

- VR provides fully immersive environments that allow the rehearsal of real-life situations without risks.
- AR enriches the real world with digital layers, turning exercises into playful and motivating activities.
- MR goes a step further by enabling real and digital elements to coexist and interact, making training more dynamic.
- XR serves as the umbrella concept, giving professionals a flexible “toolbox” to select the most appropriate solution.

For gait training and fall prevention, these technologies can enhance both physical practice and cognitive stimulation. By integrating gamification and interactivity, they also address one of the most significant challenges in rehabilitation: maintaining motivation and adherence over time.

Ultimately, these tools should be seen as complements to human care, not substitutes. When used thoughtfully by professionals and carers, VR, AR, MR and XR can contribute to more person-centred, enjoyable, and effective rehabilitation programmes.

6. POST-FALL REHABILITATION PROTOCOLS

Introduction

Following a fall, particularly in people with dementia, rehabilitation is critical not only to recover physical function but also to prevent subsequent falls and additional decline. Post-fall rehabilitation must consider both physical impairments and cognitive/emotional sequelae.

People with dementia often have slower or incomplete recovery after a fall, compared to cognitively healthy older adults. This is due to the interplay of physical injury, reduced mobility, cognitive deficits (e.g. attention, executive function), emotional consequences such as fear of falling, and sometimes comorbidities like delirium. Evidence from service-organisation studies shows that dementia limits recovery unless rehabilitation is tailored.

Dual-task deficits (walking while doing another cognitive task) tend to worsen after falls, and post-fall rehabilitation that includes dual-task training may help.

Learning Outcomes

By the end of this chapter, you will be able to:

1. Understand the importance of post-fall rehabilitation in people with dementia.
2. Identify the essential components of a post-fall rehabilitation protocol (assessment, physical training, environmental changes).
3. Adapt rehabilitation strategies to the needs of people with cognitive impairment.
4. Recognize the role of caregivers, psychosocial support, and motivation in recovery.
5. Apply European and Danish guidelines to design safe, effective post-fall rehabilitation pathways.

Background

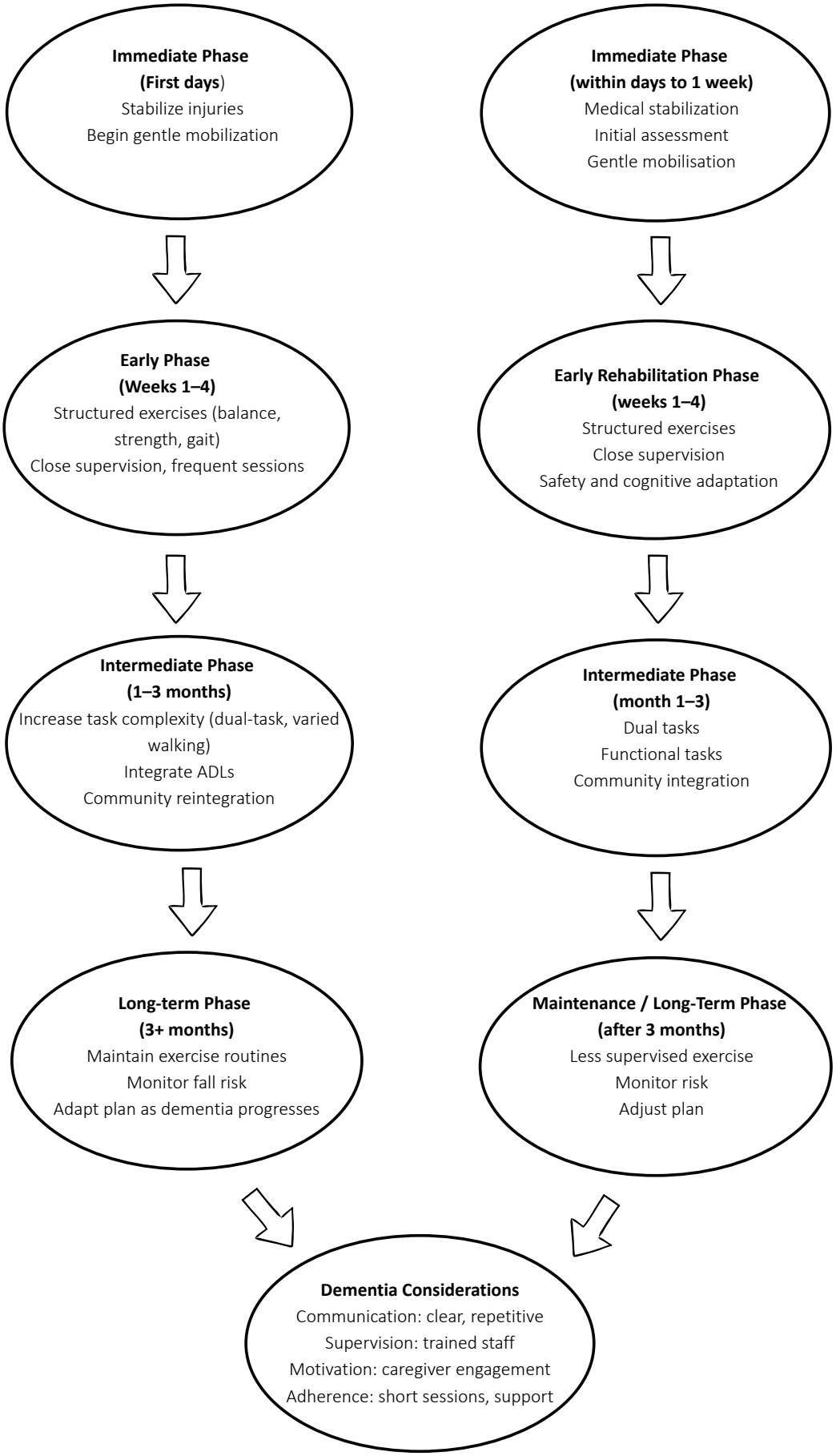
- Falls are frequent in dementia; recurrence risk is high. Each fall may lead to injury, reduced mobility, fear of falling, loss of confidence, and further decline.
- Additional evidence: A cohort study showed that individuals with dementia who fell more than twice in a year had faster cognitive decline than those with no falls.
- European guidelines (e.g. the World Falls Guidelines) recommend post-fall assessment and multifactorial interventions in care homes, hospitals, and community settings.
- Rehabilitation in dementia must adapt for cognitive impairment: issues with following instructions, motivation, dual-tasking, safety.

Components of a Post-Fall Rehabilitation Protocol

Component	Aim	Key Elements / Best Practices
Post-Fall Assessment	Identify causes, injuries, risk factors to tailor rehabilitation plan	Mechanism of fall; injuries; acute medical conditions; delirium; reassessment of gait, balance, vision, medications.
Individualized Physical Rehabilitation	Restore mobility, strength, balance, confidence	Strength training; balance exercises; gait training; progressive and supervised; integrate functional tasks (sit-to-stand, stair climbing)

Cognitive and Dual-Task Training	Address cognitive deficits, improve performance under challenge	Incorporate tasks combining walking with cognitive load; ensure simplified instructions; use cueing, repeated practice.
Environmental Modification	Reduce hazards that contributed to the fall	Review living space; remove trip hazards; improve lighting; assistive devices; consider flooring and footwear.
Medication Review	Remove or adjust medications increasing fall risk	Especially psychotropics, sedatives, cardiovascular medications causing orthostatic hypotension or dizziness.
Psychosocial Support	Address fear, anxiety, promoter engagement	Encourage social activities; caregiver involvement; education; monitor mood and behaviour changes.

Post-Fall Rehabilitation



Key Takeaways

- Post-fall rehabilitation must be holistic: physical, cognitive, environmental, psychosocial.
- Early, frequent, and progressively challenging rehab leads to better outcomes.
- For people with dementia special attention to safety, communication, and adaptation is essential.
- Dual-task training, and combined physical + cognitive interventions, have moderate evidence supporting their effectiveness in improving gait, balance, and cognition in dementia.
- Fear of falling or concerns about falling are important outcomes to target, since they affect the behavior, activity, and therefore risk of future falls.

Are you a caregiver? Here are some tips and recommendations.

- Stay calm and supportive after a fall; help the person regain confidence by encouraging gradual mobilisation.
- Work closely with physiotherapists and follow a home exercise programme carefully.
- Encourage participation in enjoyable, meaningful activities to keep motivation high.
- Monitor for signs of fear of falling, anxiety, or depression, and communicate these to healthcare providers.
- Adapt the home environment continually, based on professional recommendations to minimize risk of recurrent falls.

Conclusions

Post-fall rehabilitation in dementia must be holistic, combining physical therapy, cognitive adaptation, environmental modifications, and psychosocial support. Early and structured rehabilitation reduces the risk of recurrent falls and improves confidence, independence, and quality of life. Caregiver involvement is essential, both in supporting adherence to exercises and in maintaining a safe and motivating environment.

Emerging evidence supports dual-task training, exergaming, and cognitive-motor combined interventions for improving both physical functioning and reducing fall risk.

Rehabilitation protocols that tailor to the cognitive stage, using accommodations (simplified instructions, cueing, repetition) show better outcomes in dementia populations.

7. CONCLUSIONS AND RECOMMENDATIONS

Starting from an in-depth analysis of today's ageing society, analysing the challenges due to the aging population and the increase in dementia-related pathologies, and having conducted a wide analysis of the training needs among professionals from the different member countries of the project, this Educational Programme Manual has been able to provide theoretical and practical indications for the development of an innovative culture and a holistic approach to the care of seniors with mild dementia.

Since cognitive deterioration often involves walking problems and possible risks of falling with consequences that can be serious in terms of rehabilitation time and well-being of the elderly person, burden on the caregiver and increased need to resort to healthcare services, this Educational Programme Manual has the ambition to provide both professionals in the social and healthcare sectors, as well as caregivers, with knowledge and tools useful for improving their professionalism and specific skills.

The contents within this Manual, written in the most targeted yet accessible way possible, addressed topics such as: gait training, gait assessment, fall prevention strategies, rehabilitation protocols after falls, the opportunities offered by the latest digital tools available, the holistic approach to dementia care and the inclusive and person-centred communication.
These aspects were presented in a simple yet comprehensive and exhaustive manner, drawing on reliable and verified sources. Furthermore, we believe that the use of practical examples, case studies, and international best practices can represent an important added value.

At the conclusion of this Manual, we believe it is now essential to draw some conclusions and provide a summary of the latest recommendations addressed to both professionals and caregivers.

Are you a professional? Here are some final tips and recommendations.

Performing an holistic approach to dementia care, means considering all aspects of your patient's life, not just their memory or gait problems, but also their physical health, feelings, emotions, social interactions, and environment. All these aspects could play and important role in the healing process, making it easier or more difficult. The way you approach your patient can improve not only the quality of life of the person you care for, but also the one of his/her caregiver.

In this regard, it is important to remember that communication with the person affected by dementia or MCI, but also with the family members and caregivers, and with other professionals must be as effective as possible. It is important that communication, especially with family members and caregivers, is simple (trying to avoid too technical medical terms or accompanying them by explanations that do not take for granted), direct, accurate and not too hasty.

Caregivers may have less in-depth medical knowledge, but they know patients, their history, and their living environment better than you do. For the care and treatment process to be most effective, the caregiver must be your ally, and you must be able to work together for the well-being not only of the patient, but also for your personal and professional well-being and that of the caregiver involved.

The caregiver, if properly involved, is a resource that can provide you with useful information on the home environment, on the physical and mental state of the patient, he can help you facilitate communication with the patient and support the process by keeping the elderly person's motivation high.

Since nowadays on the one hand the population is aging, but on the other hand more and better supports are being created for the treatment of various pathologies, it is essential that the healthcare professional keeps himself updated, training and informing himself with respect to the new scientific developments and the possibility of taking advantage of new technologies made available.

In our context, several good practices and digital tools using Extended Reality (XR) technology have been presented, and we believe the added value could be the fact that they could be used not exclusively by professionals, but also by caregivers in the most accessible and sustainable way possible.

Are you a caregiver? Here are some tips and recommendations.

As a caregiver, you have a privileged perspective because you know the person, his/her story, and the environment where the person lives, much better than external healthcare professionals. Therefore, remember that your contribution is crucial in many respects. First, you have the opportunity to notice the first signs of gait issue (changes in walking speed, stride length, or balance).

You can therefore support the person by creating safe living environments (by removing tripping hazards, ensuring good lighting, and installing grab bars or handrails in bathrooms and stairways), encouraging physical activity and daily cognitive stimulation, promoting proper footwear and assistive devices, and facilitating communication and collaboration with specialized professionals.

Good communication is especially important when caring for a loved one with Mild Cognitive Impairment. It's not only about the words you use, but also about how you listen, your tone of voice, your body language, and the patience you show. Caring for someone with dementia can feel challenging at times, especially when communication becomes more difficult. Remember, it's not just about exchanging information, but about creating moments of connection, reassurance, and dignity. By using simple strategies every day, you can make your loved one feel safer, calmer, and more understood. These approaches also make your role as a caregiver easier and more rewarding.

Supporting a loved one with MCI or dementia during physical training can feel challenging, especially when memory, attention, or confidence make exercises harder.

Also remember that your role may involve not only physical but also psychological assistance, providing emotional support to the loved one you care for. In doing so, however, remember to educate yourself not only in terms of knowledge, skills, and attitudes, but also in taking care of your own personal well-being.

If, despite your attention, the elderly person falls, remember that it is essential to remain calm. After the event, working closely with healthcare professionals (like for example physiotherapists) the role of the caregiver is important to help the person regain confidence by encouraging gradual mobilisation and following a home exercise programme carefully. Caregivers could also encourage the participation in enjoyable, meaningful activities to keep motivation high, adapt the home environment based on professional recommendations to minimize risk of recurrent falls and monitor possible signs of fear of falling, anxiety, or depression, and communicate these to healthcare providers.

Conclusions

In concluding this Educational Programme Manual, we would like to gratefully thank all those professionals and experts who contributed to the revision of the contents to ensure the accessibility and the nice graphic design, to provide useful and interesting case studies and best practices all around Europe, and, last but not least, all the project partners of the GaitXR

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Whether you are a healthcare professional or an informal caregiver, we hope this Manual can serve as a starting point for truly creating innovative care that combines the humanity of a holistic approach with digital tools in order to improve the quality of life of people with dementia, alleviate caregivers' burdens, and enhance healthcare workers' specific skills.