LEVERAGING IMPLEMENTATION SCIENCE TO ADVANCE NON-PHARMACOLOGICAL DEMENTIA RESEARCH

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Gebruikmaken van implementatiewetenschap om niet-farmacologisch dementieonderzoek te bevorderen.

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CONTENTS

1

Introduction

INTRODUCTION

"It is impossible to address the large burden of global brain disorders unless radical change happens now. Such change should include the scaling up of evidence-based interventions through better integration of health-care services, including diagnostic and management approaches that transcend disease categories and provide a continuum of care tailored to the needs of the individual. (…) Innovative solutions to gaps and needs (e.g,, human resources, digital technology, big data, community engagement, and financing) must be sought, and research in different global contexts must be promoted to generate new knowledge on brain health, especially novel strategies for prevention and care." (The Lancet Global Health 2024) [1]

"To best help people living with dementia and their families and carers, beneficial research findings must be applied as quickly as possible in health practice and public health policy. There are, however, considerable barriers to translating even robust research. Moreover, implementation can reveal unsuspected challenges; their resolution feeds into knowledge creation, thereby providing bidirectional exchange of information. Increasing the awareness, presence and standard of implementation science is therefore critical to bringing the benefits of research rapidly to the people who need it." (World Health Organization) [2]

BACKGROUND

Dementia is a debilitating condition characterized by a gradual decline in cognitive function and the emergence of neuropsychiatric symptoms, often leading to a significant reduction in an individual's functional capacity [3]. Population ageing is a growing issue that increases the prevalence and burden of challenges associated with dementia. The global incidence rate of dementia is projected to rise from approximately 57.4 million in 2019 to an estimated 152.8 million by 2050 [4, 5]. In terms of economic implications, the rise in dementia prevalence is associated with heightened cost of hospitalization, community-, and home-based care, contributing to an increased national health expenditure [6, 7]. Population ageing will also cause a demographic shift toward a grey population, creating a disproportionate demand on the health and welfare workforce to provide dementia care and long-term care services [8]. Implications of dementia also extend beyond health care to encompass significant economic and social burdens on families and communities. The loss of productivity due to caregiving responsibilities, combined with the psychological and emotional toll on caregivers, underscores the necessity for solutions to address these challenges [8]. These trends are consistent across high income countries and low- and middle-income countries, positioning dementia as a top global health priority that will continuously contribute to economic, health, and social systems challenges.

There are few pharmacological treatments that can reverse the symptoms or halt the neurological decline associated with dementia [9]. Given the limited curative treatment options, these circumstances call for a critical reassessment of current dementia research priorities and practices in global health systems. The World Health Organization Dementia Research Blueprint [2] proposed 15 strategic goals, aimed to address current research gaps, including promoting prevention and risk reduction, strengthening diagnostic capacity, and developing non-pharmacological interventions that improve health outcomes. These goals steer international dementia research and innovation priorities toward investing in non-pharmacological dementia research, defined in this dissertation as “the investigation designed to contribute knowledge or to develop innovations that directly or indirectly improve patient health outcomes along the dementia care trajectory, without the use of chemical agents”.

Non-pharmacological dementia research may produce a range of innovations (products and services) that can be used to support healthcare providers, people with dementia, and their informal caregivers across the dementia care trajectory, such as prevention and risk reduction programs (e.g., health promotion, risk assessment scales) [10, 11], diagnostic and clinical decision support (e.g., test battery, clinical guidelines) [12], and dementia care management interventions (e.g., social, psychological, and behavioral interventions) [13, 14]. These innovations are intended for use across the dementia care trajectory to improve the quality of care provided by healthcare professionals and provide people with dementia with timely access to care interventions that mitigate symptoms [10, 12, 13]. There is robust evidence that demonstrates the clinical effectiveness of these non-pharmacological research products, focusing on various aspects such as prevention, diagnostics, and care management.

First, research on prevention of dementia requires a multifaceted approach, combining tailored individual interventions with broader population-level strategies (i.e. health promotion) that address structural risk factors [15]. Fourteen modifiable risk factors have been determined in dementia research, including education, hearing loss, cholesterol, depression, traumatic brain injury, physical inactivity, diabetes, smoking, hypertension, obesity, alcohol consumption, social isolation, air pollution, and visual loss [16]. Following, diagnostics research has focused on improving early detection through cognitive assessments and digital health innovations, contributing to more accurate and timely diagnoses. Global dementia diagnostic research investments are aimed toward neuroimaging (PET imaging), biomarkers (cerebrospinal fluid, blood-based, genetic), and neuropsychological assessments [2]. Lastly, dementia care management research has yielded numerous effective interventions to support people with dementia and their informal caregivers, including psychoeducation programs, assistive technologies, and tailored behavioral therapies [17]. Various systematic reviews determined that non-pharmacological care management interventions can effectively reduce neuropsychiatric symptoms in individuals with dementia [18-21]. Cheng and Zhang [14] conducted a meta-review of 60 literature reviews, inclusive of over 500 dementia caregiver interventions. This extensive review presented strong evidence to develop a classification system (i.e. typologies) for informal caregiver interventions, improving consistency and homogeny in dementia research. Cheng and co-authors [17] also produced a systematic review and meta-analysis of 131 interventional studies, demonstrating the vast scope of effectiveness research available for informal caregivers of people with dementia.

Research has shown potential to improve health outcomes across the care trajectory and reduce the overall burden of dementia. However, the true benefits and impact of these research innovations, across various settings, are difficult to ascertain due to a scarcity of real-world evidence on their dissemination and implementation [22, 23]. The emerging field of implementation science offers promising solutions to address this scarcity.

Origin and relevance of implementation science in non-pharmacological research

Traditional biomedical (pharmacological) research is conducted across a translational science continuum that integrates basic science discoveries with early human testing (Stage T1/Phase 0-I), controlled efficacy (Stage T2/Phase II-III), clinical effective and real-world implementation (Stage T3/Phase III), and long-term population impact (Stage T4/Phase IV), ensuring the successful transfer of research from “bench-to-bedside” [24]. This approach has also been adapted and used to guide the research and development of non-pharmacological research, such as in genomic medicine [25] and behavioral science [26]. In non-pharmacological translational research, stage T1 activities involve developing non-pharmacological research (e.g., behavioral interventions, treatment protocols), and stage T2 activities involve rigorous investigation, using an interventional/experimental design, to determine clinical efficacy, effectiveness, dosage (e.g., number of treatment sessions), and patient outcomes [27]. Stage T3 activities involve dissemination and implementation research to translate research from clinical settings to real-world use, focusing on individual, practice-oriented research outcomes [26]. Stage T4 activities involve real-world research scale-up to enhance the overarching impact of research on societal outcomes through new guidelines, practices, and policies [26].

At stages T2, T3 and T4, translational science remains daunted by the “Valley of Death”, a metaphorical concept representing the chasm between promising laboratory discoveries and their successful transformation into innovations that have real-world impact [28]. In response to these persistent translational challenges, implementation science has emerged as an independent field of research that develops and utilizes methods to promote the systematic uptake of new research evidence and innovations into routine practice and to improve the quality of existing services [29, 30]. This field contributes to improving outcomes at stages T3 and T4 by bridging the expertise from traditional biomedical sciences with insights from multiple disciplines, such as health services research, public health policy, and management science [29, 30]. The multidisciplinary origins and transdisciplinary applicability of implementation science presents valuable knowledge to navigate real-world complexities, beyond siloed domains, and reduce the persistent “17-year bench-to-bedside (i.e. research-to-practice) gap” that has burdened the scientific community [31].

Over the past two decades, international health research funders have gradually increased the funding allocated to implementation research. For instance, the United States National Institutes of Health focused on enhancing research implementation capacity through allocating funding for researchers to conduct implementation science research and to develop graduate-level implementation science training programs [32]. This contributed to the expansion and maturity of implementation science, advancing both the theoretical and practical contributions of this field. Accordingly, the field of implementation science offers invaluable knowledge, including theories, models, and frameworks, that may contribute to accelerating the real-world use and sustainment of non-pharmacological dementia research.

Overview and application of theories, models, and frameworks in implementation science

The theoretical foundation of implementation science is built upon three core pillars: implementation determinants, implementation process, and implementation (strategy) outcome [33]. The implementation determinants are present in the dynamic environment (context) and influence implementation outcomes [34]. These determinants that influence implementation outcomes are theorized and presented in determinant frameworks. For instance, the Consolidated Framework for Implementation Research (CFIR) is a widely used determinant framework that consists of five domains: innovation, outer setting, inner setting, characteristics of individuals, implementation process. Each domain was derived from theories borrowed from various disciplines, such as public policy, organizational behavior, social psychology, behavioral science, and change management theories [34]. For example, Roger's Diffusion of Innovation theory inspired the conceptualization of research adoption and implementation scaling [35]. This compilation of interdisciplinary knowledge enables a comprehensive scan of the real-world implementation setting, scoping the varied determinants that may influence research implementation outcomes.

Next, the implementation process encompasses a spectrum of activities designed to translate research findings into integrated, routine practices in real-world settings [36]. Theory-driven process models, such as the knowledge-to-action framework (KTA), depict the phases of the implementation process and may be used to guide implementation planning. The phases of the KTA framework include knowledge creation (knowledge inquiry, knowledge synthesis and the development of research knowledge tools and products) and knowledge action cycle (identifying the problem or knowledge gap, adapting the knowledge to the local context, assessing barriers to knowledge use, selecting, tailoring, and implementing interventions, monitoring knowledge use, evaluating outcomes, and sustaining knowledge use). In addition, the use of process models may be complemented by implementation strategy taxonomies, such as the Expert Recommendations for Implementing Change (ERIC) taxonomy. These taxonomies are systematically constructed to improving the conceptual clarity, relevance, and comprehensiveness of implementation strategies, enabling both implementation researchers and practitioners to streamline their implementation processes [37].

Lastly, implementation (strategy) outcomes include key indicators of success such as acceptability, adoption, appropriateness, feasibility, fidelity, cost, penetration, and sustainability, all of which measure how effectively research-based practices are integrated and maintained in real-world settings [38]. Evaluative frameworks, such as the Implementation Outcomes Framework (IOF) and the Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) [39], consist of the (aforementioned) key indicators of success, derived from service system outcomes and clinical treatment outcomes. These frameworks support the important theoretical differentiation between intervention outcomes and implementation outcomes, which separates intervention effectiveness from implementation strategy effectiveness. Differentiating between these outcomes allows researchers and practitioners to pinpoint whether problems stem from the way an intervention is implemented or from the intervention itself, leading to more targeted improvements [38]. In practice settings, these evaluative frameworks, and pragmatic tools (e.g., evaluation criteria, validated instruments) [40], may be used to monitor and evaluate implementation efforts, provide iterative feedback, and provide evidence to support decision-making for health service quality improvement. Table 1 presents a description of the theoretical and practical contributions of implementation science, including examples of theory-informed frameworks used in this dissertation.

Table 1. Contributions of implementation science to health care research

Implementation science pillars	Related theory-driven frameworks	Example of framework	Theoretical contributions	Practical application
Implementation determinants What are the variables that influence research implementation success?	Determinant frameworks	Consolidated framework for implementation research (CFIR) [34]	Theoretical constructs in the frameworks represent contextual determinants that influence implementation outcomes, such as innovation, outer setting, inner setting, characteristics of individuals, implementation process.	Guide contextual assessment to determine barriers and facilitators to implementation of health care research.
		Promoting Action on Research Implementation in Health Services (PARIHS) [41]		
Implementation process What activities are performed to facilitate implementation?	Process models	Knowledge-to-action framework (KTA) [36]	Delineates an iterative process that links knowledge creation with action, emphasizing the cyclical nature of knowledge synthesis, adaptation, and application in real-world settings.	Provides a step-by-step roadmap to guide the translation of research into practice, including problem identification, knowledge tailoring, barrier assessment, and intervention implementation.
		Quality Implementation Framework [42]		
	Implementation strategies (taxonomy)	Expert Recommendations for Implementing Change (ERIC) [37, 43]	Systematically categorizes and defines a comprehensive set of implementation strategies, offering a structured framework that highlights expert consensus on effective methods for addressing barriers to change.	Assists practitioners (and other implementation stakeholders) in selecting and tailoring targeted implementation strategies that align with specific barriers and contextual needs to enhance the adoption and sustainability of innovations.
		Behavior Change Technique (BCT) taxonomy [44]		

Implementation outcomes How successful was the implementation approach?	Evaluative frameworks	Implementation Outcomes Framework (IOF) [38]	Comprehensive set of clearly defined outcomes—including acceptability, adoption, appropriateness, feasibility, fidelity, cost, penetration, and sustainability—to evaluate the success of implementation efforts.	Provides a measurement framework that guides the evaluation of implementation processes and impact, enabling data-driven decision-making to refine and improve practice.
		Reach, Effectiveness, Adoption, Implementation, Maintenance (RE-AIM) model [39]		

Systems ambiguity and complexity as a major challenge to dementia research implementation

The field of implementation science has gradually evolved into a vital complement to robust clinical (T1, T2) research available. The traditional paradigm of translational science often conceptualizes the translational science pipeline as a linear causal process, in a closed system with controlled variables [26]. However, research dissemination and implementation challenges emerged from real-world conditions, affecting the use and impact of clinical research. At translational stages T3 and T4, real-world implementation processes are facilitated in an open system and shaped by factors at various levels, including individual (e.g., practitioner behavior), organization (e.g., administrative conditions), (wider) implementation system (e.g., policy reforms) [45]. Contrasting with the controlled experimental setting conditions in a closed system, real-world implementation in an open system is affected by contextual determinants that may affect intervention and implementation outcomes [45]. Following, implementation science systematically addresses these determinants using methodically selected methods, actions, approaches, or techniques (i.e. implementation strategies), informed by theory and practice [37, 43].

Given the variability in real-world implementation processes, implementation science experts recognize implementation complexity as a major hurdle impacting the transition of research-to-practice, potentially hindering the application of implementation science in non-pharmacological dementia research [46]. The first step to address this challenge is to shift away from the simplistic and linear translational pipeline paradigm and approach the wider implementation context as a complex adaptive system, facilitating a more precise grasp and conceptualization of the evolving interactions and interdependencies at work [46]. Complex adaptive systems frequently encounter challenges attributable to inherent conceptual ambiguity of structures and processes involved in research implementation [45, 47]. Structure ambiguity refers to the unclear conceptual architecture of the outer implementation setting, including the agents, physical and human resources, motivations (culture, beliefs, values), and general capacity for research implementation. Process ambiguity refers to the conceptual uncertainties along the implementation process, often stemming from unclear activities, roles, and contributions from each stakeholder group. These conceptual ambiguities hinder the application of implementation science to support the real-world dissemination and implementation of non-pharmacological dementia research.

Further, the foundation of implementation science was originally developed with insights from clinicians, psychiatrists, sociologists, and health services researchers, applied predominantly in healthcare settings [48]. A recent systematic review of implementation outcomes found that 45.8% of the studies were conducted in inpatient and outpatient domains, suggesting relatively low engagement with, and application in, home- and community-based settings [49]. Current dementia research agendas are guided by the principles of ‘living well with dementia’, which encourages ageing in place, a concept that prioritizes the provision of care in home and community settings [50]. This care concept aims to support the growing number of people living with dementia and their communities by enhancing quality of life, life satisfaction, and well-being [51]. However, successful care outcomes rely heavily on the support and contributions of the informal caregiver, often including friends and family of the person with dementia [8]. People with dementia and their informal caregivers have multifaceted needs and may require active integrated support from social, welfare, and health sectors [52]. Supporting the informal caregivers requires a paradigm shift toward an integrated conceptualization of the implementation system, including evidence and perspectives gathered from beyond traditional clinical settings.

Current research agendas call for further investment to develop implementation science by incorporating evidence from a broad range of social, political, and professional contexts and disciplines to produce holistic understanding of the outer setting domain of the implementation context [32]. For example, Wandersman et al. [53] proposed the Interactive Systems Framework for Dissemination and Implementation—a model that incorporates implementation science principles to reflect the complexities of real-world interactions in dissemination and implementation more accurately. This model identified interactive systems that operate in parallel throughout the implementation process, including the delivery system and the support system. The delivery system comprises the individuals or groups more often responsible for planning, executing, and evaluating activities that directly influence research implementation outcomes. Delivery system stakeholders may include (academic) researchers (knowledge producers) and implementation setting end-users (knowledge users), such as organization managers, people with dementia and their (informal) caregivers. Next, the support system comprises of individuals and groups responsible for providing implementation (technical) assistance and wider system capacity support. Support system stakeholders were identified as technical assistance providers (e.g., coaches, consultants) [54], knowledge brokers, capacity-building organizations, and research funders. This clear conceptual delineation of implementation stakeholder groups enables the field of implementation science to address contextual ambiguity.

Given these conditions, there is a clear demand for the theoretical adaptation of implementation science frameworks for use in home- and community-based settings, thereby enhancing the potential to improve the quality of care for individuals with dementia and their caregivers. This approach extends the focus beyond clinical boundaries and invites transdisciplinary methods, evidence, and perspectives to deepen the understanding of outer implementation setting determinants [48]. Accordingly, this dissertation aims to detangle implementation complexity and determine how to use implementation science to support the implementation of non-pharmacological dementia research.

RESEARCH QUESTIONS AND DISSERTATION OUTLINE

The central research question in this dissertation is: *How can implementation science be leveraged to understand and improve the dissemination and implementation of non-pharmacological dementia research findings into practice in the Netherlands?*

This dissertation encompasses six chapters that address three sub-research questions.

Research question 1: What is already known in the scientific literature about the dissemination and implementation of home- and community-based interventions for informal caregivers of people living with dementia?

The first objective of this PhD dissertation is to systematically scope the empirical evidence on dissemination and implementation of home- and community-based interventions for informal caregivers of people living with dementia. **Chapter 2** details a systematic scoping review protocol, outlining the procedure, methods, and tools used to conduct this comprehensive study. The objective of this systematic scoping review was to map (1) implementation determinants, (2) implementation strategies, and (3) implementation outcomes. These intended outcomes required a multi-framework design, addresses the three core pillars of implementation. This enabled a holistic approach that produces a more comprehensive implementation-focused evidence synthesis. This chapter also outlines the operationalization of ASReview, an artificial-intelligence-aided tool that sequentially presented all imported publications to the reviewer from most to least relevant, reducing the title and abstract screening time [55].

Following, **Chapter 3** presents the complete results of the systematic scoping review. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) reporting recommendations were used to guide this review of 67 studies [56]. Based on the three objectives outlined in the protocol, **Chapter 3** presents two significant contributions that address the overarching research question in this PhD dissertation. First, implementation determinants, identified across various domains, may influence implementation success. A vast range of barriers that obstructed the implementation of home- and community-based non-pharmacological dementia interventions for informal caregivers were identified. Findings revealed potential types of limitations within the Dutch implementation system, highlighting specific areas to investigate and invest in to build dementia research implementation capacity. Next, the results determined the range of implementation strategies used for these interventions. Strategies from the train and educate stakeholders cluster were most frequently identified. This may direct Dutch dementia research implementation capacity-building initiatives toward strengthening the quality of, and access to, research through education through varied forms of educational materials, delivered through diverse modalities.

Following, **Chapters 4** and **Chapter 5** present two empirical studies, focusing on the implementation context at the outer implementation setting. The Netherlands has been a pioneer in supporting the implementation of non-pharmacological dementia research, promoting innovation through the research agenda set by the National Dementia Strategy [57]. Each of these chapters aim to detangle implementation complexity by exploring the architecture (structure) of the outer implementation setting and the strategies used by academic researchers and research funders to facilitate the real-world use of non-pharmacological dementia research.

Research question 2: What are strategies employed by Dutch academic dementia researchers (based at Alzheimer Centers) to create, adapt, disseminate, and implement non-pharmacological dementia research?

Chapter 4 presents a qualitative multiple case study that explores the strategies of 29 (academic) dementia researchers based across the five Alzheimer Centers in the Netherlands. An adapted the knowledge-to-action framework [36] was used to conceptualize a “knowledge implementation funnel” that encompasses four phases: *knowledge creation, knowledge adaptation, knowledge dissemination, and knowledge implementation*. The study reveals strategies employed by Alzheimer Center researchers to determine the roles and activities used to facilitate the translation of research to practice. This chapter discusses the strengths of using transdisciplinary co-creation approaches for knowledge creation and adaptation and the benefits of cross-sector partnerships with industry and government agencies to enhance knowledge use. Findings determine potential opportunities to improve research practices and capacity to accelerate the use of non-pharmacological dementia research.

Research question 3: What are strategies (and related challenges) of public and private research funders to accelerate the dissemination and implementation of funded non-pharmacological dementia research?

Chapter 5 presents an empirical study that focuses on determining strategies (and related challenges) of public (e.g., ZonMw) and private (e.g., Alzheimer Nederland) Dutch dementia research funders to facilitate the dissemination and implementation of research results obtained through their funded programs. The study was conceptualized upon the previously identified six practice areas of research funders: release of findings, dissemination, knowledge exchange and partnering, building capacity and infrastructure, implementation, and implementation research [58]. The findings suggest that research funders contribute to dissemination, implementation support, and research ecosystem capacity-building. Notably, this study proposes a unifying research ecosystem conceptual approach to understand and guide the unique roles and contributions of public and private funders. This contribution provides insight into how sector values, infrastructure, and resources may influence research funders' strategy selection, which has not previously been considered as an outer setting implementation determinant. These results may accelerate the use of non-pharmacological dementia research, contributing evidence to reduce ambiguity and strategically enhance implementation system capacity.

Chapter 6 summarizes the findings for the three overarching research questions, reflects on the strengths and limitations of the selected methodology, and discusses these contributions under the unifying research ecosystem theoretical concept that emerged to address the dissertation research question. The final section of this chapter presents the implications and recommendations for research, practice, and policy, guiding future investments toward building real-world implementation capacity for the field of non-pharmacological dementia research.

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2

Implementation and dissemination of home and community-based interventions for informal caregivers of people living with dementia: a systematic scoping review protocol

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ABSTRACT

Introduction: Ageing in place, supported by formal home and community services and informal caregivers, is the most utilized long-term care option for people with dementia (PwD). Informal caregivers are inundated by their caregiving responsibilities and resultantly suffer consequences. Despite the multitude of clinical effectiveness studies on interventions that support informal caregivers, there is a paucity of information regarding their implementation process. This scoping review aims to identify the implementation strategies, implementation outcomes, and barriers and facilitators that impede or support the dissemination and uptake of interventions that support informal caregivers of PwD at home.

Methods and analysis: This protocol is guided by the PRISMA-P, and the scoping review will follow the systematic steps of the PRISMA-ScR guideline. The search strategy will include publications produced from inception to 08 March 2021 and will be conducted in the search engines Embase, Medline (Ovid), Web of Science, and Cochrane Central Register of Controlled trials (Wiley), followed by a three stage approach. First, title and abstracts will be screened by two independent reviewers. Second, full-text articles will also be screened by both reviewers and, in case of disagreement, by a third reviewer. The first two stages are based on a set of inclusion and exclusion criteria. Reference lists of the final included studies will also be checked for relevant articles. Data from the final included studies will be extracted and synthesized using the Expert Recommendations for Implementing Change (ERIC) compilation and Proctor's implementation outcomes to ensure homogenous and standardized reporting of implementation information.

Ethics and dissemination: The review findings will be published in a peer-reviewed journal and disseminated at geriatric and implementation conferences to inform researchers, health service planners and practice professionals with an overview of existing literature to guide them in the effective implementation of caregiver-focused interventions in dementia support.

Key Words: Dementia, Informal Caregiver, Interventions, Implementation, Implementation science

ARTICLE SUMMARY

Strengths and limitations of this study

- This will be first scoping review focused on studies that directly report implementation and dissemination of a full range of home and community-based interventions for informal caregivers of people with dementia (PwD).
- The findings from this review will provide synthesized evidence that guides implementation of the overwhelming number of clinical effectiveness studies of interventions for informal caregivers for PwD and provide insight into the link between intervention studies and implementation studies, promoting the dissemination and uptake of contextually appropriate interventions.
- This will be one of the first reviews that uses the data management software of ASReview, as an AI-aided tool for title and abstract screening, promoting the integrated use of an open-source artificial intelligence program to systematically review extensive amounts of literature and to improve researcher efficiency without risking the review integrity.
- As it is a scoping review, the quality of included studies will not be formally assessed.

INTRODUCTION

Dementia is a neurocognitive disorder that affects over 36 million people and is expected to physically affect 66 million by 2030 [1]. People with dementia (PwD) gradually become incapable of independent living and lose the capacity to independently make informed decisions. They require extensive care provided by caregivers throughout the remainder of their lives, often within a formal care institution (e.g., nursing home, long-term residential care facility) [2]. Previous studies have indicated that PwD prefer home-based care with support from formal and informal caregivers.[3] Informal caregivers are identified as any individual who provides "unpaid care to older and dependent persons with whom they have a social relationship, such as a spouse, parent, child, other relative, neighbor, friend or non-kin" [4, 5]. For those at more advanced stages of dementia, regular support from informal caregivers is essential to maintaining activities of daily living. As the global prevalence of dementia cases increases, more spouses and children of PwD will adopt the role of the primary informal caregiver and become inundated with responsibilities.

Resultantly, the quality of life for informal caregivers of PwD has become a global issue [6]. Studies conducted across Europe found that informal caregivers often indicated a need for formal care for their relatives with dementia due to the impacted quality of life they experience in their role, the difficulties with managing behavioural problems of PwD, and the limited access to effective community-based respite and supportive care services [7]. In response, researchers and health policy actors have explored opportunities to develop and implement community-based interventions for informal caregivers of PwD that support and encourage the delivery of long-term care at home, or ageing in place, and delay institutionalization. In the United Kingdom, “Living well with Dementia” is a top priority in the national dementia strategy, which includes the development and implementation of supportive services for caregivers of PwD living at home [8]. In the Netherlands, the Ministry of Health, Welfare and Sport recently published The National Dementia Strategy 2021 – 2030 [9], which reported an estimated national figure of 350,000 informal caregivers for PwD, within a total national population of 17 million persons, 31% of whom devote more than 40 hours per week to providing informal care. The growing focus toward improving support for informal caregivers accelerates the development and implementation of more evidence-based programs that support and sustain home- and community-based care.

Furthermore, Wübker et al. [10] reported that the average monthly cost of institutionalized and professional home-based long-term care for PwD across eight European countries amounted to 4,491 Euro and 2,491 Euro, respectively. These results reveal the magnitude of the demand for dementia care providers, the relatively high costs of institutionalized care, and the value of supplemental formal home- and community-based dementia care resources. Previous studies have also indicated that PwD personally prefer to receive delay institutionalization and receive care at home due to their desire to maintain autonomy and preserve their personhood [11]. Informal caregivers of PwD have also previously associated institutionalization with abandonment and mainly considered this option once the disorder progressed and presented unmanageable complex care demands or once their resources became limited or insufficient to sustain home-based care [12]. Additionally, informal care for PwD living at home is the only feasible option in resource-limited countries [13].

In response to this demand, health policy actors are urged to invest in developing and implementing sustainable home and community-based care solutions for PwD and their informal caregivers that delay or replace institutionalization to conserve economic resources and to satisfy the preferences of PwD and their informal caregivers. Given these conditions, the self-efficacy and caregiving competencies of informal caregivers ultimately determine care outcomes for PwD and informal caregivers; proper education, support, and resources provided by formal care providers are essential to support informal caregivers in their role [14]. Without adequate support, according to the stress process theory, informal caregivers are more vulnerable to developing depression and anxiety and become more susceptible to developing chronic illnesses exacerbated by stress and, subsequently, compromising their caregiving abilities [15, 16].

Rationale for review

The implementation process of interventions that support informal caregivers of PwD must be examined in addition to intervention studies to gain a comprehensive understanding of their usability and real-world value and impact [17]. As for effectiveness studies of interventions, Cheng et al. [18] recently published a meta-review that included 60 separate review articles, amalgamating over 500 individual articles that examined the effectiveness of various informal caregiver-focused interventions. They identified the main types of interventions available for informal caregivers of PwD, including psychoeducation and psychotherapy (e.g., cognitive behavioural therapy), support groups, respite care, caregiver training (e.g., occupational training) and mindfulness and exercise programs [13]. However, previous studies have often reported a need for additional implementation studies that report strategies to ‘translate caregiver interventions into practice’ and ‘evaluate the mechanisms for sustainability within the health care system’ [19, 20]. Successful implementation also requires a comprehensive understanding of the barriers and facilitators to implementation and the contextual factors influencing dissemination of evidence-based practices [17].

In light of this evidence, this review is grounded onto theory and concepts developed within the recently merged multidisciplinary field of implementation science. Implementation science seeks to understand and characterise the process of translating evidence into routine practice in healthcare settings, with the ultimate aim of accelerating this translation and ensuring healthcare practice is consistently and appropriately evidence-based [21]. In doing so, the field has developed a clear focus on so-called 'implementation strategies', defined as methods or techniques used to support and enhance the adoption, implementation, and sustainability of an intervention clinical intervention [22]. The most comprehensive mapping of such implementation support interventions was developed in the context of the Expert Recommendations for Implementing Change (ERIC) study [22]. Following literature review and an expert consensus process, ERIC developed a compilation of 73 implementation strategies that has allowed researchers to report implementation process details using a homogenous and consistent approach. Waltz et al. [23] further compiled the 73 strategies into nine thematic clusters, including evaluative and iterative strategies, provide interactive assistance, adapt and tailor to context, develop stakeholder interrelationships, train and educate stakeholders, support clinicians, engage consumers, utilize financial strategies, and change infrastructure. These clusters will provide one part of the conceptual framework for this review. The other part of this framework will be offered by a brief taxonomy of 'implementation outcomes', defined as the effects of deliberate and purposive actions to implement new treatments or services [24]. The most established taxonomy for these outcomes has been developed by Proctor et al. [24] who identified acceptability, adoption, appropriateness, feasibility, fidelity, cost, penetration, and sustainability as a core set of implementation outcomes to be measured and studies alongside patient and service-level outcomes. The corpus of evidence that this review will identify will be synthesised through the prism of implementation strategies and outcomes.

To-date, a few reviews have focused on implementation strategies in the area of dementia care. Lourida et al. [25] presented a scoping review of implementation and dissemination strategies of interventions for the dementia care recipient (i.e., PwD). Bennet et al. [26] also published a systematic review on implementations studies of non-pharmacological interventions addressing behavioural and psychological symptoms of dementia. Although the reviews of Lourida et al. [25] and Bennett et al. [26] do focus on implementation strategies, interventions were not focused on informal caregivers. The review of Christie et al. [27] did focus on implementation strategy of interventions for informal caregivers of PwD living at home; however, they limited their focus to eHealth interventions and excluded implementation studies on the various other types of interventions available to support informal caregivers in their role. Furthermore, the UK National Institute for Health Research [28] and the Dutch Research Council [29] have both released calls for research proposals focusing primarily on supporting PwD and their informal caregivers carers and enhancing their quality of life. Based on these findings, this study aims to produce a scoping review to synthesize the available evidence relating to the implementation of interventions that support informal caregivers of PwD.

Review aim and objectives

The aim of the scoping review is to provide an overview of reported implementation insights of interventions for informal caregivers of PwD living at home. Our specific objectives are to identify the implementation strategies, implementation outcomes, and barriers and facilitators that impede or support the dissemination and uptake of interventions. All three objectives are essential to developing a comprehensive review that will sufficiently inform the development of future interventions and their implementation plans without creating further information fragmentation.

METHODS

Scoping review methodology with a systematic search strategy will be applied to this review. According to Arksey and O'Malley [30], a scoping review is most suitable to summarise the range of evidence, to disseminate the research findings and to expose information gaps in existing literature; scoping reviews also cover broader topics presented through various study designs. The proposed scoping review is guided by a 5-step framework by Arksey and O'Malley [30], which includes (1) identifying research questions, (2) constructing a primary search strategy and (3) identifying and selecting relevant studies with an clear inclusion and exclusion criterion, (4) extracting and charting the relevant data, and (5) summarizing, collating and reporting the final results. This protocol was guided by the PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis

Protocols) [31]. A brief protocol for this review has also been registered in the Open Science Framework (osf.io/tvdb5) to provide transparency throughout the review process [32]. The final scoping review will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)-Extension for Scoping [33].

Identifying the research questions

The main research question is ‘what are the implementation and dissemination strategies reported for home and community-based interventions that support the informal caregivers of people with dementia living at home?’. Three sub-questions were developed that will lead to answering the main question:

1. What implementation strategies have been reported for interventions that support informal caregivers of people with dementia living at home?
2. What are the implementation outcomes reported for these interventions?
3. What are the reported barriers and facilitators of implementation and dissemination that impede or support the uptake and utilization of these interventions?

Search Strategy

First, a limited search of EMBASE and MEDLINE was conducted to identify articles focusing on interventions for caregivers of PwD; texts that fit the search domain were analysed to determine key index terms. Following, with additional support from a medical librarian, an initial search strategy comprised of the identified key terms relating to ‘dementia’, ‘informal caregivers’, ‘intervention’ and ‘implementation and dissemination’ was developed. Articles published from inception through 08 March 2021 will be included. The search strategy will be adapted for use in Embase, Medline (Ovid), Web of Science, and Cochrane Central Register of Controlled trials (Wiley) to ensure comprehensive literature in the final search outcomes. Results obtained across these databases will be compiled and de-duplicated prior to screening.

Identifying and selecting relevant studies

The full process of identifying and selecting relevant studies will have three stages. First, the titles and abstracts of all unique results previous obtained will be imported and screened manually by two independent reviewers (EMZ and MB) using the novel ASReview tool (https://asreview.nl/) [34]. According to van de Schoot et al. [34], ASReview is able to detect 95% of the eligible studies after screening between only 8% to 33% of the studies, which significantly reduces time spent screening titles and abstracts. Ferdinands [35] applied ASReview to a full set of 5050 studies that were previously manually identified and screened by another review to evaluate the tool's operational performance. The results revealed that ASReview was also able to obtain "more than 80% of relevant publications after screening only 10% of all publications" and "identified 95% of relevant publications after screening about 20% of all publications", thus reducing screening effort by 78–82% [35]. ASReview was selected as a screening tool due to its novel use of machine learning to first find and present the titles and abstracts in an efficient order, from most relevant to least relevant, which will allow the reviewers to manually filter all results quickly and efficiently without compromising the review's integrity [34].

The title and abstract screening process will use a two-pronged approach. The first reviewer (EMZ) will manually screen all of the title and abstracts using ASReview and in- and exclude studies based on the exclusion criteria. The full text of included studies by the first reviewer will be screened in the next stage. Following, using ASReview, the second reviewer (MB) will manually review all of the studies excluded by the first reviewer to ensure all relevant studies have been considered for full-text assessment; once 50 successive articles have been excluded, the second reviewer will stop screening. The full-texts of all studies included by the second reviewer will also be assessed to avoid any false negatives.

Second, the selected studies will undergo a full-text evaluation, conducted by two independent reviewers (EMZ and MB), who closely examine the population, intervention, and outcomes reported in the studies to determine if the study is suitable for the purpose of this review and to avoid false positives obtained in the first step. If there are any disagreements at this stage, a third reviewer will read the full-text and discuss the areas of contention with the two independent reviewers to reach a consensus. Third, included articles will undergo a reference list check to ensure that relevant articles are found in this scoping review. ProQuest RefWorks (https://refworks.proquest.com) will be used to manage full-text articles and citations [36]. The screening process and reasons for exclusion will be reported using the PRISMA flow diagram [33].

In accordance with Arksey and O'Malley's scoping review methodology and reporting guideline [30], the inclusion and exclusion criteria may be iteratively refined during the review process; any modifications made in the full scoping review will be reported. This review will consider all empirical studies published in peer-reviewed journals to ensure veracity of information; it will exclude any type of systematic reviews, book chapters, editorial letters, opinion papers, or grey literature. There are no limitations on the types of interventions included, but they must directly aim to impact the informal caregiver of PwD. Literature published in languages other than English are excluded due to resource limitations. Study should focus on the implementation and dissemination of interventions for informal caregivers of PwD living at home; for example spouses, children, neighbours or friends. All types of interventions are included in this review if they directly support or impact the informal caregiver of PwD living at home.

To be included in this review, studies must either: (1) explicitly report detailed information on implementation strategies used and implementation outcomes examined for all types of evidence-based interventions, delivered at home or within the community, that directly impact the experience of informal caregivers of PwD living at home or (2) present detailed information on the perceptions and attitudes, or barriers and facilitators, involved in the implementation and dissemination process of these interventions from the informal caregiver perspective. This review will exclude all studies that present interventions delivered within formal institutional care settings or have a primary focus on formal care providers as study participants. Dyadic interventions that provide care for PwD, without direct impact on the informal caregiver, will also be excluded. Studies that involve interventions for informal caregivers of people with conditions other than dementia will also be excluded.

Data charting

Data from the included studies will be initially extracted using a data extraction table that includes study characteristics, including first author, year of publication, country, study design and frameworks used, aim and purpose of study, types of intervention as reported in Cheng et al. [18], participant details (e.g., number of participants, relationship between informal caregiver and PwD), and main outcomes reported within the included study.

An initial selection of 10 selected studies will be used as a pilot sample. One reviewer will extract data from this sample and populate the extraction form. The second reviewer will assess the accuracy and suitability of the domains analysed based on the study's objectives; disagreements between two reviewers will be resolved within the team. The data from the remaining included studies will then be extracted by the first author using the refined data extraction table. Any iterative modifications made to the data extraction table will be reported in the full scoping review article.

Collating, summarizing, and reporting the results

The main outcomes from this review will build on implementation science literature and use the 73 implementation strategies identified through the ERIC study [22] and the nine thematic clusters identified in Waltz et al. [23] to structure and homogenize the reporting of implementation data obtained through the included studies. Furthermore, reported implementation outcomes within these included articles will be extracted and structured with guidance from evidence provided in Proctor et al. [24]. The focus on these two aspects will allow researchers to synthesize implementation evidence from interventions across various contexts. This review will also include the identified barriers and facilitators to implementation and dissemination, including organisational, professional, individual, financial, and other perspectives, to gain a comprehensive understanding of the contextual factors that influence outcomes.

Patient and public involvement

A primary aim of this review is to offer an overview of what appears currently to be a rather disparate evidence base, and to use formal implementation science concepts to synthesize and organize this evidence. People with dementia, formal or informal caregivers or health care professionals working in dementia services will be involved in the stages following the review publication. For example, a follow-up empirical study will validate the scoping review's findings and explore end-users' perspectives on what might be viable and desirable approaches to tailor the implementation and dissemination of support interventions identified and/or to address the barriers to their scaled up application in support of informal caregivers. End-users will not be involved in any phase of the review work. The first phase in which end-users will be involved is when a viable and shareable summary of the review will be distributed.

RESULTS

Findings will be extracted and reported using a narrative synthesis approach to determine the key contextual determinants influencing the implementation and uptake process as well as the reported data regarding the implementation of caregiver-focused interventions to clarify the gaps that require further resource commitment and research. The results will also reveal the nature and trend of existing literature in implementation science regarding informal caregiver interventions and explore how implementation is being reported to contribute to a more standardized homogenous reporting strategy.

Ethics and dissemination

This scoping review aims to guide the direction of future research towards the evidence-driven implementation of effective, evidence-based practices that support informal caregivers of people living with dementia at home. The review will not require ethical approval since it will not involve fresh primary data collection, and the findings will be published in a peer-reviewed journal and disseminated at future conferences on geriatric care and implementation science.

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3

Implementation and dissemination of home and community-based interventions for informal caregivers of people living with dementia: a systematic scoping review

Zhu, E.M., Buljac-Samardžić, M., Ahaus, K. et al. Implementation and dissemination of home- and community-based interventions for informal caregivers of people living with dementia: a systematic scoping review. Implementation Sci 18, 60 (2023). https://doi.org/10.1186/s13012-023-01314-y

ABSTRACT

Background: Informal caregivers of people with dementia (PwD) living at home are often the primary source of care, and, in their role, they often experience loss of quality of life. Implementation science knowledge is needed to optimize the real-world outcomes of evidence-based interventions (EBIs) for informal caregivers. This scoping review aims to systematically synthesize the literature that reports implementation strategies employed to deliver home- and community-based EBIs for informal caregivers of PwD, implementation outcomes, and the barriers and facilitators to implementation of these EBIs.

Methods: Embase, MEDLINE, Web of Science and Cochrane Library were searched from inception to March 2021; included studies focused on “implementation science”, “home- and community-based interventions” and “informal caregivers of people with dementia”. Titles and abstracts were screened using ASReview (an innovative AI-based tool for evidence reviews) and data extraction was guided by the ERIC taxonomy, the Implementation Outcome Framework, and the Consolidated Framework for Implementation Science Research; each framework was used to examine a unique element of implementation.

Results: 67 studies were included in the review. Multi-component (26.9%) and eHealth (22.3%) interventions were most commonly reported, and 31.3% of included studies were guided by an implementation science framework. Training and education-related strategies and provision of interactive assistance were the implementation strategy clusters of the ERIC taxonomy where most implementation strategies were reported across the reviewed studies. Acceptability (82.1%), penetration (77.6%) and appropriateness (73.1%) were the most frequently reported implementation outcomes. Design quality and packaging (intervention component suitability) and cosmopolitanism (partnerships) constructs, and patient’s needs and resources and available resources (infrastructure) constructs as per the CFIR framework, reflected the most frequently reported barriers and facilitators to implementation.

Conclusion: Included studies focused largely on intervention outcomes rather than implementation outcomes and lacked detailed insights on inner and outer setting determinants of implementation success or failure. Recent publications suggest implementation science in dementia research is developing but remains in nascent stages, requiring future studies to apply implementation science knowledge to obtain more contextually relevant findings and to structurally examine the mechanisms through which implementation partners can strategically leverage existing resources and regional networks to streamline local implementation. Mapping local evidence ecosystems will facilitate structured implementation planning and support implementation-focused theory-building.

Registration: Not applicable.

Keywords: Implementation science, Dementia, Informal caregiver, Community-based care

CONTRIBUTION TO LITERATURE

- 21 of the 67 studies focused on the implementation of home- and community-based, non-pharmacological, evidence-based interventions for informal caregivers of people with dementia were guided by implementation science frameworks, which suggests a disconnect between dementia research and implementation science.
- ‘Train and educate stakeholders’ and ‘provide interactive assistance’ clusters contained the most frequently employed implementation strategies, which reveals discrepancies with previous feasibility and importance ratings.
- We propose the need to supplement implementation science with knowledge from integrated care research, which prioritizes multi-level, cross-sector partnerships in dementia care across all stages of implementation and leverages stakeholders’ experiential knowledge, networks, and resources.

BACKGROUND

Recent forecasts estimate 152.8 million global cases of dementia by 2050, which will increasingly strain health systems that already struggle to meet current elderly care demands[1]. Recent studies suggest that home- and community-based services (HCBS) for people with dementia (PwD), facilitated with primary support from informal caregivers, present a cost-effective and patient-preferred alternative to institutionalization [2, 3]. Informal caregivers are identified as family members, friends, and neighbors of PwD, and their roles consist of facilitating instrumental activities of daily living, care management and care continuity [4]. In 2019, the World Health Organization reported an estimate of 133 billion hours of global unpaid informal dementia care [5]. Additionally, Rabarison and colleagues [6] estimated that the 3.2 million informal dementia caregivers, based in North America, included in their review provided unpaid care valued at $41.5 billion, highlighting the social and economic value of informal care.

To succeed in their role, informal caregivers also require support to reduce personal experiences of stress, anxiety, burnout, and depression, commonly exacerbated by their caregiving demands [7, 8]. Cheng and Zhang [9] produced a meta-review, synthesizing over

500 individual studies on the effectiveness of non-pharmacological evidence-based interventions (EBI) that support informal caregivers of PwD, which revealed EBIs can effectively reduce caregivers' psychological distress and strengthen dyadic communication and coping skills, improving their overall quality of life [9-12]. Types of caregiver-focused interventions include psychoeducation, eHealth, support group interventions, case management and care coordination, respite care, and exercise [9]. However, despite the multitude of EBIs that effectively support informal caregivers, the pertinent details surrounding the implementation of these interventions remain unclear.

The effectiveness of EBIs is merely one component that cannot be studied in isolation but must be considered among other contextual variables across multiple levels within the local health system and implementation setting, including clients, providers, organizations, and communities [13, 14]. EBIs must be systematically implemented within HCBS to strengthen caregiver resilience, improve quality of life, and delay institutionalization of PwD [15, 16]. This goal can be actualized by applying implementation science knowledge to steer dementia care research and practice.

Application of implementation theories, models, and frameworks

Implementation theories, models, and frameworks, hereby referred to as frameworks, allow researchers to structurally examine the implementation and sustainment processes and the contextual determinants (i.e. barriers and facilitators) to implementation [17]. The Consolidated Framework for Implementation Science Research (CFIR) is a comprehensive determinant framework that uses a multi-level, multi-dimensional approach to identify "what works, where, and why", and the breadth of constructs provides the most coverage to accurately reflect the complex nature of real-world implementation [18-20]. The CFIR has been widely applied in both empirical research [21] and in a systematic review [22] to structurally assess the barriers and facilitators to implementation.

In addition, the process of implementation can be systematically studied using the refined Expert Recommendations for Implementing Change (ERIC) taxonomy, which consists of 73 discrete implementation strategies that provide a structured set of "building blocks" used to homogenize implementation reporting and tailor a multicomponent implementation strategy [23]. Waltz and colleagues [24] grouped these strategies into nine clusters and rated each discrete strategy based on its perceived feasibility and importance. Implementation strategies act via mechanisms, which explain how the implementation strategy has an effect by describing the set of strategic actions that occur [25].

The Implementation Outcomes Framework (IOF) can be used to evaluate the degree of implementation success and the effectiveness of selected implementation strategies, and to provide important distinction between intervention failure and implementation failure. The IOF explores the acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost, penetration, and sustainability of the EBI [26]. The ERIC taxonomy and the IOF have both been applied to specify and compare implementation strategies and outcomes in empirical implementation research [27, 28] and in recent literature reviews [29-31]. The combination of the ERIC taxonomy, IOF and CFIR allows researchers to comprehensively examine the multiple levels and stages of implementation.

Study aims

Lourida and colleagues [32], and Bennet and colleagues [33], synthesized the implementation literature of EBIs for PwD and, indirectly, their caregivers, and each study determined an urgent need for additional synthesized literature, guided by implementation science frameworks, on the implementation of home- and community-based EBIs that support informal caregivers of PwD. This scoping review combines three implementation science frameworks to create a detailed and systematic synthesis of implementation science literature, to construct a comprehensive understanding of implementation, reflective of multi-faceted, real-world complexities. This facilitates the understanding of implementation strategies employed, outcomes reported, and the contextual barriers and facilitators to implementation. Accordingly, this scoping review aims to accomplish the following objectives:

1) Guided by CFIR, map, describe and synthesize the contextual barriers and facilitators to implementation of EBIs.
2) Guided by the ERIC taxonomy, map, describe and synthesize the implementation strategies employed to deliver home- and community-based EBI that support informal caregivers of PwD.

3) Guided by the IOF, map, describe and synthesize the implementation outcomes that have been used to report and measure the success (or failure) of implementation of these EBIs.

METHODS

Arksey and O'Malley's scoping review framework [34] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) reporting recommendations were used to guide this review [35]. The scoping review protocol for this article [36], published in January 2022, provides a detailed overview of this review's methodological steps and justifications at each stage; therefore, the methods are summarized in the sections that follow.

Study eligibility criteria

The review included studies that focused on home- and community-based EBIs that support informal caregivers of PwD, which a) explicitly reported the implementation strategies used and implementation outcomes examined and/or b) explicitly reported the barriers and facilitators to implementation of EBIs. Studies were excluded if they examined EBIs that primarily focused on supporting the PwD or were delivered outside of the HCBS settings (e.g., institutionalized care, acute care).

Information source and search strategy

The research team, with support from a specialized medical librarian, developed a full search strategy surrounding four key words: 'dementia', 'informal caregivers', 'intervention' and 'implementation and dissemination'. Following, literature search was conducted across Embase, Medline (Ovid), Web of Science and Cochrane Central Register of Controlled trials (Wiley) to include all peer-reviewed studies, written in English, published from inception to 08 March 2021. Critical appraisal of included texts was performed by two reviewers (EMZ and MB) using the Mixed Methods Assessment Tool-version 2018 (MMAT), which is used to appraise the quality of empirical research designs and the comprehensiveness of data reporting [37].

Study selection

In title and abstract screening stage, all relevant publications identified were imported into ASReview (https://asreview.nl/), an artificial-intelligence-aided tool that sequentially presented all imported publications to the reviewer from most to least relevant [38]. Previous studies indicated that ASReview's algorithm could detect 95% of the final included publications in their study within the first 20% of publications presented, which significantly reduced time spent screening titles and abstracts while effectively maintaining result quality and integrity [39].

The first author (EMZ) programmed the tool by screening 10 randomized (trial) publications and manually screened all imported titles and abstracts to completion. Following, the second author (MBS) only screened the titles and abstracts of studies excluded by the first author to avoid false negatives. Given the tool's capabilities, the second author stopped screening after 50 successively excluded studies, which was the team's pre-determined terminal point [36]. Following, the full texts of all included publications were assessed by both the first and second reviewers to exclude false positives. Any disagreements between the two authors were resolved by the third (KA) and fifth author (RH). Lastly, the reference lists of final included studies were checked to detect additional publications.

Data extraction

Data extraction, summarizing and collating process was conducted by the first and second author using a consensus approach, with regular discussion with all co-authors. A first table, guided by the domains and (sub)constructs of the CFIR, was used to extract and chart the identified barriers and facilitators. A second table was constructed based on the ERIC taxonomy and the nine clusters of implementation strategies reported in the literature. The first author identified detailed actions and mechanisms reported within each study, then "translated" and "matched" each with its corresponding discrete implementation strategies and respective clusters within the ERIC taxonomy. For example, a reported mechanism, such as "provide alternative mode of service delivery", would "match" the discrete strategy "promote adaptability (ERIC 51)" found in "adapt and tailor to context (Cluster 3)". A third table, guided by the IOF descriptions, was also developed to systematically extract and chart the data for implementation outcomes reported. Prior to data extraction, the first author trialed the three unique data extraction tables on 10 random studies and made iterative refinements to each table after discussion with the research team.

Upon team consensus, the implementation strategies, outcomes, and barriers and facilitators to implementation from included studies were extracted by the first author (EMZ). Categorization and “matching” of extracted data was reviewed for accuracy and confirmed by the second author (MBS); any disagreements between reviewers at this stage were resolved by discussion until consensus was achieved. Additionally, study characteristics, including country of study origin, research design, type of intervention, target population, outcomes reported, and frameworks applied, were also extracted, and synthesize

RESULTS

The full search yielded 2667 de-duplicated publications; 175 full-text publications were assessed for eligibility, and the reference lists of 62 publications were searched for additional relevant literature, which identified five additional publications. 67 publications were included in the final qualitative synthesis. Using the MMAT-version 2018, 56 of 67 studies were rated 100% and 11 studies were rated 80%. Appendix 1 presents a full overview of the results.

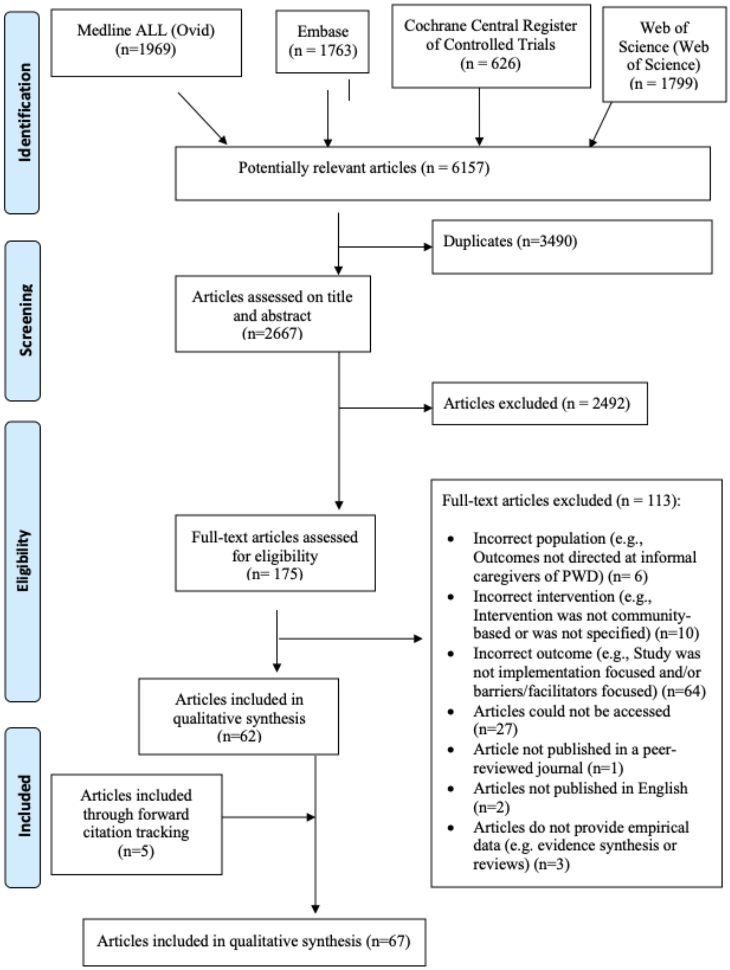

Figure 1. PRISMA diagram illustrates the process used to identify eligible studies

Study characteristics

The 67 included studies were published between 1996 and 2021; more than half were published between 2016 and 2021 (40/67; 59.7%). These studies reported 58 unique interventions, which were classified into one of eight types of interventions for informal caregivers of PwD based on the most prominent intervention components. This stratification was performed to examine the implementation characteristics of EBIs with clear commonalities to enhance the review's usability. Multi-component interventions (e.g., the combined use of case management, support groups and eHealth tools) (18/67; 26.9%)

[40-57] were most common, followed by eHealth (15/67; 22.3%) [58-72], psychoeducation (12/67; 17.9%) [73-84], care coordination and case management (6/67; 8.9%) [85-90], support interventions (5/67; 7.4%) [91-95], respite care (5/67; 7.4%) [96-100] exercise (3/67; 4.4%) [101-103], and occupational therapy (3/67; 4.4%) [104-106]. Studies originated mostly from the USA (36/67; 53.7%), followed by The Netherlands (11/67; 16.4%), the United Kingdom (9/67;13.4%), Australia (4/67; 5.9%), Portugal (2/67; 2.9%), and India, Israel, Poland, Germany, Canada (each n=1). The most common study designs were pre-posttest studies (38/67; 56.7%), followed by descriptive qualitative studies (20/67; 29.9%) and parallel convergent mixed methods design (9/67; 13.4%).

Use of implementation theories, models, and frameworks

Twenty-one articles were explicitly guided by an implementation framework (21/67; 31.34%). Ten unique frameworks were used, including Adaptive implementation model [46, 91, 92, 94, 95], Multimethod Assessment Process (MAP)/Reflective Adaptive Process (RAP) [64] , Reach, Efficacy, Adoption, Implementation, Maintenance (RE-AIM) [54-56, 106], Medical Research Council Framework [45, 62, 63], Fixsen and Blasé Implementation Process Model [50, 80], Consolidated Framework for Implementation Research [66], Leontjevas Process Evaluation Model [63, 71], Process Evaluation model by Reelick and colleagues [103], Lichstein's Treatment Implementation model [40], and Normalization Process Theory [44].

Several constructs were frequently included within these frameworks. Intervention characteristics, including quality and validity of evidence, were prevalent considerations made prior to implementation [44-46, 54, 56, 62, 63, 66, 71, 91, 92, 106]. All ten frameworks included constructs relating to implementation setting factors, including both internal (e.g., resources) and external (e.g., government policy) to the implementing organization, and the implementation process, including planning, program adoption, implementation execution and sustainment. Iterative and reflexive monitoring and (re-)evaluating implementation strategies and outcomes were also components of all included frameworks (see Appendix 1).

Barriers and facilitators to implementation (CFIR)

The barriers and facilitators to implementation were mapped based on the domains (and constructs) of the CFIR, including *intervention characteristics*, *outer setting* and *inner setting* of the implementing organization (e.g., nursing home), *characteristics of individuals* and *process* of implementation, which allowed for systematic examination of the contextual variables.

Barriers to implementation

Intervention characteristics domain presented barriers to implementation, including lack of relative advantage (4/67; 6%), poor adaptability (12/67; 17.9%) and unsuitable design quality and packaging (25/67; 37.3%). New interventions are hindered by high market saturation and are less likely to penetrate organizations due to the presence of similar 'usual care' programs [54, 56, 85, 94]. The EBI user's poor digital literacy hindered use, as did the interventions' complicated user interface designs, fragmented information, complex language, and unsuitable components that fit poorly with users' capabilities [54, 56, 58, 65, 71, 72, 85, 94].

The outer setting domain presented barriers to implementation, including patient needs and resources (24/67; 35.8%), such as implementing agencies' lack of awareness surrounding influential cultural nuances that deter caregivers from seeking external support (e.g., filial piety) [48, 94], and caregivers' personal circumstances, including insufficient personal finances, time constraints, poor digital literacy, and adequate information to confidently participate [45, 48, 59, 95, 96, 100, 103]. Additionally, an intervention is less likely to be positively received if introduced to caregivers at an inappropriate stage. For instance, introducing occupational therapy to caregivers immediately following a PwD's dementia diagnosis creates confusion; alternatively, engaging caregivers in a support program at a later stage in the care trajectory will be less effective since they need communication training and decision-making guidance beginning in early stages [74, 75].

Barriers to implementation under external policy and incentives (15/67; 22.4%) include lack of care coordination and continuity within less developed health systems [87, 89, 92, 95], top-down policies that established unsuitable or limiting funding mechanisms to implement and sustain community-based programs [79], and fragmented care financing that requires caregivers to (re)apply for assistance covered under different legislations [51, 91, 92, 94, 95, 106]. Cosmopolitanism (14/67; 20.9%) also contained barriers to implementation, including the complexities of vast networks that foster misalignments between partnering agencies and obscure respective actors' roles and responsibilities [50, 55, 91, 94]. Consequently, poorly networked EBI initiators face distrust with implementing agencies, limited regional partnerships, and impeded service referrals and dissemination [87, 89, 91, 92, 94, 95].

Inner setting barriers to implementation are found within implementation agencies (e.g., community nursing homes). Barriers classified under structural characteristics (2/67; 3.0%) and internal network and communications (2/67; 3%) constructs included rigid hierarchal organization structures, inflexible operating budgets, and lack of role clarity and fragmented information transfers between staff members [91, 94, 95]. Tension for change (5/67; 7.5%), compatibility (7/67; 10.45%), and relative priority (2/67; 2.99%) presented barriers, including staff reluctancy toward adopting externally developed interventions and implementing agency's lack of capacity for and commitment toward promoting new innovations [50, 81, 92, 94]. Leadership engagement (4/67; 6.0%), available resources (15/67; 22.4%), and access to knowledge and information (5/67; 7.5%) presented barriers, including ambiguity surrounding leadership roles [91], inadequate physical and human resources [56, 88, 96], and absence of implementation guidance and staff training resources [52, 89, 96].

Characteristics of individuals, including caregivers' and implementors' knowledge and beliefs about the intervention (5/67; 7.46%), also impeded implementation if they are skeptical about the intervention's privacy and safety [54, 63, 68, 102]. Caregivers' and implementors' self-efficacy (3/67; 4.48%) and individual identification with organization (2/67; 2.99%) impeded implementation if the actors lacked confidence in their roles or if they perceived a misalignment between the organization's mission and the intervention's intended outcome [101, 102]. Caregivers' and implementors' other personal attributes (15/67; 22.39%), such as a deficit in caregivers' personal capacity (e.g., financial, and physical capacity, digital literacy) to participate in the intervention [40, 101, 103, 105] or staff members' lack of social and cultural awareness [48, 54, 100], impeded implementation.

The process of implementation also presented barriers to implementation. Planning (13/67; 19.4%) was hindered by the absence of implementation manuals and fidelity monitoring mechanisms [40, 52], inconsistent and fragmented communication between partnering agencies [61, 88, 92], and poor familiarity with the implementation sites' contextual nuances [94]. Engaging (13/67; 19.4%) was hindered by ineffective recruitment strategies employed exclusively at the local intervention sites, and unanticipated difficulties promoting the intervention and gaining caregivers' and implementation partners' acceptance due to a fragmented regional network [46, 54, 66, 81, 92, 103]. Formally appointed implementation leaders (2/67; 3.0%), champions (3/67; 4.5%), and external change agents (2/67; 3%) presented fewer barriers to implementation, but the absence of clear leadership, high staff turnover, and fragmented information across partnering agencies created tension that disrupted all stages of implementation [54, 55, 91]. Executing (7/67; 10.5%) was hindered by high caregiver attrition rate [52, 70] and unexpected organizational changes and diminished capacity [88, 95]. Reflecting and evaluating (3/67; 4.5%) revealed discrepancies between clinical and real-world results, which caused unanticipated implementation barriers that required iterative responses from implementers [50, 54, 95].

Facilitators to implementation

Intervention characteristics that facilitated implementation include the EBI's relative advantage (10/67; 14.9%), adaptability (19/67; 28.4%), design quality and packaging of intervention components (42/67; 62.7%) and cost (4/67; 6.0%). Advantageous interventions possessed flexible, patient-centered, and culturally-adapted programming, and they promoted service continuity through a comprehensive range of integrated services. Adaptable EBIs ensured homogenous participant groups and provided multi-modal delivery of intervention components [48, 57, 69, 71, 85, 92]. EBIs were more successfully adopted by end-users, if moderated by a human facilitator (e.g., therapist, IT specialist, coach), and by organizations, if implementation is guided by a protocolized implementation guide [48, 49, 52, 57, 60, 61, 64, 69, 70, 74, 79, 81, 84, 101-103, 105]. Interventions with costs covered through sustainable funding sources (e.g., private foundation or government grants) were more likely to survive [80, 100].

Outer setting domain contained the most reported facilitators to implementation. Patient needs and resources (22/67; 32.8%) included convenient service location equipped with appropriate physical infrastructure and scheduling flexibility [78, 96], sufficient user awareness and preparedness [82, 85, 105], and suitable fit between intervention and users' levels of digital literacy and needs [58, 60, 61, 70]. Cosmopolitanism (29/67; 43.3%) facilitators included establishing and harnessing strong, active local collaborative networks with dedicated implementation and dissemination partners, including intersectoral organizations (i.e., intermediary organizations) with influence spanning across sectors, whose insights and contributions are valuable across all stages of implementation [41-44, 47, 65, 79, 80, 85, 91, 94, 95, 98, 107]. External policy and incentives (20/67; 19.9%) facilitate implementation through the successful funding and reimbursement of intervention costs, delivered through mechanisms established by existing national legislations [46, 51, 57, 80, 86, 91, 95, 100, 107].

Inner setting constructs, including structural characteristics (1/67; 1.5%), network and communications (3/67; 4.5%) and culture (3/67; 4.5%), facilitated implementation through continuous structural financing, regular staff communication and training, and staff enthusiasm about the intervention [46, 54-57, 94]. Facilitators associated with tension for change (2/67; 3.0%), compatibility (15/67; 22.4%) and learning culture (1/67; 1.5%) included the alignment of the intervention's intended outcome and implementing agency's mission, the agency's willingness and administrative capacity to routinize the intervention as part of usual care (e.g., utilizing existing billing/work codes to receive compensation, integrate EBI into clinical workflow), and the modification of existing staff members' roles to adopt new interventions [46, 47, 50, 54, 56, 64, 81, 82, 95]. Facilitators under leadership engagement (7/67; 10.5%) included engaging managers that possessed a clear agenda, a creative mindset, and a proactive approach of continuous improvement [50, 66, 80, 88, 91, 95]. Facilitators under available resources (13/67; 19.4%) included motivated, well-trained staff members, accessible and convenient implementation location, and supplemental financial and collaborative support from regional government agencies [54, 56, 61, 66, 80, 94-96, 100]. Access to knowledge and information (11/67; 16.42%) was facilitated by using a cascade model of training, hiring external training agencies, and requiring protocolized licensure and certification for intervention staff to ensure fidelity and program validity [43, 46, 49, 51-53, 55, 57, 79, 80].

Characteristics of individuals, including caregivers’ and implementors’ knowledge and beliefs about the intervention (2/67; 3.0%), facilitated implementation if the intervention was developed locally or within the implementing organization [48, 66]. Caregivers’ and implementors’ self-efficacy (8/67; 11.9%) and individual state of change (2/67; 3.0%) facilitated implementation if they possess competencies required to succeed in their roles and are well-equipped with communication and coping skills [50, 54, 58, 63, 74, 75, 80, 104]. Individual identification with organization (3/67; 4.48%) facilitated implementation if the implementation agents identified with the intervention initiators and were enthusiastic about its success [46, 66, 80]. Other personal attributes (10/67; 14.9%), such as staff members’ ability to adapt and cater to caregivers’ iterative needs (e.g., bilingual and technical competencies) and caregivers’ positive attitudes toward participation, also facilitated implementation [45, 46, 48, 54, 58, 79, 91, 98, 105].

The process of implementation was also facilitated by unique contextual factors. Planning (13/67; 19.4%) was facilitated by adapting and translating interventions to fit local implementation setting and co-creating implementation and marketing plans that considered influential contextual nuances [40, 44, 52, 55, 56, 88, 91, 94, 95, 98, 106]. Engaging (21/67; 31.3%) facilitators included the active dissemination of intervention information, by applying marketing strategies to reach specific audiences and disseminating recruitment materials through partners’ networks [43, 46, 48, 51, 55, 56, 58, 65, 69, 71, 79, 86, 88, 91, 92, 94, 95, 98, 102], and the engagement of caregivers through referrals from general practitioners and members of local care organizations [54, 55, 69, 85, 90]. Additionally, opinion leaders (2/67; 3.0%), formally appointed internal implementation leaders (8/67; 11.9%), champions (7/67; 10.5%), and external change agents (11/67; 16.4%), facilitated implementation by engaging local influential religious leaders to support normalizing the use of new interventions [48, 88], by leveraging individual strengths from external agencies to establish a multidisciplinary advisory team [43, 54, 55, 65, 95], and by appointing a leader to guide implementation and sustainment [85, 86, 88, 91, 92, 94, 95, 99]. For example, faith-based organizations may influence public perception and approval of interventions; academic partners support recruitment and registration of new participants [48], and intermediary organizations (e.g., Alzheimer's Association) inform regional partners and support in facilitating knowledge transfer. Executing (14/67; 20.9%) and reflecting and evaluating (8/67; 11.9%) facilitated implementation through regular monitoring and evaluation, securing partnerships through formal agreements (e.g., Memorandum of understanding), and iteratively adapting operational processes to meet real-world demands and unanticipated complications. Appendix 1 provide further details found surrounding barriers and facilitators to implementation.

Implementation and dissemination strategies (ERIC taxonomy)

Of the 67 included studies, 61 studies reported details on the implementation strategies employed to support the delivery of the chosen EBI for caregivers of PwD. Sixty-eight of the 73 ERIC taxonomy's discrete strategies, across all nine clusters, were identified; six discrete strategies (ERIC 45, 50, 68, 3, 28, 10) were not reported by any included study. Multi-component interventions employed the widest range of discrete strategies (58/73; 79.5%), followed by psychoeducation interventions (48/73; 65.8%), and care coordination and case management (40/73; 54.8%). The most frequently identified discrete strategies were found in the "Train and educate stakeholders" cluster. Mechanisms found within this cluster included training through multi-modal delivery, including delivering education and information through an internet platform equipped with real-time feedback from trainers via a toll-free telephone line [44, 47, 50, 54, 58, 65, 71, 101]. The "Provide interactive assistance" cluster also contained frequently employed discrete strategies; mechanisms identified included providing tailored, individualized feedback to end-users [72, 79, 90], facilitating flexible scheduling for end-users [54, 78, 90, 98, 102] and enhancing the connectivity and reflexivity between referrers and services [43, 44, 65, 79, 80, 85, 86]. More details can be found in Appendix 1.

Several discrete strategies within the same cluster were also frequently employed together. In the "Develop stakeholder interrelationship" cluster, "Build a coalition" and "Obtain formal commitments" (9/67; 13.4%) were employed together across six studies [41, 56, 79, 88, 91, 94]. In the "Train and educate stakeholders" cluster, "Develop educational materials" (27/67; 40.3%), "Make training dynamic" (34/67; 50.7%), and "Distribute educational materials” (31/67; 46.3%) were employed together in 15 studies [40, 42, 44, 49, 50, 65, 66, 69, 70, 76, 77, 81, 82, 90, 99]. In the “Adapt and tailor to context” cluster, “Tailor strategies” (26/67; 38.8%) and “Promote adaptability” (27/67; 40.3%) were employed together in 18 studies [40, 41, 46, 47, 49, 56, 58, 61, 65, 69, 71, 74, 80, 90, 93, 102, 103, 105].

Eighteen of 67 studies [40-42, 44, 47, 50, 54-57, 80, 91, 92, 94, 95, 99, 103, 106] conducted initial assessments of contextual determinants and, based on these, adapted the implementation strategies to target the barriers and improve the translation of the EBI into local practice. Adaptations made to enhance feasibility due to local constraints (i.e. available financial resources, compliance with local insurance reimbursement regulations) include reducing the frequency of intervention delivery [41, 54, 103, 106] and adapting the professional profile of the EBI provider to fit the available local human resources [47, 55, 57, 91]. Other challenges included the need to adapt the language used to suit users’ capabilities [40, 57] and the location, medium and format used to deliver the EBI [41, 56, 94]. However, none of the studies were explicit about the mechanism of each adaptation nor did they report a formal evaluation of the impact the adaptation had on the effect of the selected strategies on implementation outcomes, which may indicate a lower degree of maturity of implementation science application in this area.

Implementation Outcomes (Implementation Outcomes Framework)

The IOF presents an implementation outcome taxonomy, including *acceptability, adoption, appropriateness, costs, feasibility, fidelity, penetration, and sustainability* [26]. *Appropriateness* (49/67; 73.1%) was reported as the intervention’s ‘suitability’, ‘usability’, and ‘helpfulness’ for users and its ‘fit into existing workflow’ within implementation agencies [66]; evaluative indicators included respondents’ rating of perceived ‘helpfulness’ and their ‘intention to use’. *Acceptability* (55/67; 82.1%) was reported as the end-users’ and implementing agencies’ ‘satisfaction’ with intervention effectiveness and components, including delivery modality, timing of intervention, duration of program, and quality of interventionist [62, 63, 67].

Penetration (52/67; 77.6%) was only reported in relation to the wider implementation setting; studies mainly descriptively reported how users were recruited, including marketing strategies, and leveraging financial resources and interpersonal relationships from cross-sector partners [42, 43, 48, 65, 69, 76, 81, 83, 85, 87, 105]. *Sustainability* (40/67; 59.7%) was described as users' and organizations' 'demand for program continuation' and 'routinization of care'. Studies mainly focused on describing the existing internal and external financing mechanisms and the role of collaborators and external agencies in training and scaling up [42, 43, 56, 62, 79, 86, 92, 100, 106].

Implementation fidelity (14/67; 20.9%) was characterized as the facilitators' degree of 'adherence' to the implementation protocol and was explicitly reported through fidelity enhancing, measuring, and monitoring mechanisms. Implementation fidelity enhancing strategies included protocolizing implementation [49, 53, 76, 99], training certification programs with initiators [44, 46, 49, 53-56, 76, 81, 99], and using fidelity checklists and guiding scripts [50, 55, 81]. Fidelity measuring and monitoring strategies included the use of delivery assessment forms and checklists [44, 55, 99, 106] and ongoing coaching and consultation with initiators [44, 53-55, 78, 81, 99].

Adoption (18/67; 26.9%) was reported as how administrations are motivated to 'buy-into' the intervention and how the engagement of local 'influencers' promotes user uptake [48, 50, 57, 94]. *Feasibility* (18/67; 26.9%) was reported as the degree to which intervention components fit within the organization; for instance, components tested in the RCTs (e.g., fidelity monitoring mechanisms [i.e. surveillance records]) were not pragmatic, or practices could not be easily streamlined into existing workflow [40, 72]. *Implementation cost* (9/67; 13.4%) was mainly reported as how operational and staffing costs were covered, mainly though government-regulated financing programs (e.g., Medicare, Social Support Act, Older Americans Act) [43, 80, 86, 99, 100, 106].

Studies did not evaluate the relationship between implementation strategies and implementation outcomes, but several descriptive trends were identified across included studies. Facilitation (ERIC 33) was employed in 23 of 55 studies that reported on acceptability. Using train-the-trainer strategies (ERIC 71) influenced implementation fidelity in 11 of the 14 studies that reported on fidelity and 23 of 40 studies that reported on sustainability. Mass media (ERIC 69) were employed in all studies that reported on penetration.

DISCUSSION

To our knowledge, this is the first review to be guided by three unique implementation science frameworks to study barriers and facilitators to implementation, implementation strategies, and implementation outcomes found in literature relating to EBIs for informal caregivers of PwD. Applying multiple frameworks allows researchers to examine the various components across implementation processes to potentially establish links between contextual determinants, implementation strategies, and implementation outcomes [108]. Through this methodological approach, our findings illuminate the achievements and gaps in theory-informed implementation thinking in modern dementia care, and they highlight contextual factors that influence successful implementation of EBIs of importance to informal caregivers of PwD.

The MMAT rating results indicated that included studies were of high quality overall, but the appraisal criteria did not assess the quality of implementation reporting nor the rigor of evaluative implementation research designs, suggesting that more suitable appraisal tools are essential to ensure high quality implementation research [109]. Only 21 out of 67 included studies were guided by an implementation science framework, indicating a need to reinforce the application of implementation science in dementia care research. Further, this review also found that the mean importance and feasibility ratings for discrete strategies, as determined by Waltz and colleagues [24], did not reflect the frequency of implementation strategies used in the real-world implementation of EBIs in home- and community-based services (HCBS). For example, the discrete strategy “use mass media”, employed by 12 of 67 studies, and “use train-the-trainer strategies”, employed by 26 of 67 studies, were both labeled in the original study as low feasibility and low importance, revealing the potential lack of suitability and relevance of existing ratings in HCBS contexts. These results call for an extension of the ERIC taxonomy, or the development of an entirely new framework, with insights from real-world community practitioners with implementation experience, as proposed by Balis and associates [110].

Included studies were also not explicit about implementation strategy mechanisms and did not evaluate implementation strategy effectiveness, nor the degree of influence on implementation outcomes, potentially due to shortage of funding for Type II and III implementation-effectiveness hybrid study design prior to 2020 [111, 112]. Only one study in this review reported the rationale for the use of an implementation-effectiveness hybrid design [44] – overall, a direct link (statistical or otherwise) between the implementation strategy selected and implementation outcomes assessed could not be established or evaluated formally in this review. Further, 18 included studies seemed to have adapted their implementation strategies to target barriers and enhance the translation of EBIs to fit their context, but these studies did not directly evaluate the degree of alignment between the barriers and adapted strategies, nor did they propose evaluative methods, which may suggest low maturity of implementation science application in dementia care research.

Similar to the challenges mentioned by Lengnick-Hall and colleagues [113], implementation outcomes were also inconsistently reported, and authors were not explicit about the level of analysis (i.e. individual- or organizational-level). Delineation is critical to determine casual mechanisms and evaluate implementation strategy effectiveness, particularly when reporting fidelity as an outcome, as authors often referred to both end-user adherence to intervention protocol and facilitator adherence to implementation protocol. The Outcomes Addendum to the CFIR can be used to support researchers in delineating the level of measurement to improve the reporting and synthesizing of contextual determinants [114].

Relating to the barriers and facilitators to implementation, the modifiable intervention characteristics, primarily design quality and packaging, should be strategically and iteratively adapted through feedback from end-users to fit the implementation context. In accordance with Lundmark and colleagues [115], this review concluded that consideration of inner and outer setting determinants is also central to ensure alignment between the intervention, the implementing agency's mission and structural capacity, and sociocultural needs and preferences in the local community [48, 57, 69, 71, 85, 92]. In the outer setting domain, cosmopolitanism included the relationship dynamics between the implementing agency, cross-sector stakeholders, and researchers in academic institutions (e.g., community-academic partnerships [116] and public-private partnerships [106]). The findings suggest for the description of cosmopolitanism to distinguish between multi-level, cross-sector partnerships to focus resources and expertise more effectively, which aligns with the recommendation of Proctor and colleagues [117] to leverage the individual strengths of each partner and co-develop toolkits to facilitate evidence dissemination and EBI implementation. These complex networks facilitate multiple stages of implementation, but further implementation research supported by experiential knowledge from implementation support practitioners is required to systematically examine processes of collaboration, including each partner's role in knowledge translation, knowledge brokering, and EBI sustainment and scale-up, to advance implementation theory [118-120].

RECENT DEVELOPMENTS

To ensure the relevance of the results, an updated search was conducted in August 2023 using the original search terms. Only ten of the 1186 results published after March 2021 fitted the inclusion criteria, and these studies primarily focused on the early-stage adaptation and implementation of three EBIs, iSupport [121-126], Reducing Disability in Alzheimer's Disease (RDAD) program [127, 128] and STrAtegies for RelaTives (START) [129, 130], which have been previously included in the Results (see Appendix 1). The new articles indicated progress in enhancing real world applicability but did not yield any new barriers or facilitators. Implementation and adaptation processes were guided by the i-PARIHS framework [129], ecological validity framework [123], WHO iSupport Adaptation and Implementation Guidelines [121, 122, 124-126], and EBI adaptation guide by Escoffery and colleagues [128, 131]. Trends in recent publications suggest that implementation science in dementia care research is slowly progressing, mainly with implementation and adaptation guidance from the World Health Organization and through international collaboration. Overall, there has been little significant progress made in recent years, and the results from this review remain representative of current literature.

LIMITATIONS

This review has several limitations. First, the synthesized results did not include studies published after March 2021, which may have excluded implementation details from recent publications. Next, the ERIC taxonomy has limitations since it was developed exclusively through insights from hospital-based clinicians, and implementation strategies employed at the community setting may not be clearly presented in the taxonomy, which potentially limited the reviewer’s ability to optimally extract and match reported strategies from the literature. The review proposes a call to action for the implementation science community to systematically develop a new taxonomy more appropriate for use in the community setting. Additionally, since the search strategy was also developed with guidance from existing implementation science research largely conducted outside of the community setting, more suitable terminology may have been missed, which may exclude relevant articles. Next, although the validity of ASReview tool has been studied [39], there is currently no evidence-based terminal point for article screening by the second reviewer using ASReview, potentially (although unlikely) excluding relevant records. Lastly, due to the poor utilization of suitable implementation reporting guidelines by included studies, the review results were unable to present clear connections between implementation determinants, strategies, and outcomes.

FUTURE DIRECTIONS AND RECOMMENDATIONS

The main findings from this scoping review indicate a growing demand for systematic implementation and dissemination of EBI for caregivers of PwD. Further research to develop implementation frameworks that systematically guide implementation processes and address contextual barriers involved in community-based implementation of non-pharmacological EBI is needed. For example, the Community-Academic Aging Research Network’s pipeline for dissemination [116] provides a framework, inclusive of community, academic and intermediary stakeholder perspectives, to create a contextually suitable implementation plan and to leverage cross-sectoral partnerships that facilitate EBI implementation and continuation.

Future research in this area would benefit from employing more rigorous evaluative methodology, and future reviews may perform meta-analyses to further evaluate the impact of implementation strategies on implementation outcomes. Lastly, scoping reviews focused on implementation literature often report limitations due to heterogenous implementation reporting [132, 133]. Therefore, promoting the use of standardized implementation reporting guidelines (e.g., STaRI [134]) in future studies will enable reviewers produce more clear, consistent, and reliable results.

CONCLUSION

The novel combination of three implementation frameworks in the context of evidenced interventions to support informal caregivers of PwD has offered a first analysis of the implementation strategies and mechanisms applied to actualize implementation and the multi-level implementation barriers and facilitators that directly impact implementation success (or otherwise) of these interventions. This review provides a systematic overview that can be used as a foundation to inform and guide implementation researchers to structurally examine outer setting facilitators and implementation strategies, at multiple levels and across sectors, and can guide implementation agents to strategically leverage existing resources and regional networks to streamline local implementation. Mapping local evidence ecosystems will facilitate more structured implementation planning and support for HCBS interventions, and new evidence will also contribute to strengthening implementation science theory and application in dementia care.

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4

Transforming dementia research into practice: a multiple case study of academic research utilization strategies in Dutch Alzheimer Centres

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ABSTRACT

Background: Non-pharmacological dementia research products, such as social and behavioral interventions, are generated in traditional university settings. These often experience challenges to impact practices that they were developed for. The Netherlands established five specialized academic health science centers, referred to as Alzheimer Centers, to structurally coordinate and facilitate the utilization of dementia research knowledge. This study leverages implementation science to systematically explore the research utilization strategies used by academic researchers from each Alzheimer Center, based on the 'knowledge-to-action' (KTA) framework that includes knowledge creation, adaptation, dissemination, and implementation.

Methods: Individual semi-structured qualitative interviews were conducted with 29 respondents across the five Alzheimer Centers in the Netherlands. Participants were selected through purposive (snowball) sampling. Interviews were conducted in-person and virtually through Microsoft Teams, and all were audio-recorded and transcribed verbatim. Data analysis was guided by the dimensions of the KTA framework.

Result: There was a high variation in the strategies used across the five Alzheimer Centers to bring non-pharmacological dementia research into practice. Selected strategies in each Center were influenced by the typology of research products produced and the Centers' organizational heritage. The knowledge creation and adaptation phases were mainly facilitated by funders' guidance toward research impact and research product co-creation with patients and implementing organizations. Dissemination and implementation phases were often facilitated through utilizing support from university-based technology transfer offices to facilitate implementation and valorization and establishing and strategically leveraging formal infrastructure, such as public-private partnerships and professional collaborative networks.

Conclusion: Successful research utilization requires evolving researcher competencies to meet environmental demands and facilitating co-creation with research end-users and implementing partners. Understanding external determinants influencing research utilization in the Dutch dementia research ecosystem is crucial for capacity-building and aligning cross-sector agendas. The KTA framework appears to reveal the intricacies of research utilization, guiding future studies to explore strategies employed across various contexts.

Keywords: Knowledge translation; Implementation science; Research impact; Dementia

BACKGROUND

Non-pharmacological dementia research knowledge products, such as eHealth interventions, psychoeducation programs, and diagnostic tools [1], are often siloed within academic settings and research domains. This contributes to the 17-year research-to-practice gap that delays research use and societal impact [2]. Knowledge and pragmatic tools that guide pharmacological drug discovery and development processes, including product production, validation, valuation, and commercialization [3, 4]. These tools are considerably more mature compared to those available to guide researchers in non-pharmacological dementia research utilization [5, 1]. Formal research infrastructures, such as academic health science centers, have been developed as capacity-building initiatives to strengthen the research ecosystem and enhance research impact of such academic outputs [6-8]. The structure, governance, and organizational dynamics within these formal research structures have been investigated [8], but previous studies have not structurally identified strategies, employed by academic researchers, to utilize research products [7, 6].

The concept of research utilization is also referred to as ‘knowledge translation’, ‘knowledge transfer’, or ‘knowledge mobilization’ [9]. However, these terms are often inconsistently used in literature, and the explicit stages and strategies employed in the research utilization process are enigmatic in literature [10, 11]. Implementation science theories, models and frameworks help guide research utilization phases, identify specific strategies used, and monitor and evaluate process outcomes [12, 13, 5]. The complex and iterative processes involved in delivering knowledge products to the intended end-users can be explored using process models, such as the knowledge-to-action (KTA) framework. This framework consists of two main components: the knowledge creation funnel and the knowledge action cycle [14]. It was originally developed by Graham et al. as a comprehensive ‘planned action model’, or ‘process model’, that guides the translation and transfer of academic research findings into real-world impact [15, 9, 16]. This framework was chosen to guide this study over other implementation process models, such as i-PARIHS [17], due to its adaptability and wide application across various disciplines [14].

This study is guided by a four-phase research utilization model that includes knowledge creation, adaptation, dissemination, and implementation. These phases were derived based on the two components of the KTA framework: the knowledge creation funnel and the knowledge action cycle [14]. The first component, the knowledge creation funnel, consists of three stages: knowledge inquiry, knowledge synthesis, and the development of research knowledge tools and products, such as health education programs and decision support tools [9]. The knowledge creation funnel guided the development of the first phase in this study's research utilization model: 'knowledge creation'. In this first phase, research output may be supported by a Mode 1 approach, driven by funders and researchers, or a Mode 2 approach, emphasizing society- and practice-focused research that encourages a participatory approach [10, 7]. A participatory approach uses input from various stakeholders to create equitable and feasible research knowledge products [18, 19]. Such stakeholders may include health practitioners in care settings and patients with lived experiences [18, 19].

The knowledge action cycle is the second component of the KTA framework. The seven iterative stages of this component are organized into three research utilization phases: 'knowledge adaptation', 'knowledge dissemination', and 'knowledge implementation'. This is done to clearly explicate the strategies employed by researchers at each phase of the continuum. The phase of 'knowledge adaptation' begins with a contextual needs assessment to determine environmental influences. This step is followed by knowledge adaptation activities to fit the research to the user context, such as co-designing and adapting research product components with local stakeholders and end-users [20-22]. For fundamental (biomedical) research products, this stage focuses on translating research findings into products, such as diagnostic tools, that are ready for implementation in clinics and other practice settings [23]. Knowledge adaptation should be delineated into intervention adaptation and implementation adaptation. Intervention adaptation refers to tailoring components of the intervention to fit the targeted user group. Implementation adaptation focuses on modifying the implementation plan to fit the contextual determinants (e.g., available resources, organizational readiness) [24].

Knowledge dissemination is an implicit stage in the KTA trajectory, characterized as an activity of ‘end-of-grant knowledge translation’ [9]. However, this study explicates dissemination as a critical stage used to translate knowledge to practice and policy [25]. Knowledge dissemination, the third phase in the research utilization model, is defined here as the transfer and exchange of knowledge beyond the boundaries of the research origin. This involves disseminating knowledge to the intended recipients, such as implementation agencies and patients [26]. Dissemination strategies can be categorized as a ‘push’ or ‘pull’ strategy, in which either (1) the knowledge producers proactively provide knowledge to their target recipients (e.g., conducting training) or (2) the knowledge recipients seek knowledge to support their decision-making (e.g., conducting a scoping review to inform policy) [27, 28]. Knowledge ‘exchange’ strategies, also identified in ‘integrated knowledge translation’ (IKT) literature, as facilitate active co-creation and partnership engagement. These strategies focus on strengthening research infrastructure and health policies to effectively disseminate knowledge [29]. Notably, this stage is often facilitated prior to, or parallel to, the implementation process [12]. The last phase of the research utilization model is knowledge implementation. This consists of (1) assessing barriers and facilitators to implementation, (2) selecting and tailoring implementation strategies, (3) monitoring and evaluating implementation outcomes, and (4) scaling and sustaining the intervention in the implementation setting [9].

A scoping review found 146 articles that mentioned the use of the KTA framework, but only 10 articles provided clear examples that demonstrated how the framework was used to guide implementation, all from the perspective of clinicians and healthcare practitioners [16, 14]. This study explores the perspective of researchers to structurally explore the activities performed to facilitate the research utilization process. This can inform the creation of theory-driven implementations strategies, which can explicate the knowledge utilization process to reduce implementation complexity and enhance process clarity [30]. In the Netherlands, five academic Alzheimer Centers were created to strengthen the dementia healthcare services and dementia research systems. These institutions also connect actors involved in research, treatment, and education. Guided by the research utilization model and the KTA dimensions, this study aims to explore the unique research knowledge utilization activities of each Alzheimer Center. It seeks to identify overarching strategies employed to create, adapt, disseminate, and implement non-pharmacological dementia research to achieve research impact.

The main research questions include:

1) What strategies were used by the Alzheimer Centers to facilitate creation and adaptation of research findings into research products?
2) What strategies were employed to disseminate research products?
3) What strategies were used to facilitate the implementation of research products?

METHODS

Study design

This study had a multiple case study design, guided by Yin [31], to explore the respective research knowledge utilization processes present in each Alzheimer Center. This design was advantageous to identify “how” these processes occur and explore “why” certain strategies appeared in one context and were absent in others. To ensure reliability and validity, an in-depth analysis of each case was performed to identify the activities performed by each Alzheimer Center at each stage of the KTA trajectory. Patterns in the activities were identified to inductively extrapolate research utilization strategies [32]. Cross-case comparisons (i.e. cross-referencing) were used to compare strategies from each Alzheimer Center and strengthen validity of findings across varied contexts. This approach also helped determine the contextual variables within each Alzheimer Center that may influence the selection of certain strategies [31]. Results were developed based on the findings from semi-structured interviews with key informants from each Alzheimer Center.

Setting

In the Netherlands, there are seven university medical centers (UMCs), located in Amsterdam, Rotterdam, Nijmegen, Groningen, Maastricht, Utrecht, and Leiden, responsible for providing patient care, education, and research [33]. Between 2000 and 2019, five UMCs have embedded Alzheimer Centers, to centralize the creation of dementia research, education, and care (diagnostic and treatment) and to provide tertiary support in each of their respective regional catchment areas [34, 35]. The Alzheimer Centers are academic health science centers and have a tripartite aim of providing patient care, education, and research [8]. This structure promotes close multi-disciplinary collaboration and engagement between academic researchers and (clinical) practitioners [36].

Further, each Alzheimer Center focuses on various areas and stages of dementia research, ranging from fundamental knowledge creation to applied research implementation and sustainment. These Alzheimer Centers were purposively selected as the focus of this study due to their unique tripartite structure, their significant research output, and their social and professional connectivity with other stakeholders within the Dutch dementia research ecosystem, detailed in Table 1.

Table 1. Description of Dutch dementia research ecosystem stakeholder groups

Stakeholders	Description of role and function in research ecosystem
ZonMw	ZorgOnderzoek Nederland (Care Research Netherlands) (ZonMw) is a government-financed research funding agency that designs programmes that facilitate the allocation of public health research funding. In addition to providing funding, ZonMw performs activities including providing research impact planning guidance (e.g., theory of change) and knowledge brokering between research teams, practice, and policy.
Dutch Organization for Scientific Research (NWO)	NWO is a government-financed research funding agency that ensures quality and innovation in science for a wider range of basic and interdisciplinary research areas.
Alzheimer Nederland	Alzheimer Netherlands is a charity and patient-representative organisation for people with dementia and their caregivers, as well as a dementia research funding agency and knowledge broker. Activities performed include advocating for better patient care, raising public awareness, and facilitating informative support services, including: • "Dementia dialogues": Structured events that involve researchers and other stakeholders to discuss and share experiences, influence policies, and strengthen support networks. • "Alzheimer Cafes": Informal community support meetings organized for people with dementia, caregivers, and care and research professionals to share experiences, disseminate research, and gather real-world perspectives.
National knowledge institutions	National knowledge institutions (e.g., Pharos and Vilans) enhance the research ecosystem by synthesizing evidence, guiding policy, and ensuring knowledge translation to improve societal health outcomes. Researchers receive support from such institutes in knowledge brokering and translation.
Health insurance agencies	Health insurers may support research utilization by financing, adopting and sustaining evidence-based practices. For example, van thuis uit is an initiative from CZ insurance that promotes ageing in place (home-based care).
Dutch Ministry of Health, Welfare, and Sport (VWS)	VWS directs the national health research agenda and funds healthcare research, influences policy, sets standards, and promotes innovations, significantly shaping healthcare quality and public health initiatives in the Netherlands. VWS established the National Dementia Strategy 2020-2030 to stimulate research (via ZonMw and NWO) aimed at improving quality of life for people with dementia and their caregivers. VWS also stimulates research through funding the Stimuleringsregeling E-Health Thuis (SET) initiative, which promotes the adoption and implementation of e-health solutions in home care settings.
	Professional associations, including the Dutch Federation for Psychology and Dutch Federation for Neurologists, set professional standards, accredit educational

Professional associations or federations	programs, and impact research by promoting ethical guidelines and facilitating collaborations within their respective fields.
	Verpleegkundigen & Verzorgenden Nederland (V&VN) is a professional association for nurses, nursing assistants, and professional carers in the Netherlands and support each group through professional standards, educational resources, advocacy, networking opportunities, and promoting best practices. V&VN supports occupational groups (e.g., case managers) by providing professional development and guidance tailored to their needs within the healthcare industry.

Sample and recruitment

Research participants include program managers and researchers employed by an Alzheimer Center, specializing in a range of disciplines (e.g., psychiatry, neuropsychology, epidemiology) that contribute to dementia research. The research team obtained permission from the leader(s) of each Alzheimer Center, prior to the study, to conduct research in their organization. Individual participants were recruited using purposive and snowball sampling, identified through each Alzheimer Center's official website, official LinkedIn pages, and through the referral of Alzheimer Center leaders. These leaders also shared an introductory e-mail, on behalf of the research team, to inform and invite selected staff members to participate in this ongoing research project. Staff members responded with their intention to participate. Selected participants had a wide range of years of work experience and research area expertise, including developing fundamental research, social and behavioral programs, and digital health technologies. The variety of participant backgrounds included aimed to provide a representative sample of staff profiles and research portfolio of each Alzheimer Center.

Data collection

The research team, consisting of one PhD candidate and three university professors, conducted semi-structured qualitative interviews with 5-6 participants from each Alzheimer Center. On average, each interview was 60 minutes and focused on the insights of 1-2 participants. The interview guide (see Appendix 2) was developed with guidance from the stages of the KTA framework, focusing on the (1) mode of knowledge creation, (2) knowledge adaptation activities, and (3) dissemination and implementation strategies. Each author listed in this study participated in developing the interview guide and conducting interviews. Topics and questions were pilot-tested in the first two interviews and remained the same. There were no repeated interviews needed. Informed consent forms were provided to each respondent prior to the interviews, detailing the scope of the project and the data management plan to provide transparency to participants. There were no withdrawals during the data collection process. All authors participated in conducting interviews. Interviews were conducted in-person or through video-conferencing between March 2023 and December 2023, and audio- and visual-recordings were made to ensure data accuracy during data transcription. Interviews were conducted until data saturation was reached (i.e. responses became homogenous and repetitive).

Data analysis

Each interview recording was transcribed verbatim, and transcripts were sent to the respondents for final comments and approval. Sensitive information was redacted upon request. Each transcript was first examined individually, and repeated concepts were systematically labelled and thematically grouped to conduct content analysis using an abductive thematic coding approach, based on Timmermans and Tavory [37, 38]. First-order codes were deductively extracted and organized along the established dimensions of the KTA framework. Following, inductive thematic second-order codes were identified, extracted, and analyzed to explicate the research utilization strategies employed at each stage. This was the most appropriate approach given the dual research aim of identifying the novel strategies identified in this research context and their position in the KTA trajectory. The first author (EMZ) conducted the initial first-order coding of the raw data. All authors were involved in developing and refining the second-order thematic codes to validate the final interpretation of themes. The final themes were used to develop research utilization strategies that informed the case description for each Alzheimer Center. The coding framework can be found in Appendix 2. The qualitative reporting in this study was guided by the COREQ checklist [39].

Ethical approval

Ethical approval was obtained from the Research Ethics Review Committee at Erasmus University Rotterdam (ETH2223-0473), and all participants signed informed consent forms, detailing the scope of the study and the intended use of the data provided, to ensure research transparency and to protect the privacy rights of participants.

RESULTS

Case descriptions

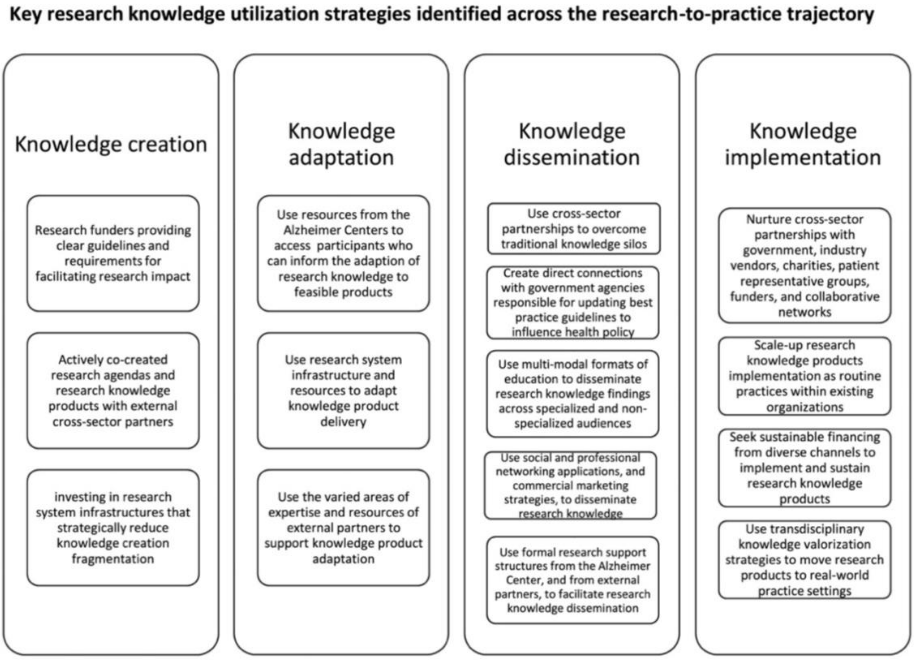
Data from 29 respondents were included in this study. The response rates for each Alzheimer Center were Center A: 5/6; Center B: 6/8; Center C: 6/9; Center D: 6/10; and Center E: 6/7. Respondents were early-career professionals [1-4 years of experience] (8/29; 27.6%), mid-career professionals [5-10 years of experience] (6/29; 20.7%), and senior-career professionals [10+ years of experience) (15/29; 51.7%). Each Center facilitated collaboration between various UMC departments involved in dementia research, such as neurology, psychiatry, epidemiology, radiology and nuclear medicine, and geriatrics. Each Center invested in different research priority areas, including risk and prevention, etiology of dementia, and dementia care services. Case descriptions for each Alzheimer Center are presented in Table 2. Details on research utilization strategies utilized in each Alzheimer Center are presented in Figure 1 (found below).

Table 2. Alzheimer Center case descriptions

Center A Center A was established in 2013 and serves a catchment area with 3.5 million inhabitants. This Center specializes in frontotemporal dementia, heredity in dementia, culturally-adapted dementia diagnosis, and identifying risk factors for dementia. The main types of research produced by this Center include neuroimaging databases, intercultural dementia diagnostics and care, and diagnostic criteria of familial frontotemporal lobar degeneration. The team at Center A is bolstered by the collaborative efforts of the departments of Neurology, Neuroscience, Radiology and Nuclear Medicine, and Epidemiology.
Center B Center B was established in 2003 and serves a catchment area with 1.5 million inhabitants, and specializes in dementia risk and prevention, biomarkers, diagnostics and disease mechanisms, psychosocial interventions and eHealth. The main type of research produced include a biobank for dementia progression analysis, Living Lab for innovative care environments, AI-based tool for dementia detection and risk reduction, and plasma biomarker development for secondary prevention in at-risk individuals. Center B

involves the departments of Psychiatry and Neuropsychology, Neurology, Radiology and Nuclear Medicine, Epidemiology, and Health Services Research to advance dementia care and research.
Center C Center C was established in 2000 and serves a catchment area with 2.5 million inhabitants. Center C specializes in molecular diagnostics, risk and protective factors, intervention and prevention, early diagnosis and prognosis, and neuroimaging to advance understanding, early detection, and treatment of Alzheimer’s disease and other dementias. Center C involves the departments of Neurology, Psychiatry, Radiology and Nuclear Medicine, Clinical Chemistry, Neuropsychology, Public Health, and Genetics, collaborating on dementia research and patient care to enhance diagnosis, treatment, and prevention strategies.
Center D Center D was established in 2019 and serves a catchment area with 1.7 million inhabitants. This Center focuses on investigates genetic and molecular markers of brain aging and neurodegenerative diseases, a largescale multigenerational Cohort Study examining health behaviors over the life course to reduce dementia risk, and the TAP-dementia project, a national collaboration aimed at improving dementia diagnosis and incorporating patient feedback. Center D involves the departments of Elderly Medicine, Neurology, Neuropsychology, Psychiatry and Radiology.
Center E Center E was established in 2010 and serves a catchment area with 2.1 million inhabitants. This Center focuses on enhancing long-term dementia care, utilizing AI for better diagnostics, developing innovative imaging technologies, and advancing clinical research on Alzheimer's mechanisms and therapies. Center E involves the departments of Geriatric Medicine, Neurology, Medical Imaging, and Primary and Community Care in its research on dementia care, AI diagnostics, advanced imaging, and clinical interventions.

Figure 1. Key research knowledge utilization strategies identified across the research-to-practice trajectory



Strategies facilitating knowledge creation

Three main strategies were used by the Alzheimer Centers to facilitate the creation of feasible research knowledge products and accelerate the societal use of research knowledge. First, respondents from all five Centers noted that research funders' clear guidelines and requirements facilitated implementation planning in the knowledge creation stage, such as by mandating the submission of a dissemination and implementation plan in grant applications. Additionally, funding agencies offered varying research impact models. This guided researchers in developing a 'theory of change' to explicate the process toward achieving research impact, beginning with knowledge product development.

"They're [funders] really working on forming this learning communities, and involving all stakeholders who are also now working on an impact plan. So now we're really thinking more small in each work pack to also overall for [the consortium] using the theory of change

methods from Alzheimer Nederlands, try to see on different levels, "Who are you targeting? What are you influencing? What are your bigger goals?" And really make more visual image plan for impact." (Respondent 10)

Second, respondents collaborate with diverse cross-sector partners, including government agencies, private organizations, and third-sector collaborative partners, to co-create research agendas and knowledge products. For example, Alzheimer Center researchers received insights into the societal demand for research from patients with lived experiences and healthcare professionals through connections, formed via UMC memory clinics and external events. These events, such as the Dementia Dialogues and Alzheimer Café, focused on dementia knowledge sharing. Research demand was also derived from practice-settings. This includes government officials at the municipality level, national associations (e.g., Dutch federation for psychology), and steering committees of regional elderly care networks, consisting of nursing home teams and implementation practitioners.

"What I really learned during this project also is that it's important to, like in the earlier stages of development, already have the end users involved also. So we always had this neurologist on the team who sees the patients and sees, like the real cases, as they are being discussed at the multidisciplinary meetings and that helps a lot to get this really clinically feasible [diagnostic] tool." (Respondent 17)

Last, respondents reported actively investing in research system infrastructures that strategically reduce knowledge creation fragmentation (e.g., research lifecycle discontinuation), and leverage knowledge beyond project silos. Continuity was achieved by employing research systems interventions, such as long-term public-private (consortium) research projects and learning communities. In addition, Alzheimer Centers A, D and E each hired an Alzheimer Center coordinator to facilitate the continuation of research projects, through securing subsequent rounds of funding. The coordinator also helped connect interdisciplinary research groups to reduce departmental knowledge silos. Alzheimer Center A, B, and C also emphasized the significance of leveraging formalized public-private partnerships (through research consortia) to reduce knowledge creation fragmentation across sectors.

“We work together a lot because, for example, [name] is the coordinator for the Alzheimer Center, but also she joins the regional dementia platform. So there are links between the research and the care. For the local GPs, for example, dementia is not an interesting group, but the vulnerable elderly is an interesting group for them, and dementia is a part of this group. So when you make a bit broader, then you have more effect what you're doing.” (Respondent 25)

“In the new consortia, we're looking more into co-designing interventions with companies to be part of the application from the start and then also have to contribute in cash or in kind because it makes them more a part of this application. (…) You really have to collaborate with the industry because people are starting to see that only academia driven interventions are usually not the ones that are still used in practice in the long run.” (Respondent 11)

Strategies facilitating research knowledge product adaptation

Three main strategies were used by Alzheimer Centers to adapt research knowledge products to fit the determinants found in the implementation setting and research ecosystem. First, respondents leveraged resources from the Alzheimer Centers, such as the research, education, and healthcare infrastructure, to access patients and participants. This infrastructure can support and inform the adaption of research knowledge to feasible products. For instance, all Alzheimer Centers had access to memory clinics within the UMC, and client panels consisting of people with dementia and their informal caregivers. The proximity to patient groups allowed researchers to seek immediate feedback and adaptation support from the relevant end-users (e.g., patient groups and clinicians) to develop culturally appropriate research knowledge products and equitable implementation plans. Alzheimer Center B, C, D and E also reported training support for researchers, such as for project management, science communication, and lobbying and advocacy.

“We have a list of patients who consent to be asked for these things so we can call them, for example. But often of course we set up a specific task and a specific client panel for the project. So in our latest project where investigated feasibility of implementing digital tools from five memory clinics. We asked patients in five memory clinics to comment on the tool.

(…) So we included 15 clinicians [including geriatricians] and 40 patients and their significant others." (Respondent 13)

Secondly, all Alzheimer Centers used wider ecosystem infrastructure and resources from regional networks to adapt knowledge product delivery. For example, respondents adapted the research knowledge product into multiple language options and created simplified, multi-modal (e.g., print, website, application) versions, closely based on the original intervention components, to increase implementation feasibility and remove end-users' barriers. Alzheimer Center A, D and E actively obtained feedback and insights from participants of external networks (e.g., regional elderly care networks) to advise the cultural adaptation of research knowledge product components and select implementation strategies that fit the contextual determinants.

"Alzheimer Nederland is a partner in this consortium and Vilans and other partners that really try to translate the research to the public. So we in our junior training program, there are afternoons that we visit, Alzheimer Nederland or Vilans. I think part of these afternoons was how to involve the public in research design. But also if you have results, how do you try to make the impact that you are aiming for and how to spread the knowledge?"
(Respondent 19)

Lastly, respondents utilized the expertise and resources of cross-sector external partners to support knowledge product adaptation. For instance, national knowledge institutes (e.g., Vilans, Pharos) acted as implementation support practitioners and knowledge brokers in the dementia research ecosystem. These organizations have trained researchers to use theory of change models to plan research utilization and pragmatically adapt the research knowledge product to fit the infrastructure of the wider implementation ecosystem. Further, funding agencies (e.g., ZonMw, Alzheimer Nederland) have also provided technical support to researchers to adapt and communicate research knowledge with cross-sector stakeholders, such as by translating research findings into practical advice to influence policy reform and decision-making.

"You know the way to organize in the Netherlands is the government provides increasingly little direct funding to the university. So there's still some, but much of the research funding goes through ZonMw [national health research funding agency] and NWO [national research funding agency]. And of course, within these distributing organizations, people focus more on translating the science to policy advice. So that's their job in particular to try to obtain the results from researchers. Yeah, and they formulate advice to government policy." (Respondent 2)

Strategies facilitating research knowledge product dissemination

Five main strategies were used by Alzheimer Centers to disseminate research findings and research knowledge products to targeted end-users and relevant stakeholders. First, respondents from each Alzheimer Center actively sought out, established, and fostered cross-sector partnerships between academic institutions, government agencies, private sector (industry), and third sector intermediaries (e.g., nonprofit organizations, charities) to overcome traditional knowledge silos. All Alzheimer Centers actively shared research findings through intermediary organization channels, such as national knowledge institutes (e.g., Pharos and Vilans), and utilized technical support and science communication training from these organizations. Alzheimer Centers A, C, D, and E have received accreditation from health associations, such as the Dutch Federation for Neurologists, to conduct training courses for healthcare professionals. This accreditation facilitates participation from healthcare professionals by offering continuing education credits. Alzheimer Center C distinguished itself through fundraising activities, merchandise sales, and coordination of charity events to disseminate research updates and solicit support from individuals and industry donors.

"We need to make sure that we then send it also to all the funders. So make sure that Alzheimer Nederland has seen it, or ZonMw. (…) Often, for example, funders might say "oh, this is a really nice project. We're so happy to do it together with you, very willing to write something for your website or an interview." (Respondent 13)

"And then the wish was to have more in-service training, with credits or points. For the symposium, I also arranged to pick up points as well. Then maybe that helped with the [clinician] attendance numbers. But of course they deserve it. They learn a lot during those days. So there was a wish for more in-service training. So we did a pilot this year, and it was very well received." (Respondent 18)

Second, respondents from Alzheimer Centers A, B, E shared the importance of establishing direct connections with government agencies responsible for updating best practice. A range of activities were reported across each Alzheimer Center. Main research findings and implications were presented through a ministry report to inform policy. Existing connections and partnerships to were utilized optimize dissemination efforts. Researcher acted as advisors to support the National Dementia Strategy, and they communicated directly with influential political figures through research consortia events. Researchers also engaged funding agencies to act as knowledge brokers with government agencies.

"I'm also in the Advisory Board of the National Dementia Strategy of the Ministry of Health, Welfare and Sport. So every three months we come together, also with the Minister, to talk about dementia and what are gaps, what we have to do. And so I think we have nice channels also to send our message." (Respondent 7)

Third, multi-modal formats of education were used by Alzheimer Centers to disseminate research knowledge findings across specialized and non-specialized audiences. For instance, common activities of research knowledge transfer included conducting virtual webinars and training workshops for healthcare professionals through YouTube. Knowledge was also shared through the Alzheimer Café events and across regional professional networks. These channels foster dissemination beyond the professional networks of the research teams.

"We have a strong connection there and we also have warm links with other Alzheimer cafes so some of them ask us every year for specific sessions to be presented there and also present an overview of new insights in Alzheimer's disease or new insights in dementia." (Respondent 8)

"We have had a webinar about this topic last week, explaining more about how to do cross cultural dementia diagnostics as a neuropsychologist, and that was also within our strategy to reach as many healthcare professionals as possible at once. So everybody can watch it. And so that's step one of the plan: reach as many people as possible." (Respondent 1)

Fourth, the Alzheimer Centers used social and professional networking applications and commercial marketing strategies to disseminate research knowledge. Each Alzheimer Center leveraged connections with the communications team from the UMC to share research findings through their social media accounts, marketing channels, and official website and newsletter. Alzheimer Centers A, B, and C strategically used social and professional networking applications, by creating dedicated webpages on LinkedIn (LinkedIn Corp) and Twitter (X Corp). Alzheimer Centers A and C monitored dissemination outcomes through web and social media analytics tools to incorporate engagement metrics, including total reach and post impressions, but did not use the data to select or tailor dissemination strategies.

"I help with the communication activities and make sure that after every publication the students write a blog, and they share it online and they make an overview of one PowerPoint slide of what the study was about and what are the results. So we have the collection of all those slides, of all the results of the studies, and we use it in presentation." (Respondent 16)

"You have your different channels; we have our own social media channels. We have newsletters, we do a lot of public lectures. We have Alzheimer's cafes that a lot of people are involved in the region. So dissemination is something that we really love." (Respondent 7)

Lastly, formal research support structures from the Alzheimer Center and external partners, including formal public-private collaborations and regional care networks, were used to facilitate research dissemination. Alzheimer Centers D and E each hired a coordinator to manage and facilitate all dissemination activities, including sharing new research findings via social media and internal and public newsletters, creating a formal communication strategy, and actively maintaining relationships with partners (e.g., steering committees of regional networks, client panels). Alzheimer Center C provided more formalized internal structures to disseminate research knowledge, such as science communication training and meetings for researchers to share about their ongoing research projects and standardized templates used for tracking and reporting research outputs for annual reports (e.g., consortia research output tracker) and knowledge sharing through social networks (e.g., LinkedIn post template).

"For example, in the [consortium], we have outlined all the different target groups that we're interested in because we also have an aim in that consortium to reach the healthcare professionals. So there we did a kind of mapping of who are the health care professionals that we want to target, and how can we reach them and in what way are we going to reach them?" (Respondent 8)

Strategies facilitating research knowledge product implementation

Four main strategies to implement, scale-up, and sustain research knowledge products across various implementation settings were reported by respondents. First, respondents from each Alzheimer Center reported the importance of nurturing cross-sector partnerships with government, industry vendors, charities, patient representative groups, funders, and collaborative networks. Respondents also reported the value of facilitating such partnerships to adopt and sustain research knowledge products within existing the infrastructure and workflow of industry and third-sector partners. For example, these partnering organizations purchased and implemented the research knowledge product, such as a training module for nurses. The organizations embedded the training module to their website to continue providing education to end-users. Alzheimer Centers B, D, and E emphasized the importance of maintaining partnerships with industry to foster trust, ensure continuous communication, and leverage respective resources and expertise for scaling collaboration. Sustained partnerships streamline future research knowledge product implementation and reduce resource waste associated with initiating new collaborations.

"And then we also try to make educational materials for healthcare professionals on this topic We just made them and now available also freely available via Alzheimer Netherlands.

We're working on educational models for healthcare professionals on dementia risk reduction to educate them." (Respondent 7)

Second, respondents from all Alzheimer Centers performed various activities to scale-up research knowledge products implementation as routine practices within existing organizations. Alzheimer Center A, C, and E implemented new research knowledge products (e.g., diagnostic tools) directly into the memory clinics, and peripheral clinics within the catchment area, with less resistance since these products were co-created with clinical staff members. Alzheimer Center B, D, and E implemented and scaled-up research knowledge products for use in non-clinical settings, such as by adapting a diagnostic approach suitable for implementation in nursing homes. Similarly, strategies were mentioned for implementation across societal systems (e.g., education, welfare, health, environment). For example, a health educational module that promotes understanding and inclusivity of people with dementia fit the pillar of an education curriculum that promoted inclusive citizenship. This cross-system implementation demonstrated how strategically aligned, cross-systems collaboration can help to scale research knowledge products implementation beyond system silos to increase research impact to diverse end-user groups. Alzheimer Center B, D, and E sustained research knowledge products within organizations by providing iterative support to a local champion who employed 'train the trainer' strategies to facilitate scale-up within implementing organizations.

"We're looking always a bit for ways to have an entrance with schools because they're so busy and often very hesitant. So you have this course about citizenship. It's obligated for primary schools to teach the children to become good citizens. So there's a project that kind of fits in like because it's good citizenship to learn about dementia and to do this." (Respondent 10)

Third, respondents from Alzheimer Centers B, C, D, and E reportedly sought out sustainable (alternative) financing from diverse channels to implement and sustain research knowledge products. Alzheimer Centers B and D actively sought additional funding instruments and opportunities to support implementation and sustainment from both public (e.g., government funders, municipality subsidies) and private (e.g. private foundations) funders. Activities from Alzheimer Centers C and E were partially funded by the revenue obtained through licensing fees and product sales, paid by adopting organizations and end-users. Respondents from Alzheimer Center B and E attempted to have new research knowledge products covered by health insurance reimbursement channels, which required the products to be (cost-) effective and produce positive health outcomes. However, the precise requirements and process to qualify a new product for reimbursement through health insurers were unclear to respondents. Only respondents from Alzheimer Center B mentioned reimbursement mechanisms from alternative (non-academic) funding sources, such as the Stimuleringsregeling E-Health Thuis (SET), a government-funded initiative that supports the scale-up of eHealth technologies that facilitate home-based care.

"We also, for example, have funding from SET. And so we have also these pilots in the region, but that's in [city], where we work together with, for example, case managers and care organizations also to implement it in those regional pilots." (Respondent 8)

In that line, there are also opportunities to embed the research knowledge product within existing health purchasing policies, such as the sustainable coalition initiative (via health insurer).

"[Health insurer] said that they wanted to include this as a priority area in the strategy of 'van thuis uit'. It's care concept in the sustainable coalition of [health insurers]. So they want to fund the intervention." (Respondent 8)

Lastly, respondents from Alzheimer Center A, B, and C reported the use of transdisciplinary knowledge valorization strategies to move research products to real-world practice settings. Alzheimer Center A, B and C reported that research knowledge was implemented and scaled-up using commercialization practices (e.g., structured processes of production, distribution, marketing, and sales). Knowledge of legal and regulatory requirements, such as obtaining CE marking and ensuring GDPR compliance for eHealth products, was also beneficial to structure implementation planning. Technology transfer offices at the central university supported the Alzheimer Centers with developing structured business plans and formal contracts that facilitate collaboration with private sector partners. These offices helped to manage the intellectual property rights and legal ownership of the research, and to remain up-to-date on the latest regulatory guidelines throughout the product development process.

"Another part is the valorization that we also worked on and that was dissemination for commercial studies. And so we also had that in mind, in commercial studies, we want to use this as an outcome measure, that would be possible, but they would need to pay a license fee for using the instrument. And using the scoring algorithm, et cetera.(…) we started out early with thinking about implementation. This could be a model in which we earn some money to sustain the academic development and the clinical implementation." (Respondent 12)

"We're also speaking to people of the Technology Transfer Office to see, once we have this model, hopefully in a year or two, what steps do we need to do either right beforehand or afterward, to get the CE marking for instance, to be able to bring to a clinical setting and to use it by other healthcare providers." (Respondent 2)

DISCUSSION

The results identified a range of real-world strategies that promote dementia research utilization. Successful use of these strategies required each Alzheimer Center to iteratively engage diverse stakeholders, including individuals with lived experiences, caregivers, and practitioners, in co-producing both the research knowledge products and the dissemination and implementation processes. The involvement of multiple stakeholders in research co-production aligns with the principles of integrated knowledge translation (IKT), which aim to develop research directions, through engaged scholarship between researchers and knowledge end-users in practice [11]. This is often facilitated through community-based participatory research and knowledge linkage and exchange [18]. Real-world opportunities and challenges for using an IKT approach to research coproduction and utilization were clarified through the perspective of dementia researchers. Results confirmed the real value of engaging cross-sectoral stakeholders and end-users to improve research utilization outcomes, while also highlighting the need for new researcher competencies, such as effectively communicating and facilitating collaborations across multi-disciplinary teams [40].

Further, this study found that several research funders mandated the use of IKT, requiring research teams to engage end-users and practice agencies in the co-creation of knowledge products and the implementation plan. However, as critiqued by Holmes and Jones [41], the requirements and criteria set by research funders, guiding the nature and strength of co-creation in funded projects, were often loosely defined. The impact of funder activities that promote co-creation and implementation remains unclear. A separate study on dissemination and implementation activities of international research funders revealed that monitoring and measuring research impact was also a prevalent challenge [42]. Further investment is needed to understand how research impact is monitored and evaluated by various funding agencies across diverse research ecosystems.

The choice of research utilization strategies may also be explained by path dependence theory, which implies that strategies are selected based on each Alzheimer Center's development trajectory, past decisions, organizational heritage, and team competencies [43]. As political and societal forces cause evolution and revolution within the external research ecosystem, Alzheimer Centers may be vulnerable to risks from path dependency, including poor responsiveness to environmental changes, such as disruptive challenges in partnerships and networks or changes in policy [43, 6]. Risks can be mitigated by enhancing team resilience and responsivity. This can be achieved by strengthening researchers' competencies at each stage of the research continuum through didactic activities, mentorship and expert consultation, knowledge sharing, and specialized financing instruments [44, 45]. At an organizational level, Alzheimer Centers may consider structuring annual researcher performance appraisals to include societal research impact in the assessment criteria. Using impact narrative case studies can highlight the societal value of research, as recommended by the national Dutch Strategy Evaluation Protocol 2021–2027 [46]. The practices of other actors within the wider dementia research ecosystem may also evolve to incentivize and support research utilization scaling, such as funding agencies developing dissemination- and implementation-focused financing instruments [42].

The selection of research dissemination and implementation strategies may also vary, based on the typology of research products. Respective positions of research products can be mapped across the translational science pipeline: T1 (conducting basic research), T2 (effectiveness in human clinical trials), T3 (implementation of clinically effective products), and T4 (conducting real-world outcome evaluations) [23]. The typology of research products developed in each Alzheimer Center is largely influenced by the Center's research priority areas. For instance, Alzheimer Center C focused mainly on conducting fundamental research (T1-T2), including biomarker discovery and (pre-) clinical trials, whereas Alzheimer Center E focused mainly on conducting applied health research (T3-T4), including the implementation of clinically effective non-pharmacological programs. Respondents from Alzheimer Center C commonly reported the importance of fostering bilateral R&D partnerships with pharmaceutical companies that relied on the Center's research infrastructure and leveraging the advantages of integrated public-private discovery and development networks [47]. In contrast, respondents from Alzheimer Center E emphasized the value of developing and utilizing participatory knowledge infrastructure in the dissemination, implementation, and sustainment of research products. Knowledge infrastructure included social and professional collaborative networks with third-sector organizations [48].

Accordingly, depending on which stage of the translational science pipeline the research product is positioned, researchers require certain sets of competencies to overcome the unique determinants (i.e. barriers) that influence research utilization. By applying implementation science knowledge, the research utilization process can be explicated using impact and process models. Specific research utilization strategies can be systematically selected and tailored to address specific determinants. Pragmatic tools, such as the research impact logic model (Jones and Bice [49]), and context-specific implementation planning instruments (Prausnitz et al. [50]) are needed to systematically guide research teams in implementation planning. This approach explicates the research utilization process to help monitor and evaluate the outcomes of their utilization strategies.

Several notable dissemination and implementation strategies were identified in this study. First, a cross-systems collaboration strategy was successfully used to implement a health education program, originally set in healthcare organizations, in a school curriculum. Bunger et al. [51] determined similar benefits of aligning and leveraging existing resources across systems to improve research product implementation feasibility, fidelity, and sustainment.

Second, the use of alternative funding mechanisms was commonly reported as a strategy to financially sustain non-pharmacological research products, through adapting products to fit the reimbursement criteria of certain government-funded initiatives and health insurance channels. Findings from Van Kessel et al. [52] further validated this result and reported that the pricing and reimbursement of non-pharmacological research products (e.g., digital health interventions) in the Netherlands are determined by negotiations between care providers, health insurers, the Dutch Healthcare Authority, and the National Health Care Institute. However, no explicit requirements or guidelines are available to guide researchers to design a sustainable financial reimbursement plan [52].

Lastly, valorization strategies were employed to implement the research products, but a series of challenges impede this approach. The Code of Practice on the management of intellectual assets for knowledge valorization in the European Research Area emphasized the importance of 'valuing all intellectual assets' generated through research and innovation activities [53]. However, current practices in academic entrepreneurship and research product commercialization focus on patenting and distributing licensing rights on intellectual property and creating independent spin-offs and start-ups [54, 55]. Resultantly, academic 'intellectual assets' with lower commercial value are not valorized and often remain siloed within traditional academic settings. To mitigate this risk, future research can explore how an open innovation approach can be applied to dementia valorization, such as by establishing formalized living labs with contributions from cross-sector partners [56]. Best practices from this interdisciplinary method can support stakeholders in the research ecosystem to adopt systems-thinking for knowledge management. It can also enable exploring alternative business models (e.g., social enterprise) and feasible implementation pathways for non-traditional research products [57]. As emphasized by Marr and Phan [55], the activities performed by university technology transfer offices to facilitate the valorization of products with lower commercial value are enigmatic. Further systematic exploration of strategies used within such support teams is required to explicate the determinants surrounding the valorization of such products and to create a mutually beneficial link between implementation science and research valorization.

This study may have potential research design and data collection limitations. Purposive sampling was used to recruit respondents, which may introduce selection bias and limit the generalizability of the findings to other settings outside the five included Alzheimer Centers. Another limitation is related to our specialized focus on research utilization and implementation science. The implementation science jargon used by the interviewers required frequent clarification for the interviewees. The need to explain specific terms and concepts might have influenced participants' answers, as they may have provided responses based on their interpretation of the clarified terminology rather than their initial understanding. This challenge may be influenced by the early stage of implementation science in dementia research in the present Dutch context. Data collection was conducted in English, but some language and cultural nuances shared by respondents, who were native Dutch speakers, may not have been adequately captured. Respondents were given the opportunity to elaborate on ideas further in Dutch to mitigate miscommunication risks. Any elaborations shared in Dutch were discussed and interpreted with the native Dutch speakers in the research team. While in-depth insights were gained, the study's conclusions should be considered within the context of these limitations.

CONCLUSION

Results from the Alzheimer Centers suggest that successful research utilization of non-pharmacological dementia research products requires academic health science centers to build research capacity and develop researcher competencies. This facilitates co-creation with end-users, establishing, and maintaining collaborations with public and private partners, and facilitating implementation, scale-up, and sustainment. Researchers must take initiative to scale their products, integrating them into existing organizations across sectors and navigating systems to secure inclusion in reimbursement schemes. Using the KTA framework from the perspective of researchers revealed the intricacies involved in streamlining research utilization. That may pave the way for future implementation science studies to enhance the monitoring and evaluation of the research utilization processes, delineated between research producers and users, across various contexts. Employing a comprehensive ecosystem approach ensures the broader impact and practical application of research findings in real-world setting.

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Bridging research and practice for dementia care: strategies and challenges of public and private funders in the dissemination and implementation of dementia research

Zhu, E.M., Buljac-Samardžić, M., Ahaus, K. et al. Bridging research and practice for dementia care: strategies and challenges of public and private funders in the dissemination and implementation of dementia research

ABSTRACT

Background: Although dementia research agendas increasingly prioritize dissemination and implementation (D&I) of research findings, there is still limited understanding of the role and activities of dementia research funders. Implementation science literature offers theories, frameworks and tools to integrate diverse stakeholder perspectives, supporting the translation of research evidence into practice and policy. This study identifies and categorizes the D&I strategies and related challenges, faced by public and private dementia research funders in The Netherlands. This study aims to provide evidence that clarifies the roles of public and private dementia research funders and offering guidance for planning and executing dementia research D&I. This study contributed to evidence and perspectives generated outside the traditional clinical settings, which are essential to advance implementation science.

Methods: Semi-structured qualitative interviews were conducted with 20 individuals, selected through purposive snowball sampling. Respondents involved representatives of three public and four private funding agencies in the Netherlands. Interviews were conducted in-person or virtually, audio-recorded, and transcribed verbatim. Data extraction and data analysis were conducted using an iterative abductive thematic coding approach, based on the methodology of Timmermans and Tavory.

Results: The strategies, and related challenges, of public and private funders of dementia research were clustered into three themes: ‘dissemination’, ‘implementation support’, and ‘research ecosystem capacity-building’. Strategies for ‘dissemination’ and ‘implementation support’ were facilitated through brokering knowledge and providing financial incentives, procedural guidance, and action mandates. Public and private funders contributed significantly to ‘research ecosystem capacity-building’ through strategies such as establishing research consortium models, implementation training programs and professional connective networks. Results suggested that both types of funders are guided by distinct value systems and contribute different resources and expertise to the D&I

process. Collaborative capacity between public and private funders was hindered by D&I role ambiguity and conflicting value systems, which emphasizes the lack of insights in how and when to engage each type of funder in D&I.

Conclusion: This study provides contextual insight on the opportunities to invest in developing D&I professional competencies and leveraging strategic public-private partnerships to optimize D&I processes. Future research could develop this research ecosystem concept to overcome persistent contextual D&I challenges.

Key words: Integrated knowledge translation, Dementia, Implementation science, Capacity-building, Research funders

CONTRIBUTIONS TO LITERATURE

- This study identifies the contributions, strategies, and challenges of public and private dementia research funders in the Netherlands, steering the management of public-private implementation partnerships and the development of research and innovation implementation agendas.
- This work introduces the conceptual design and components of a *research ecosystem*, including potential groups of implementation stakeholders, their respective contributions, and their interdependencies to build implementation collaborative capacity.
- These results highlighted opportunities for trans-disciplinary knowledge from entrepreneurial practice, innovation management, and public administration to contribute knowledge to advance the maturity of implementation science.

BACKGROUND

Globally, the implications of an ageing population and increasing rates of dementia creates demand for adaptable and scalable care solutions for people with dementia and their caregivers [1]. By 2040, the Netherlands is projected to experience significantly increased social and economic burden, with the population of people with dementia reaching 520,000 and national dementia care costs rising to 15.6 billion euros [2]. Internationally, the Netherlands participates strongly in international initiatives, such as the EU Joint Programme - Neurogenerative Disease Research, contributing to strengthening international dementia research [3]. Domestically, the Dutch government previously allocated €65 million to fund research in the *Memorabel* programme (2013-2020) in response to the projected demand for high quality dementia care [4]. The final programme evaluation emphasized challenges with research project fragmentation and research uptake due to funding discontinuation and limited stakeholder engagement with practice and industry [4]. This led to the establishment of the Dementia Research Programme (DRP) (2021 – 2030), which allocates € 140 million, through consortia models, to strengthen fundamental research, risk reduction, diagnostic tools, innovative therapies, early onset dementia, and knowledge transfer [5]. Consortia connect traditionally siloed academic research projects to industry and societal partners via public-private partnerships [6, 7]. Consortia models also enhance efficient research practices and emphasize the knowledge transfer from research to practice and policy, also referred to as research dissemination and implementation (D&I).

Implementation science maturity in the field of dementia research is currently low and require contextual evidence to inform research uptake [8, 9]. The complexity of dementia research implementation is also enhanced by the required integrated multi-dimensional care approach for people with dementia, which covers the social, care, and welfare domains [10, 11]. Implementation science provides theoretical and conceptual guidance to reduce research D&I complexity and strengthen evidence-based decision-making capacity in research systems [12, 13]. However, implementation science research has predominantly focused on implementation determinants and strategies at the individual and organization level, which can entrench a linear reductionist view of implementation determinants and overlook the broader external factors that shape clinical implementation outcomes [13]. Implementation science research, particularly conducted at the systems level, is needed to increase understanding on how to develop more efficient research D&I practices and improve research uptake [14].

The systems level research D&I process is partially facilitated through integrated knowledge translation (IKT) activities, such as the active involvement of 'knowledge end-users' (e.g., clinicians, research funders) in creating relevant and useful research [15]. IKT principles suggest that strategic engagement of end-users at each phase of the D&I process can systematically address the contextual D&I challenges [16, 17]. The research D&I process can be abstracted into multiple iterative phases, including (1) research co-creation, (2) research dissemination, (3) contextual assessments and selection of appropriate D&I strategies, (4) research (clinical) implementation, and (5) monitoring and evaluating research D&I outcomes to drive scale-up and continuous improvement efforts [18]. Given the demand for systems level evidence, perspectives from systems level actors are needed, such as those of the research funder.

The role and contributions of the research funder in research implementation has been explored in several studies [19-21]. These studies revealed that dissemination and implementation were important to funding organizations, and characterized the activities performed by funding agencies. For example, Van der Linden [22] surveyed 31 public and private funding agencies across 12 countries to characterize and categorize their D&I activities. Those results determined six main practice areas: release of findings, dissemination, knowledge exchange and partnering, building capacity and infrastructure, implementation, and implementation research [22]. Further, Leeman et al. [23] broadly classified funders' research D&I strategies into 'dissemination', 'capacity-building' and 'scale-up' clusters. However, there remain significant gaps in evidence, such as the determining the precise strategies and related challenges of research funders at each phase of research D&I process and delineating activities of public and private funders to enhance inter-organizational efficiency for research D&I. The ambiguity complicates the organization of D&I roles between public and private funders collaborating in co-funding arrangements within research consortia models [7]. Additional empirical research on the specific strategies and challenges from the research funder perspective is needed to generate contextual evidence that detangles D&I process complexity [5, 24].

This study explores the research D&I process from the perspectives of public and private dementia research funders in The Netherlands. study's overarching aim is to contribute contextual evidence (i.e. research D&I strategies and challenges) that clarify the roles and boundaries between public and private dementia research funders and guides them in planning and executing research D&I. This approach translates the value of implementation science knowledge and tools beyond clinical settings, thereby improving research uptake through identifying and addressing organizational and systems determinants [25]. This is in line with the plea of Chambers and Emmons [26], who determined that further evidence and perspectives, generated from beyond traditional clinical settings, is needed to advance implementation science maturity and accelerate the use of research in practice and policy. With conceptual guidance from the six D&I practice areas [22], this study explores two central questions:

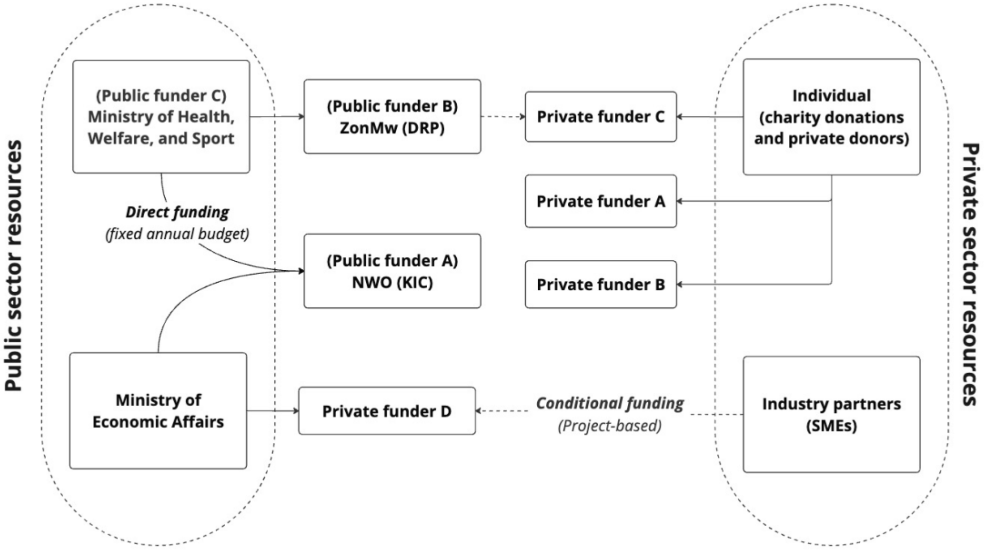
(1) What main activities and strategies were performed by public and private funders of dementia care research to facilitate research dissemination and implementation?
(2) What related organizational and external challenges did public and private funders encounter in facilitating research dissemination and implementation?

METHODS

Setting

Dementia research in the Netherlands is conducted primarily by academic researchers, based in public universities and research centers [27]. Research funding is allocated to these centers through these public and private funders [2]. In the Netherlands, the National Dementia Strategy (2021 – 2030) guides dementia research agenda priorities by outlining investment areas and thematic focuses, primarily in research innovation and implementation [2]. The Ministry of Economic Affairs and Ministry of Health, Welfare, and Sport receive direct funding from the central Dutch government and are tasked with allocating funding to public and private research funders. The Dutch Organization for Scientific Research (NWO) and The Netherlands Organization for Health Research and Development (ZonMw) are public funders, tasked with allocating € 140 million through the Dementia Research Programme (DRP) 2021–2030. This focuses on strengthening areas of basic research, diagnostics, risk reduction, technological innovations, young onset dementia, and integrating research, care, and education [5]. Cross-sector involvement with private (industry) partners and private research funders is also encouraged, notably through participatory research infrastructure [28] and public-private partnerships in research consortia [29]. Public and private funders obtain financial resources from a variety of sources, as depicted in Figure 1. Public and private research funders also construct co-funding partnerships to foster collaboration and share responsibility, risk, and ownership [7]. This organization of stakeholder groups also allows each group to contribute based on their resources and areas of expertise, strengthening research D&I outcomes at each phase of the process.

Figure 1. Funding streams of dementia research funders in The Netherlands



Participant recruitment

Participants were purposively selected based on a strict criterion to ensure external validity. Participants were included if employed by either a public or private research funding agency funding in the Netherlands. Additionally, participants must primarily oversee dementia research funding, dissemination, and/or implementation, serving as program officers, managers, or similar roles. The study research team, comprising a PhD candidate and three university professors, identified potential funding agencies to include in this study through their professional networks and through referrals from prior working relationships with Dutch dementia researchers [27]. Seven funding agencies (three public and four private) were identified using each organization's website, and respondents were contacted through email, phone, or LinkedIn with individualized introductory messages. All contacted staff agreed to participate. Through snowball sampling, participants introduced other relevant colleagues and provided introductory emails on our behalf. Participants brought varied professional backgrounds—from social to medical and implementation expertise—ensuring a representative sample of the activities and challenges faced by public and private dementia research funders in the Netherlands.

Data collection

The interview topic guide was developed based on the six funder D&I practice areas (release of findings, dissemination, knowledge exchange and partnering, capacity building and infrastructure implementation, implementation research) developed from a survey study of 31 international funding agencies [22]. These areas were selected to guide the data collection given the comprehensiveness and pragmatic relevance. Specific open-ended questions were designed to explore Dutch dementia funders' strategies that facilitate the practice areas and identify the related emerging contextual challenges (see Appendix 3). The interview topic guide was refined with support from the original study's first author to ensure accurate understanding and application of the practice areas by the research team [30]. The interview guide was pilot-tested in an initial interview with a pair of respondents but did not require any changes.

The first (EMZ) and last author (RH) conducted the interviews together, in-person and online via Microsoft (MS) Teams. In total, 15 interviews (five with pairs, ten with individuals) were conducted with staff members in Dutch dementia research funding agencies between May and July 2024, each lasting 60-75 minutes. Each interview was audio- and video-recorded (via MS Teams), transcribed, and pseudo-anonymized. Respondents were provided a copy of their own interview transcript to provide clarification or retract statements. None of the participants withdrew from the study. Interviews were conducted until data saturation was reached (i.e. responses were repeated).

Data analysis

Each interview was transcribed verbatim and reviewed by the first author (EMZ) to generate in-depth familiarity with the content and initial insights on the potential patterns in the transcripts. Data extraction was performed by the first author manually using Microsoft (MS) Word to create a coding framework to organize data. Data extraction and data analysis were conducted using an iterative abductive thematic coding approach, based on the methodology of Timmermans and Tavory [31, 32]. This abductive approach iteratively executed inductive and deductive data extraction and analysis across three stages.

In the first stage, the first-order (open) codes were labeled throughout each transcript to ensure the intended meaning was accurately captured and conveyed [33]. This allowed the authors to inductively identify emerging concepts or ideas that may transcend the conceptual boundaries of any singular practice area [34]. These open codes captured the specific activities undertaken by research funders and the related challenges they encountered throughout the research D&I process. In the next stage, second-order (axial) codes were abductively developed and discussed in the whole research team, based on the six practice areas [22] and the commonalities identified across the inductive open codes. Initially, the six practice areas were used to organize the inductive open codes (i.e. activities and related challenges) and create deductive axial codes (i.e. overarching strategies) for further analysis. However, in their team discussions, the authors recognized that several open codes (i.e. activities) fit in multiple practice areas. This prompted the authors to reconstruct the grouping of open codes, creating inductive axial codes (i.e. strategies) that appropriately capture the linkages and commonalities between open codes (i.e. activities). Lastly, selective codes were generated by grouping axial codes (strategies) into thematic relational clusters (strategy clusters) to produce higher-level constructs used for implementation theory-building [33, 35]. All authors actively reflected and discussed these axial and selective codes to ensure reliability and internal validity [36]. All authors were involved in developing and refining the themes reflected in the final manuscript. The qualitative reporting in this study was guided by the COREQ checklist [37].

Ethical considerations

This study was approved by the Research Ethics Review Committee at Erasmus University Rotterdam (ETH2324-0620). Participants signed informed consent forms outlining the study's scope and intended data use, ensuring transparency, and protecting their privacy rights.

RESULTS

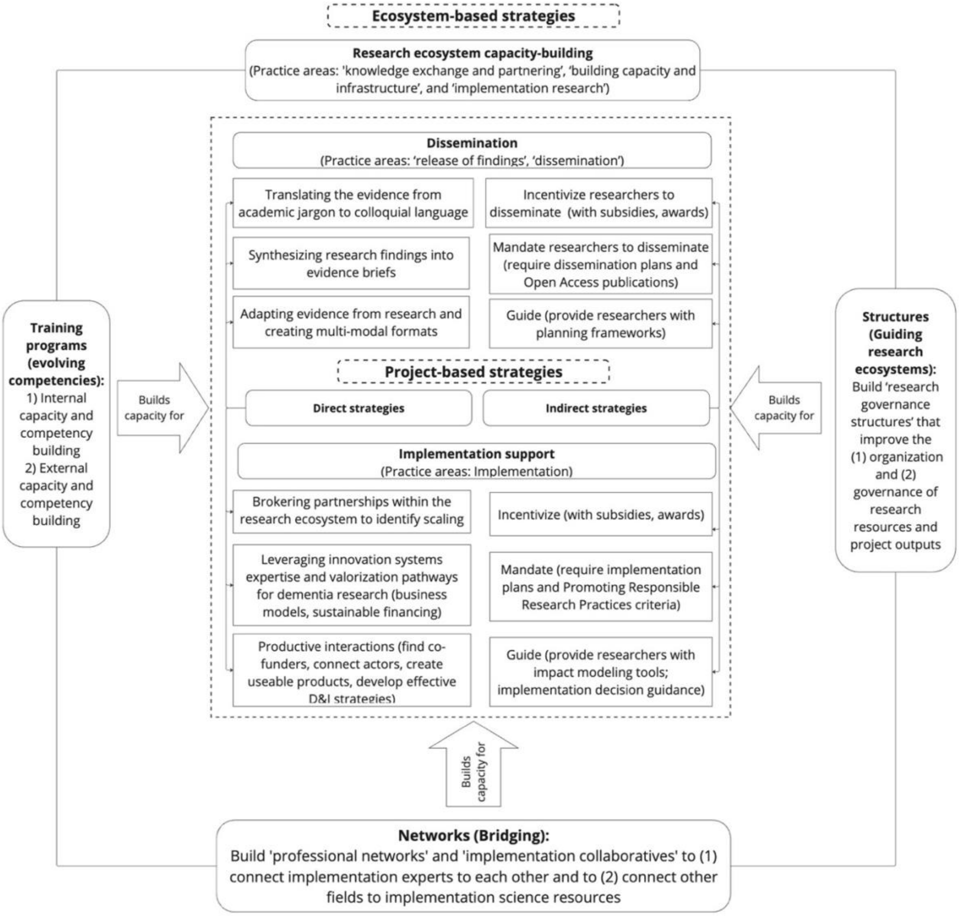
A total of 20 respondents, recruited from three public and four private research funding agencies, participated in the interviews. Individual respondents included 10 entry-level program officers (1-5 years of experience), 7 senior-level team managers (5-10 years of experience), and 3 director-level agency leaders (over 10 years of experience). The primary functions of participants spanned research grant and project management (12), public dissemination and advocacy (4), and strategic coordination (4).

The strategies, and related challenges, of public and private funders were clustered into three themes: ‘dissemination’, ‘implementation support’, and ‘research ecosystem capacity-building’. The ‘dissemination’ and ‘implementation support’ clusters included the original activities in the ‘release of findings’, ‘dissemination’, and ‘implementation’ practice areas. Strategies found in these clusters were selected and carried out by funders on a project-basis. In addition, ‘dissemination’ and ‘implementation support’ strategies were further delineated into ‘direct’ and ‘indirect’ strategies, based on the activities of each strategy. Indirect strategies enable funders to achieve the intended outcome by guiding, incentivizing, or mandating action from an intermediary body (e.g., research teams). Direct strategies enable funders to achieve their intended outcome (e.g., dissemination) without involving any intermediaries. This distinction provided further conceptual clarity to guide the strategic selection of strategies that facilitate research D&I process planning and execution.

Additionally, ‘research ecosystem capacity-building’ strategies encompass research funders’ direct activities in the ‘knowledge exchange and partnering’, ‘building capacity and infrastructure’, and ‘implementation research’ practice areas. These strategies also contribute to building clarity of the systems level structures and processes, which also strengthen the outcomes of project-based strategies. These strategies strengthen all research ecosystem actors’ research D&I capacity, by strengthening the knowledge needed to inform research D&I process decision-making and facilitation.

I. Strategies for dissemination and implementation of dementia research funders

Figure 2. Overview of D&I strategy clusters and individual strategies employed by funders



Dissemination strategies of research funders

The ‘dissemination’ cluster encompassed strategies and activities associated with 'release of findings’ and 'dissemination’ practice areas. ‘Release of findings’ activities assumed that research findings will diffuse to relevant audiences and be accessed by end-users autonomously, whereas ‘dissemination’ activities assumed that the research results should be ‘translated’ and ‘tailored’ by funders to fit the interests and contextual needs of their targeted audiences.

Public and private funders employed indirect dissemination strategies, stratified into three typologies: ‘incentive-based’ (i.e. additional funding), ‘mandate-based’ (i.e. requirements), ‘guidance-based’ (i.e. frameworks, tools). Public funders incentivized researchers to disseminate research by providing research subsidies, which also ‘mandated’ Open Access publications and data sharing under FAIR (Findable, Accessible, Interoperable, and Reusable) principles. They provided guidance (e.g., Dutch Research Council NWO Impact Framework) to help research teams plan for dissemination and engage external research stakeholders and end-users. Private funders also incentivized research dissemination by providing PhD thesis awards to researchers and requiring research end-users’ involvement in the initial project planning stages.

But one thing that is kind of hard for us is that our subsidy isn't allowed to be used for broader dissemination. We can only finance activities that are scientific dissemination, scientific papers, scientific congresses, academic visits, etc. (…) But we also try to push more and more to include the end user in their research from the start. (Respondent 19; Private funder)

Public and private funders also employed direct dissemination strategies, primarily involving knowledge translation and public-private engagement to widen research accessibility to targeted audiences. The range of knowledge translation activities included (1) translating the evidence from academic jargon to colloquial language, (2) synthesizing research findings into evidence briefs, and (3) adapting evidence from research and creating multi-modal formats (e.g., videos, booklets) to scale dissemination and reach. Public funders synthesized research findings into decision-making tools (i.e. evidence synthesis) for policymakers and created multi-modal media to share findings with patient groups. Private funders translated research findings for industry sponsors, individual donors, patient groups, practitioners, and policymakers (i.e. advocacy teams). Both public and private funders facilitated engaging cross-sector matchmaking events (e.g., Mix and Match, Alzheimer Cafes) to share translated evidence and create opportunities that foster cross-domain collaborations along research ecosystem stakeholders. Private funders furthered cross-sector engagement by engaging policy advocates and leveraging professional networks from external partners to enhance research dissemination. Table 1 provides further clarity to delineate between the dissemination activities of public and private funders.

We were searching for an [ambassador], and we asked her to connect organizations and to make things change more quickly about case management, dementia, about daycare activities, and about housing. So she talked to a lot of people. And she organized a lot of conferences and made a report after a year (…) I think it helps that a woman of that stature did what she did and talked to people. She was very good in convincing and connecting organizations and opposites [sides]. (Respondent 14; Private funder)

We tried to reach the general public more on social media. I think there are other partners that can reach other target audiences better, such as health care professionals. For example, Zorg voor Beter (Care for Better), the Netwerk Kennissteden Nederland (Network Knowledge Cities Netherlands), and the Dutch Memory Clinics. We can use those partners' [networks] to reach the health care professionals. (Respondent 12; Private funder)

What we do is we try to collaborate with researchers to inform Members of Parliament and politicians. Not very often, but we do. And of course we invite them to the media to tell their stories about how they do things and what they what about the results. We have a TV show with researchers telling about what they are doing and why it's important for people with dementia (…) we like those researchers who can talk about what they are doing and their results in a way "normal" people can understand. (Respondent 14; Private funder)

Table 1. Dissemination strategies of public and private research funders

Nature of funders	Main strategies identified from both public and private	Sector specific details
Public funders	(1) Indirect dissemination strategies: • Incentive-based (i.e. awards) • Mandate-based (i.e. requirements) • Guidance-based (i.e. frameworks, tools) (2) Direct dissemination strategies: • Knowledge translation • Public-private (research ecosystem) engagement	• (Indirect) Requires Open Access publications resulting from funded research (FAIR principles). • (Direct) Translate evidence to decision-making tools to support policymaking • (Direct) Translate evidence to multi-modal formats for public end users
Private funders		• (Direct) Engage champions (i.e. ambassadors) to share research to policy context • (Direct) Translate evidence for individual donors, patient groups, policymakers • (Direct) Share research through (professional) networks of external partners with relevant audiences (e.g., healthcare institute, Memory Clinics)

Implementation support strategies of research funders

Funders' implementation support strategies encompass the 'implementation' practice area. Results suggest that funders are not involved with the actual implementation of research findings into implementation settings (e.g., nursing homes, hospitals), but, more accurately, they facilitated implementation support through direct and indirect strategies.

Indirect implementation support strategies of funders were also 'incentive-based' (i.e. additional funding), 'mandate-based' (i.e. requirements), and 'guidance-based' (i.e. impact frameworks). Public funders offered incentives through implementation subsidies, such as Dissemination and Implementation Impulse (VIMP) grants and impactful program awards (ZonMw PEARLs). Knowledge vouchers were also issued for research teams to hire implementation specialists that contribute to building the implementation capacity. Public and private funders required research implementation and impact plans, guided by 'Promoting Responsible Research Practices' (BVO) criteria, to promote equitable societal benefit from research. Public funders required structured implementation plans at the grant application stage and provided impact modeling tools (e.g., NWO Impact Focus Approach [38]) as guidance. In contrast, private funders used a proactive and adaptive approach to guiding, refining, and tailoring research impact and implementation plans based on implementation progress, such as a digital health product's technology readiness level. This enabled private funders to anticipate potential challenges to implementation (e.g., procedural barriers), respond with timely and appropriate implementation support, and efficiently steer research implementation.

We had a big part in dissemination of the results, putting on some nice texts on our websites or LinkedIn, funding certain parts, but now we try to be more proactive (…) we want to say to them, "Hey, this looks interesting. Did you already think about certain implementation stages?" So we try and steer more active. (Respondent 17; Private funder)

Researchers have to complete an application form, which is specifically built according that impact plan approach. So every researcher has to complete that application form, fills in parts of that impact plan approach, basically. With, of course, the advice on our side, to really start with the end in mind. And then, reason back. (Respondent 8; Public funder)

The direct implementation support strategies, employed by public and private funders, required their active contribution to facilitate project-based research implementation. Strategies primarily included (1) brokering partnerships other research D&I stakeholders to identify implementation and scaling opportunities (e.g., across municipalities and across health and social domains) and (2) leveraging innovation systems expertise and valorization pathways for dementia research. Public funders primarily fostered professional relationships across the research ecosystem to connect health and social domain research partners with evidence, such as embedding and scaling dementia research findings within municipal health services for broader impact. They also performed activities that focused on four 'productive interactions' that guided implementation support, including stimulating research co-ownership between public and private funders, connecting with research ecosystem stakeholders, making usable products for societal benefit, and developing effective dissemination and implementation strategies.

In every program and project, you will see metrics on either productive interaction, in these four categories, or an open question: Who is going to profit by these results? How are you going to reach them? Is there a role for [funder]? Can we help you? Do you need extra money for an extra grant for implementation? (Respondent 6; Public funder)

Next, public funders were legally restricted from supporting projects that commercialize, or profit from, their research investments. In contrast, private funders applied innovation management principles to promote valorization and innovation in research funded by their investments. They leveraged valorization structures, including incubators, accelerators (e.g., Health Impact Accelerator), and technology transfer offices, to advance dementia research accessibility and commercialization. Private funders also engaged private sector stakeholders (i.e. investors) to connect academic research with industry, securing sustainable financing, enhancing business models, and creating pathways for scaling dementia research. Table 2 provides further clarity to delineate the implementation support activities of public and private funders.

There is a lot of discussion. In principle, everything that is created by [public] money should be openly available, should be reported on, it should be put on our website and included in all our products and databases. (…) We want implementation, but we are not allowed to commercialize it. Sometimes, it makes you think that if we didn't need to do it [implementation], we wouldn't exist. This is also a big discussion on this state support, which makes it that you [public funders] are not allowed to support commercial organizations from Europe, as a public funder. But on the other hand, if it would be done by the market, we wouldn't need to exist. (Respondent 6; Public funder)

A lot of colleagues of mine now have knowledge on valorization. Valorization goes over the whole aspect of research. It's all about knowledge utilization. And of course, I have some knowledge of patent filing, but I don't have the knowledge of patent filing that a Knowledge Transfer Office has at an academic center. What we tried to do is support and facilitate researchers the best we can. So we try to connect them with other parties that actually can help them further on the road. (Respondent 17; Private funder)

So we're going to form a panel of external investors and they are also going to rate the project on their market viability (…) there's also the idea or the goal to also start a phase three so that projects that come from the phase two projects can also apply for future follow up funding. So we really try to guide the projects and the innovation from the start from different levels, phase one or phase two, and then can go on to the to the next funding possibility. (Respondent 19; Private funder)

Table 2. Implementation support strategies of public and private research funders

Nature of funders	Main strategies identified from both public and private	Sector specific details
Public funders	(1) Indirect dissemination strategies: • Incentive-based (i.e. awards) • Mandate-based (i.e. Promoting Responsible Research Practices criteria) • Guidance-based (i.e. frameworks, tools) (2) Direct dissemination strategies: • Knowledge translation • Cross-sector (research ecosystem) engagement	• (Indirect) Dissemination and Implementation Impulse grants; Impactful Program Awards; Knowledge vouchers (for implementation specialists) • (Indirect) Structured implementation plans and modeling tools • (Direct) Establish professional relationships across systems (education, health, welfare) to broker connections • (Direct) Four productive interactions (cross-sector co-funding; connecting with research ecosystem stakeholders; making usable products; and developing effective D&I strategies)
Private funders		• Proactive, adaptive approach to implementation planning, based on research progress (e.g., product Technology Readiness Level) • Valorization and commercialization of research through incubators, accelerators, technology transfer offices • Seeking private investors to provide sustainable financing opportunities

Research ecosystem capacity-building strategies of research funders

Research ecosystem capacity-building strategies include activities under the ‘knowledge exchange and partnering’, ‘building capacity and infrastructure’, and ‘implementation research’ practice areas. Funders of dementia research employ these strategies at the system level to strengthen infrastructure and processes that support the entire dementia research D&I process, simultaneously enhancing the project-based dissemination and implementation support strategies. Funders reported capacity-building strategies as direct strategies that improve research implementation outcomes by iteratively and continuously strengthening the formal research ecosystem infrastructure and resources. Such strategies focused on advancing the infrastructure of human capital (via training), professional (collaborative) networks, and research governance structures, which all contribute to improved research D&I outcomes.

First, funders strengthened the capacity of human capital by broadening their internal (staff) professional D&I competencies. Cross-professional training, such as for advocacy and lobbying, research communication and brokering, and cross-sector partnership management, was provided to public and private funders. These skills allowed funders to improve their ability to act as knowledge brokers and boundary spanner between academics and industry stakeholders. Public funders also strengthened (external) human capital by building an implementation science training program (Implementation Science Practitioner Fellowship) that aims to formally train external researchers and practitioners and expand the knowledge and scale of D&I professionals in the Netherlands. This develops the depth and scale of D&I expertise available externally to support research practices.

We noticed that it is not enough to ask certain questions on implementation. We also need to build the infrastructure… help to build the infrastructure of people and networks that is needed to do that implementation. (…) We are becoming a little bit stricter when it comes to implementation. But we also noticed that we need to help to fill that knowledge.
(Respondent 7; Public funder)

Next, funders strengthened the capacity of professional networks by creating research D&I implementation pathways and collaboratives to systematically design and mobilize evidence across the research ecosystem. Public funders, researchers, and practice professionals established a formal network of implementation science professionals (Netherlands Implementation Collective) to enhance connectivity within the implementation science community and to build connectivity across the wider professional D&I support infrastructure. Public and private funders strengthened ‘professional networks’ by creating formal cross-sector consortium partnerships (e.g., ABOARD consortium) to stimulate research use beyond academia. These networks were established by funders to help align research ecosystem stakeholder interests, determine research agendas, and set research funding programs.

There are few people within the university, in the technology transfer centers, that are specialized in implementation. That's of course also why we put it on the national agenda to have more capacity in this field. We started with founding the Dutch implementation collaboration. So it's broader than only valorization centers. The specific corner of our organization focuses on fundamental research and E-health. Those domains of research talk more about valorization instead of implementation. (Respondent 5; Public funder)

Lastly, dementia funders strengthened research D&I capacity by building research governance structures that improve the organization and governance of research projects and their outputs. Such structures include the public-private research consortia model (e.g., DEMPACT consortium), which help reduce research fragmentation and promoted knowledge connectivity across sectors, shared risk and ownership over research, and expertise exchange between academia and industry. Funders also developed 'monitoring and evaluating structures', such as implementation evaluation metrics and theory of change models, to audit and assess research D&I outcomes. This strengthens their own ability to organize D&I efforts, monitor implementation outcomes, and adapt to external demand for implementation support. Table 3 provides further clarity to delineate the research ecosystem capacity-building activities of public and private funders.

We have also trained our colleagues to be facilitated to do those big matchmaking and collaboration sessions. We are very much interested in how we can help [funder] give the information, but also help with getting partners to collaborate with each other. (Respondent 9; Public funder)

We had contact with [other funders] to create the Call text, to make arrangements about who funds what, and since they want to incorporate companies, but the government cannot *fund free market companies. They have to be efficient on that. So they cannot fund all the costs of companies. It's a percentage of 50 to -60%, and our money can match these funding so we can pay for the company's bill because we are an NGO [not restricted by government budget]. (Respondent 16; Private funder)*

Table 3. Research ecosystem capacity-building strategies of public and private research funders

Nature of funders	Main strategies identified from both public and private	Sector specific details
Public funders	(1) Strengthened the capacity of 'human capital' • Internal (funder staff competencies) • External (workforce competencies) (2) Develop professional networks • Implementation support practitioner collaboratives • Public-private consortium network (3) Research governance structures • Public-private research consortium models (shared ownership, risk, responsibilities) • Monitoring and evaluating structures	• Establishing formal training programs for implementation support practitioners • Expanding the core competencies of funders to include project D&I planning and management, cross-sector collaboration, and knowledge brokering • Construct professional (expert) networks (e.g., Netherlands Implementation Collective) • Developing monitoring and evaluating criteria for implementation projects
Private funders		• Use infrastructure (e.g., volunteer network) to monitor and evaluate regional dementia conditions • Expanding the core competencies of funders to include research brokering, research advocacy, and partnership management • Joining public-private partnerships to influence research agenda development

Challenges of dementia research funders for dissemination and implementation

Public and private funders reported several distinct challenges relating to each thematic cluster. For the *dissemination* cluster, funders observed that research teams were underutilizing the funders' available dissemination channels (e.g., newsletters, blog posts, media), which led to low engagement with the public. Additionally, funders identified challenges in reaching broader audiences through their current channels, particularly vulnerable groups such as older individuals with low digital literacy and limited access to technology.

For communication, the problem is that you cannot always reach the people that you want to reach, but you reach the people that want to read it. I think that's a really big issue. How do you reach the people that really need to know it? And I think that's in general challenging. But there are just hard to reach target audience and especially for older people…maybe not that used to the Internet. How do you reach them? (Respondent 12; Private funder)

I want to develop new strategies to connect researchers and implementers. Because people doing research only think about articles and presentations. But this is not enough… because people working in dementia care, they don't go to those presentations. They don't read those articles. I think those consortia researchers even have to change their ways of doing research. Participation of people with dementia, carers, health carers, welfare carers... they have to participate along. So we have to think of other ways of doing research. (Respondent 14; Private funder)

In the *implementation support* cluster, public and private funders faced two major challenges in providing project-based support. First, the unclear research D&I roles among public funders, private funders, and research teams led to conflicting expectations regarding each party’s respective responsibilities and competencies. For instance, the absence of implementation support guidelines, that clarify such responsibilities across the research D&I process, has led to a reactive approach to implementation support. Without clear determination of stakeholder roles across the research D&I process, funders struggled to select appropriate implementations support strategies and deliver effective implementation support. Next, there is low engagement from researchers with interdisciplinary expertise and resources to support research D&I. Funders provided implementation support infrastructure, including innovation valorization structures and implementation support vouchers, to enhance D&I efficiency and reduce resource waste within research teams.

However, the limited engagement from researchers reduced the reach of evidence to diverse audiences and impeded public access to the benefits of research.

We try to stimulate the researchers. We are funding research. So, we try to stimulate the implementation. (…) But the field will have to take it on. Also, if you want it to work for the coming years, there has to be some money [invested] from the organization itself, because otherwise, after one year of money from [funder], then who is going to pay for it then? They have to look at how they are going to pay for this. We can do things to stimulate it or to give the first push, but the field has to take it… (Respondent 1; Public funder)

There's a pathway from the side, from the bench to bedside. And I think you cannot expect that the researchers at the bench bring it to the bed. It's a chain and we think it's important that you talk to the right person, and that they think forward, to whom I can hand it over. Most of the time, what happens is [that] they did something at the bench. They discovered it. And then they started over again with another project. (Respondent 16; Private funder)

In the *research ecosystem capacity-building* cluster, public and private funders encounter complexity-related challenges resulting from (1) the low maturity of current research D&I infrastructure and (2) conflicting value systems in public-private partnerships. First, complexity-related challenges stemmed from the low maturity of research D&I infrastructure, such as limited expertise (workforce capacity), inadequate structural financing for implementation, and insufficient research impact evaluation mechanisms. These limitations reduced funders' ability to systematically select and employ strategies that enhance D&I outcomes.

It takes a lot of attention or time to start this program in a good way, and then we have too little time or attention for really following up [on] the results and making sure that it reaches its impact. So that's one of the challenges. And the other thing is, that we do a lot of projects. So it's very difficult to see all these connections between this problem, and then there are a lot of connections. (Respondent 5; Public funder)

Further, these limitations hinder the ecosystem’s capacity to monitor, evaluate, and improve the outcomes of current D&I strategies, contributing to further implementation uncertainty and complexity.

One of the questions that we were asked, was how the program contributes to the national dementia strategy. Specifically on the [goal that] 80% [of people with dementia] has access to meaningful activities etc. We said that we can't do that. There is no direct link between what we're trying to achieve in the field and the access [to research impact] that people have. (…) We can try to colour them with stories from the project [results] and the municipalities with their experience within the program. (Respondent 4; Public funder)

It is a challenge because we want to be able to say “this is the impact of our project”. But the things that come out of projects that are measurable are the amount of patents and amount of publications. So we have a whole list where they need to fill in. “What are the outputs of your research?” But it is quite hard to measure the societal impact and also the economic impact. So they need to address this in their application. But there's not yet a real strong way for us to assess all the impacts from our project and it is something that we try to develop and make it better. But we have some numbers, for example, on publications. But we all know that it's not the best indicator. (Respondent 19; Private funder)

Next, in the dementia research field, public-private partnership consortia models are research governance structure that connects cross-sector interests to advance dementia research impact. However, funders experience challenges within these partnerships, primarily relating to (1) strategic stakeholder engagement and (2) value systems (mis)alignment for goal and agenda setting. Strategic stakeholder engagement in public-private partnerships is vital for research ecosystems to thrive, but this comes with unique challenges. For example, public funders face legal and regulatory barriers, such as EU State Aid rules that restrict the commercialization of publicly funded research. Public-private co-funding partnerships enable publicly funded research products to leverage commercialization strategies supported by private funders. However, these partnership models are new in the Dutch dementia research context, and funders are often challenged by the conflicting value systems between stakeholders. Funders characterized value systems in this context as the set of values, priorities, and objectives that motivate individuals and institutions from different sectors and settings to be involved in research D&I. For instance, funders reported that practice setting stakeholders often prioritized simple, feasible, effective research products, whereas academic stakeholders, primarily responsible for producing research, may be evaluated based on innovation and scientific rigor. This creates tension among stakeholders and poses challenges for funders to set research agendas that align practice and academic value systems.

But this is the key of what is happening also because sophisticated research and results and interventions are more quickly highly rated… and people who develop more simple interventions which people with dementia like, they're not for The Lancet or for high rated journals. This is a problem. (Respondent 14; Private funder)

I know that one of the problems, for example, for medical products is that it's under European legislation and you have to have a certain certification, which also accounts for very small interventions like an app. And this whole trajectory also involves legal people from Brussel, which counts € 800 per hour for that advice. And the talk about the cost of such territory is about € 150,000 or something. So then they're not able to get this accreditation. So they're not allowed to go to the market. So that's one of the things that I know that are really blocking the implementation or the use of this knowledge. (Respondent 5; Public funder)

If a party will generate money from it, then we have a problem with the public money that comes from the Ministry of Health. (…) We have these strict regulations about that you cannot earn money with it and have an advantage over other organizations in the field. (…) we give money to one organization, and they will have an advance on the market and the other organization not… Then, it is stated that it is prohibited. (Respondent 1; Public funder)

DISCUSSION

The strategies and challenges identified in this study provide contextual nuance and depth that informs research D&I processes at the system level. Findings from this study produced valuable theoretical and practical contributions to advancing D&I research, informed through evidence from the dementia research domain. The main D&I strategy clusters identified in this study include dissemination, implementation support, and research ecosystem capacity-building. These findings closely align with the 'dissemination', 'capacity-building' and 'scale-up' strategies of support system actors, as proposed by Leeman et al. [23]. Each of these strategies require contributions from diverse stakeholders. This aligns with the principles of integrated knowledge translation (IKT), which encourages the involvement of research funders, research teams, practitioners, and policy actors in the research co-production and D&I process [39]. Additionally, this study also revealed that there are clear interdependencies between institutions (e.g., research funders, research teams) and across sectors (e.g., public and private funders) at every phase of the research D&I process.

Given these findings and insights, this study proposes a *research ecosystem* approach to frame and structure the IKT activities of research D&I stakeholders. This conceptualization builds upon Adner's *innovation ecosystem* concept, commonly utilized in the fields of entrepreneurship management and innovation science [40]. The innovation ecosystem concept contains structures and processes, unified through an *ecosystem-as-a-structure* approach, that frame and align the activities, actors, positions, and links involved in value creation [41]. There are several clear commonalities between the *innovation ecosystem* and this study's proposed *research ecosystem* (see Table 4 for more details). Accordingly, the research ecosystem concept could also be operationalized using the *ecosystem-as-a-structure* approach and used to guide funders in explicating interdependencies and organizing boundaries between the peripheral stakeholder groups involved in value creation [41]. Tools and models, such as the Ecosystem Pie Model [42], are available to structure innovation ecosystems and support planning. This model includes several elements that contribute to understanding and capturing 'value' in the ecosystem, such as the actors and resources involved, activities performed, value addition, and value creation [42]. These tools may be adapted for use in the dementia research ecosystem context to specify, frame, and coordinate actors' roles, responsibilities, and resources across the phases of the D&I process.

Table 4. Innovation ecosystem and research ecosystem commonalities (definitions and examples)

	Traditional definition of each element applied in the *innovation ecosystem* [41]	Description of each element applied in the r*esearch ecosystem*
Focal firm	The entity (individual or organization) around which the ecosystem is structured	(In this study) Research funding agency
Value creation	The promised benefit that the target of the effort is to receive (i.e. intended outcome of activities)	Dissemination outcomes Implementation outcomes Wider (health, social, educational) impact outcomes
Activities	Discrete actions to be taken for value proposition to be created	Dissemination strategies and activities Implementation strategies and activities Implementation support strategies and activities Capacity-building strategies and activities
Actors	Entities (individuals or organizations) that undertake the activities	Research teams; (other) funders; patient representative groups; policymakers; implementation settings (nursing homes, hospitals); media outlets
Positions	Positions refer to where actors stand in terms of influence, resources, and responsibilities within the ecosystem.	Funders occupy a central role in research agenda setting and capacity building; peripheral role in direct research implementation Researchers focus on evidence generation; peripheral role in research agenda setting and systems capacity building
Links	Links are the relationships and interdependencies between actors	Formal partnerships (consortia partnerships; public-private partnerships) Data-sharing agreements across the ecosystem

This study revealed that there was no clear consensus on the D&I roles and responsibilities of dementia research funders and research teams within the research ecosystem. This aligns with existing IKT literature that highlights the need for additional research that identifies *when* and *how* to engage each stakeholder group in research D&I [16]. Literature also suggests that a systematic approach to facilitating IKT is needed, such as by using implementation science logic models to explicate each step of the IKT process and rationale for each decision [12, 16]. Results from this study delineated the strategies of research funders into ‘direct’ and ‘indirect’ dissemination and implementation support strategies. This distinction provides deeper insights into the nature of research funders’ and research teams’ activities to guide IKT processes and support the development of an appropriate D&I logic model that enhances collaborative capacity [12].

The distinction between ‘direct’ and ‘indirect’ strategies provides funders with more conceptual clarity of their role in the D&I process. This aids decision makers in D&I strategy selection and capacity-building investment agenda (see Figure 2). Funders that employed direct strategies (e.g., evidence translation, knowledge brokering) accepted their active role in research D&I. This prompted additional investment in internal capacity building, such as by building staff competencies for managing cross-sector connections and collaborations. Noordegraaf [43, 44] argues that shifts in external demands may stimulate the ‘reconfiguration’ of traditional professional roles and responsibilities. The national prioritization of dementia research D&I [2] stimulates research funders to ‘reconfigure’ their traditional role and responsibilities and adopt hybrid competencies that strengthen their ability to conduct direct dissemination and implementation support activities. Such hybrid competencies include fostering intervention and implementation co-creation [45] and facilitating research ecosystem stakeholder engagement through organizing cross-boundary collaborations (e.g., public-private partnerships) [46]. Building internal hybrid competencies can strengthen research funders' D&I capacity and position as an implementation support hub, enabling them to play a centralized 'coordinator' role within the research ecosystem.

Alternatively, funders that employed more indirect strategies (i.e. incentives, guidance) shifted D&I responsibilities toward the research teams and other research D&I ecosystem stakeholders. This outward shift of D&I responsibilities required funders to investment in the external capacity building, such as by establishing implementation support practitioners as a formal profession that complements the clinical healthcare workforce [47]. The gradual emergence of this new profession requires the timely development of context-appropriate implementation support training programs (e.g., Implementation Science Practitioner Fellowship) [48] and national D&I professional networks (e.g., Netherlands Implementation Collective) to connect and support implementation researchers and practitioners [49]. These external capacity-building activities also directly contribute to strengthening implementation science maturity, which has been hindered by a global shortage in implementation science experts and context-appropriate educational programs [50].

Results also highlighted the impact and opportunities of diverging value systems of public and private research funders collaborating within public-private partnership (PPP) consortia models. For example, public funders activities demonstrated “accountability, impartiality, transparency, and quality”, prioritizing the societal impact of research [51]. This was achieved through their ‘productive interactions’ with society, focused on facilitating D&I through co-creating relevant products from research with end-users [52]. Private funders more often valued "profitability, efficiency, and innovation” in research and directed resources toward research uptake and value creation through commercialization [53]. The contrasting value systems of the public and private domains may contribute to role ambiguity among actors in co-financing arrangements. However, there are also emerging opportunities to leverage practices to overcome respective institutional barriers.

According to public management literature, PPPs are valuable as a management structure for collaboration to reduce intersectoral knowledge fragmentation and promoting innovation and evidence uptake [54]. Successful PPPs are driven by a clear understanding of the unique strengths and competencies that each public and private actor brings to the table, coupled with a strong alignment of values and shared objectives among all partners [51]. For example, as identified in the results, publicly funded dementia research in the Netherlands is regulated by the European Union (EU) State Aid policies, which restrict public investment in commercial activities to protect market competition in EU Member States [55]. These policies potentially stymie innovation in publicly funded academic research and pose challenges in aligning value creation in PPPs [55]. Therefore, these unique contextual conditions require strategic organization of roles and resources of public and private actors in the research ecosystem.

Results highlighted that public-private co-funding mechanisms in dementia research consortium projects may help circumvent these State Aid limitations. The optimal role and position for public and private funders in the D&I process may be determined based on the values, resources, expertise, and contributions. For instance, Dutch public funders may provide subsidies for ‘pre-competitive research’, including fundamental research and early-stage research and development [56], and offer implementation support by connecting research teams to (public) implementation settings (e.g., municipal health services). Private dementia research funders are well-positioned in their professional networks to foster university-industry connections. Private funders may also provide complementary financial subsidies and offer expert guidance to transform pre-competitive research into market-ready products. Emerging research from the technology domain provides insight on this convergent approach and may help navigate valorization and commercialization of dementia research [55, 57]. However, stronger empirical evidence is needed to optimize the management of PPP resources and determine the optimal positions for public and private actors in the dementia research D&I process.

Research implications and future direction

The study identified two key areas for further development: enhancing capacity-building infrastructure to strengthen research D&I and optimizing the roles and responsibilities of actors in the research ecosystem. First, this study determined an additional need to strengthen capacity-building, in the research ecosystem, to build dementia research D&I. This can be achieved through conducting implementation research, which did not appear in this context, potentially signifying that this is a low priority. Focused implementation research, and ‘research-on-research’, is crucial for advancing the maturity of implementation capacity and enhancing societal impact. Further, capacity-building may be achieved by building large-scale connective D&I infrastructures, such as the Cancer Control Centers (ISC3) Network (USA) [58], to reduce fragmentation of roles, responsibilities, and resources across the D&I process. The development of implementation science training programs, specifically for dementia research, may also strengthen D&I capacity [59]. This requires combined efforts from funders, researchers, and educators to understand the D&I

training needs of all implementation stakeholders, to produce suitable content, and to deliver training effectively and equitably [60].

Second, the research ecosystem conceptual approach is steadily emerging in IKT literature but requires empirical research and interdisciplinary collaboration to produce clear contextual insights to inform role clarity and develop decision aids and pragmatic tools (e.g., Ecosystem Pie Model). This may be achieved by using a Delphi method to create a valid dementia research ecosystem stakeholder map, build a consensus on the scope of each stakeholder's role and contribution, and identify areas of disagreement to direct future research. Further, interdisciplinary methodological research may integrate knowledge from innovation management and implementation science to build adapted tools that bolster this research ecosystem approach and reduce the evidence gap between disciplines.

This study may have limitations relating to the research design and data collection. First, the study used purposive (snowball) sampling to identify and select respondents. This may introduce selection bias and reduce the generalizability of findings beyond the Dutch context. Participants were also limited to funders of dementia research, which may limit the applicability of results beyond this funding landscape. Further, the study relied on data from interviews, which may be subject to social desirability bias. Future studies may address these limitations by exploring the validity of these findings through mixed-methods approaches. Second, given the focus on research D&I through an implementation science lens, technical jargon was often used in the interviews. However, funders were accustomed to using a different set of terms to describe D&I activities. This required the interviewers to adapt their questions and adopt the funders' terms. Data collection was conducted in English due to the language limitations of the first author. Respondents were given the opportunity to elaborate on ideas further in Dutch to mitigate miscommunication risks if this felt necessary. As all interviews were conducted by two researchers (first and last author), a native Dutch speaker was present in all interviews to facilitate language interpretation and translation. The study's conclusions should be interpreted with these limitations in consideration.

CONCLUSION

Public and private dementia research funders play a pivotal role in supporting research D&I through diverse *dissemination*, *implementation support*, and *research ecosystem capacity-building* activities informed by each sector's unique resources and value systems. Public funders' strategies focused on societal benefits and impact. In contrast, private funders' strategies centered on delivering value to industry donors and individual contributors, while enhancing fair market commercial outcomes. Public and private funders experience persistent challenges with navigating roles and responsibilities among the actors within the research ecosystem and steering capacity-building resources to improve implementation outcomes. These findings offer valuable contextual insights to guide the strategic selection of activities that address challenges at each phase of D&I. Future research may focus on designing and developing strategic planning tools that fully support funders in optimizing their D&I impact. Adopting a research ecosystem approach presents a promising pathway to overcome persistent D&I challenges in dementia research and other fields.

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6

General discussion and conclusion

6.1 INTRODUCTION

As detailed in Chapter 1 (Introduction), the field of dementia research has rapidly evolved, and robust evidence showcasing best practices is available in international literature. Despite the growing successes in clinical effectiveness research [1], there remains a largely unmet need for research on the dissemination and implementation of such evidence. Chapter 1 also described the current state of dementia research and detailed the potential impact that implementation science has on transforming translational science and health research mobilization and uptake. Accordingly, the premise of this PhD project was to understand and improve the dissemination and implementation of non-pharmacological dementia research, defined by this PhD dissertation as "*the investigation designed to contribute knowledge or to develop innovations that directly or indirectly improve patient health outcomes along the dementia care trajectory, without the use of chemical agents".* To address the persistent challenges of non-pharmacological dementia research implementation, the central aim of this dissertation was to conduct an in-depth exploration of how implementation science can be applied to accelerate the translation of non-pharmacological dementia research to practice.

In this chapter, subsection 6.2 will offer a summary of the findings from the four preceding chapters and connect them to the sub-questions of this PhD dissertation. Next, subsection 6.3 will reflect on the strengths and limitations of the methodologies selected for each independent study and discuss the related lessons learned. Following, subsection 6.4 and subsection 6.5 will share the theoretical and practical implications of the findings and contributions of this PhD dissertation, respectively. Lastly, subsection 6.6 will discuss the future direction of this research area and present final concluding remarks.

6.2 SUMMARY OF MAIN FINDINGS

The main research question in this thesis was: *How can implementation science be leveraged to understand and improve the dissemination and implementation of non-pharmacological dementia research findings into practice in the Netherlands?*

Given this goal, the first step was to conduct an evidence synthesis to determine the current state of evidence in the literature on dementia research implementation. At the conceptualization stage, previous literature reviews, led by Lourida [2] and Bennett [3], focused on the implementation of interventions for people with dementia. These literature reviews explicated a clear need for an additional evidence synthesis that explored the implementation of interventions for their informal caregivers. Therefore, Chapter 2 presented a research protocol, detailing the design of an extensive systematic scoping review, focused on the dissemination and implementation of home- and community-based interventions for informal caregivers of people living with dementia. The protocol introduced a new synthesis approach and detailed the operationalization of an innovative AI-based article screening tool (ASReview) [4]. This established the basis for the systematic scoping review, presented in Chapter 3, which was guided by a central research question: "*What is already known in the scientific literature about the dissemination and implementation of home- and community-based interventions for informal caregivers of people living with dementia?"* The three main aims of this systematic scoping review were to map, describe, and synthesize the (1) implementation determinants (barriers and facilitators), (2) implementation strategies, and (3) implementation outcomes. 67 studies, published between 1996 and 2021, were included in the final data extraction and analysis. Twenty-one included studies were guided by a theoretical framework rooted in implementation science, suggesting a variation of research designs, originating from beyond implementation science, used to facilitate implementation research in the field of dementia research. This approach generated robust evidence that strengthens the bridges between these fields of research.

Within this evidence, two significant contributions stood out. First, findings suggested that most evidence-based interventions for informal caregivers are often multi-component. The multifaceted components of these interventions often required varying expertise and resources to successfully implement and deliver in home and community settings. Home and community settings offer vital care management support and often serve as the first point of contact when seeking healthcare, particularly for individuals with complex care needs (e.g., dementia) [5]. These expertise and resources are often embedded across multiple systems (e.g., welfare, health, education system). This additional demand for the coordination of resources and support across each system also introduced diverse barriers to the implementation of evidence-based interventions in home- and community settings. For instance, the misalignment of perceived responsibilities across different stakeholders involved in implementation emerged in this review as a prominent system level implementation barrier. This created difficulties for implementation stakeholders to create shared implementation plans, which are critical for achieving successful outcomes, especially in home- and community-based interventions [6].

Second, these findings also underscore that implementation science literature has not prioritized understanding the determinants and strategies applied beyond clinical contexts [7]. This clear gap in home- and community-level implementation science evidence increases the risk of implementation inequity, potentially worsening health outcome disparities [8]. The findings suggested that implementation strategies in the Expert Recommendations for Implementing Change (ERIC) taxonomy [9] did not adequately encompass real-world home- and community-based implementation strategies. This has also noted in implementation science literature as a persistent challenge in the field, requiring empirical evidence from various contexts to build a relevant taxonomy to provide a standardized language that facilitates communication with community partners [10]. A community-based implementation strategy taxonomy would be particularly helpful in low- and middle-income countries that rely more on primary care and community-based institutions for their healthcare needs [11]. Further empirical evidence from various contexts, such as community-based nursing homes, is needed to further scrutinize the relevance and usability of the discrete strategies in the ERIC taxonomy. This may follow the guidance of Balis et al. [10] that proposed refinements to build upon the ERIC taxonomy, based on insights from community-based practice, policy, and research. Greater investments to strengthen home- and community-based implementation research is needed to enhance the relevance and applicability of implementation science theories, models, and frameworks across diverse healthcare contexts.

Further, most activities identified in this review fit in the description of the 73 identified strategies in the ERIC taxonomy, but some new strategies emerged from this study. For example, *collaborating across sectors and systems* emerged as a potential strategy under the *develop stakeholder interrelationships* cluster. From these findings, activities were identified, such as “cooperation between organizations includes local Alzheimer’s Associations, mental health organizations, general practitioners, home care organizations, case managers, and local caregiver support organizations”. These findings were labeled in the data analysis as *promote network weaving* (ERIC 52), broadly described in the taxonomy as “*promoting information sharing, collaborative problem-solving, and a shared vision/goal related to implementing the innovation”.* However, this strategy description failed to acknowledge and address the inherent complexity of network weaving. The theoretical development of this discrete strategy be clarified further by delineating it into separate (sub-)strategies, such as *promoting intersectoral collaboration, guiding role allocation,* or *brokering partnerships.* These proposed strategies contributed to constructing a broader unifying *research ecosystem* concept that may help navigate and explain the complex dynamics that contribute to the outcomes in the outer implementation setting.

The contributions from this systematic scoping review have determined specific opportunities for transdisciplinary knowledge sharing that contribute to building the field of implementation science. Multidisciplinary and interdisciplinary approaches have been used to shape implementation science by selecting and refining theories and methodologies from various study disciplines, such as health services research and management science [12, 13]. A transdisciplinary approach that obtains insights and evidence from practice and policy has the potential to strengthen implementation science theories and frameworks, enabling a more accurate reflection of real-world implementation conditions.

One key approach to achieve this ambition is through obtaining empirical real-world implementation evidence to build upon existing implementation science theories, focusing on the determinants and conditions of the outer implementation setting. The outer implementation setting, described in this dissertation, encompasses the constructs in the *outer setting domain* in the Consolidated Framework for Implementation Research [14], including the policies, partnerships, and financial infrastructure of the implementation setting. The theoretical development of this outer setting concept may benefit from including insights from broad implementation actor perspectives, introducing transdisciplinary insights to support implementation science theory-building and creating a vivid and conceptually rich understanding of the nuanced complexities of research implementation [15]. By employing a system-thinking approach to explore implementation structures and processes [16], this dissertation directed the subsequent studies to elucidate the perspectives of dementia researchers and research funders in the Dutch context. Dementia researchers contribute insights from their perspective as knowledge producers, clarifying their activities and needs to facilitate the translation of research to practice. In addition, according to Wandersman et al. [17], research funders contribute to change management by acting as key decision-makers that drive the research investment agenda through programming calls and allocating funds to researchers. Limited research in the field of implementation science has been conducted from these perspectives. These two groups are key outer setting implementation stakeholders that offer a range of resources, expertise, and activities that support the dissemination and implementation process across the four phases of the knowledge implementation funnel: knowledge creation, knowledge adaptation, knowledge dissemination and knowledge implementation.

Based on the future research directions identified in Chapter 3, Chapter 4 presented an empirical study that determined a range of research utilization strategies, employed by dementia researchers in the Netherlands, to facilitate the translation and mobilization of research findings into practice and policy. This study was guided by a central research question: “*What are strategies employed by Dutch academic researchers to create, adapt, disseminate, and implement dementia research?”* The focal aim was to determine strategies employed by dementia researchers at the five Alzheimer Centers in the Netherlands at each stage of the knowledge implementation funnel to inform and guide research practices. Data collection was facilitated through semi-structured qualitative interviews with dementia researchers, who were selected based on their professional association with one of the Alzheimer Centers. The Alzheimer Centers are regarded as highly important ‘hubs’ in the Dutch dementia research system, responsible for generating dementia research, providing patient care, and delivering healthcare education [18]. Five qualitative case studies were developed in this study, exploring the research utilization activities and strategies employed by each Alzheimer Center.

The primary results from this study provided invaluable contextual insight on *how* dementia researchers (co-)created, adapted, disseminated, and implemented their research findings in practice and policy. Further, there were two main overarching contributions relating to the central aim of the dissertation research question. First, findings provided contextual evidence that strengthened the conceptualization of the four phases of the knowledge implementation funnel, highlighting the value of different strategies like co-creating research agendas, research products, and adaptation and implementation plans. This co-creation process is facilitated by engaging various research end-users, such as people with dementia (and their informal caregivers), practitioners, and policymakers, at the various phases of research development and implementation.

Second, the results suggested a potential overarching relationship between each Alzheimer Center's organizational characteristics and their selection of research utilization strategies. Each Alzheimer Center employed strategies that fit across the four broad strategy clusters, but the specific strategies employed across each Alzheimer Center varied. This may be a result of the varied research utilization determinants experienced at each Alzheimer Center, such as the organization's research focus (e.g., fundamental research, applied research), resources (e.g., research coordinators, communication teams), and culture and traditions. For instance, institutional traditions and value systems influence researchers' behavior, such as their choice of collaborative partners, networks, and valorization pathways. These decisions influence the selection of research implementation system (e.g., health, welfare, education systems) and service setting (e.g., schools, hospitals). Resultantly, these factors influence decision-making and (indirectly) influences the wider implementation and uptake of dementia research evidence by end-users (e.g., clinics, nursing homes). These findings contribute to the dissertation's central aim of determining how to leverage specific core concepts from implementation science, such the impact of institutional features on implementation and dissemination processes, to accelerate dementia research uptake.

The findings of Chapter 3 and 4 also indicated a clear need for further evidence and insight from other implementation stakeholders to explicate systems determinants and strategies used along the knowledge implementation funnel. Previous literature from Brownson et al. [1] and Leeman et al. [19] identified research funders as an important implementation stakeholder group, responsible for facilitating implementation research and support and influencing the outcomes in the outer setting implementation determinants. Accordingly, Chapter 5 presented an empirical study that identified the strategies (and related challenges) of public and private Dutch dementia research funders to facilitate the dissemination and implementation (D&I) of research results obtained through their funded programs. This study was guided by a central research question: "*What are strategies (and related challenges) of public and private research funders to accelerate the dissemination and implementation of funded non-pharmacological dementia research?"* The focal aim was to determine the unique dissemination and implementation strategies (and related challenges) of public and private dementia research funders to clarify role boundaries across the knowledge implementation funnel and guide internal and external capacity-building initiatives. Data was collected through semi-structured qualitative interviews with individuals employed by public and private dementia research funding agencies. Each participant was selected based on their experience with facilitating dementia research funding and/or implementation research. Previous literature explored the range of activities performed for D&I activates of research funders, explicating six common practice areas: release of findings, dissemination, knowledge exchange and partnering, building capacity and infrastructure, implementation, and implementation research [20]. This study built upon this evidence by investigating the commonalities and variations between activities and strategies employed by public and private dementia funders. This delineation of public and private funders also provided novel insights into *how* sector values, infrastructure, and resources may influence funders' D&I strategy selection, which has not previously been considered as an *outer setting* implementation determinant.

The main findings in this study contribute to the overarching research question by using implementation science concepts to explicate the range of strategies and challenges of public and private dementia funders in accelerating research implementation and impact. These insights provided nuanced insights into the conceptual understanding of determinants in the wider implementation system. Two main conclusions were significant contributions to the overarching dissertation research question. First, this study provided contextual insights on the potential roles and positioning of public and private research funders in the wider dementia research D&I process. For instance, the results proposed the delineation of D&I strategies into *indirect* and *direct* strategies. Indirect strategies enable funders to achieve the intended outcome by guiding, incentivizing, or mandating action from an intermediary body (e.g., research teams). Direct strategies enable funders to achieve their intended dissemination and implementation support outcome without involving any intermediaries. If the funder is deemed responsible for the dissemination and implementation support of findings from their funded research, then they would emphasize the value of direct strategies. Therefore, investments would be more effectively directed at building the funder's internal capacity, such as by building capacity for outreach and partnership management. Alternatively, if the research teams are responsible, then funders would focus on employing indirect strategies to facilitate dissemination and implementation support and invest further in external capacity, such as by expanding professional training programs.

Second, results also revealed that public and private funders may select strategies at each stage of the knowledge implementation funnel that align with their sector values, infrastructure, and resources. For instance, public funders are driven by public norms that prioritize societal benefit from public resources. Additionally, publicly funded research is limited by European Union State Aid restrictions that prevent organizations from generating commercial profit from publicly funded research (referred to as 'level playing field' in free market competition). These factors influence the public funder's strategy selection, such as their choice of implementation partners and networks. This may be a major hinderance for certain research innovations, such as health technologies, that could benefit from market mechanisms to reach end-users [21]. Therefore, private funders may be advantageously positioned and equipped to support the researchers through commercialization pathways, such as by building partnerships with health innovation accelerators. The findings from this dissertation may be interpreted within a unifying conceptual *research ecosystem* model that introduces depth to exploring the outer implementation domain.

6.3 METHODOLOGICAL REFLECTIONS AND LESSONS LEARNED

This PhD dissertation presented three independent studies that employed diverse methodologies that were conducive to achieve the dissertation's overarching aim. Chapter 2 presented a research protocol for a systematic scoping review. This protocol provided explicit details of the conceptual development of this review, explaining the rationale for certain decisions made. This decision adhered to Open Science principles, promoting a culture of research transparency and accountability. This allowed the team to ensure that the literature screening process was strictly guided with clear inclusion and exclusion criteria, ensuring transparency and fidelity in the article screening process [22]. Following, Chapter 3 presented the full systematic scoping review, including the full data extraction, analysis, and synthesis process. Methodological reflections emerged from two innovative decisions made during the literature review process: (1) employing multi-dimensional lens in synthesizing implementation science evidence and (2) using an AI-based screening tool in the title and abstract screening stage.

Traditionally, (systematic) scoping reviews were often conducted as precursors to systematic reviews and meta-analyses to determine the type of evidence, key concepts and characteristics of research, and methodologies employed in relevant research [23]. This systematic scoping review expanded beyond traditional outcomes by examining three dimensions of implementation science: determinants, process, and outcome. This broadened approach was essential for capturing the complex factors contributing to successful dissemination and implementation. This was important to the field of dementia research to inform field leaders and decision-makers of the broad scope of challenges and potential strategies to consider when designing and planning for future research implementation [24]. This decision also led to the design of a more effective approach to synthesize evidence from implementation that reduced knowledge fragmentation in the field of dementia care and implementation science.

This systematic scoping review highlighted gaps in the constructs found in a widely used implementation determinant framework and implementation strategy taxonomy. First, the results indicated potential limitations in the applicability and generalizability of the feasibility and importance rankings proposed by Waltz et al. [25]. When compared to the prevalence of home- and community-based strategies observed in this review, several discrepancies were identified. One of the most prevalent strategies identified in the included studies, *train-the-trainer strategies* (ERIC 71), was labeled as medium importance

(3.33 out of 5) and medium feasibility (3.5 out of 5). Further, another prevalent strategy, *promote network weaving (*ERIC 52), was labeled as lower importance (2.7 out of 5) and lower feasibility (2.77 out of 5). These examples may suggest for future research to consider the relevance of the original feasibility and importance rankings for home- and community-based interventions. Consequently, future research should replicate the study of Waltz et al. [25] to produce a feasibility assessment with respondents from non-clinical settings to achieve a more relevant rating system.

This review used the ASReview tool, an AI-based open-source software, to optimize title and abstract screening, making the process more efficient without compromising integrity [4]. The tool significantly reduced screening fatigue by prioritizing relevant articles and managing a large search result set (n=2667), facilitating a broader evidence scope [26]. However, a major challenge was the lack of an empirical "stopping point" for screening, which led the review team to consult ASReview developers and adopt a structured manual verification method [27]. While this tool is beneficial for scoping reviews, its limitations suggest that more rigorous methodologies, such as the SAFE procedure [28], should be considered for systematic reviews or meta-analyses that require high precision.

Chapters 4 and 5 presented empirical studies that aimed to determine the research utilization strategies of dementia researchers and funders in the Netherlands. These research utilization strategies are used across the phases of the knowledge implementation funnel. The research team employed a qualitative methodology and conducted semi-structured interviews for data collection. Two key decisions may have influenced the generalizability of this study’s results: (1) selecting thematic analysis of semi-structured interviews as the primary data analysis method and (2) using a purposive sampling method that may introduce selection bias.

First, these studies conducted qualitative, semi-structured interviews to explore the perspectives and insights of dementia researchers and research funders. This decision allowed the researcher to determine strategies employed by these stakeholders through thematic analysis, providing in-depth nuanced insights that support the development of program theories (i.e. strategies). Previous research that explored implementation strategies employed by implementation stakeholders have conducted data collection through different approaches. Chapter 2 and 3 relied on the ERIC taxonomy as a deductive tool to produce a systematic evidence synthesis, with the partial aim of mapping extant knowledge on dissemination and implementation strategies. The ERIC taxonomy is a widely used implementation strategy taxonomy that was constructed through synthesizing the strategies presented in 205 empirical studies [29] and refined through a three-round, modified Delphi process with implementation experts [9]. In contrast, the studies in Chapter 4 and 5 aimed to contribute new insights from implementation stakeholder perspectives that have been less frequently engaged in research to elucidate novel insights. Based on these different aims, the decision to use an abductive approach resulted in new descriptive ‘strategies’ and ‘strategy clusters’ that reflected the real-world activities occurring in the outer implementation setting. These strategies may be used to refine existing implementation strategy taxonomies to broaden their comprehensiveness, relevance, and usability. Reflecting on the methods used in this dissertation, future research might improve this approach by incorporating a mixed methods research design to provide a richer, more holistic and representative view of implementation strategies in dementia research.

Next, regarding the sampling strategy, we purposively selected the respondents through the profiles from the respective organizational webpages and network referrals (snowball method). This was advantageous to ensure deeper understanding of contextual nuance from relevant stakeholders. However, this decision potentially introduced the risk of reduced generalizability and sample bias (influenced by referees’ social networks and preferences).

Dissertation methodological limitations

The methodological approach adopted in this study presented limitations that warrant careful consideration. First, the empirical studies included in this dissertation relied solely on semi-structured qualitative interviews as a data collection method and an abductive approach for data extraction and analysis. This decision to conduct a thematic analysis may have restricted the breadth of insights obtained in Chapter 4 and 5. Incorporating additional methodologies, such as focus groups, feedback sessions, or large-scale surveys, could have enriched the analysis and provided a broader range of perspectives. Further, triangulation through document analysis was difficult due to the limited documentation on dementia research implementation practices and policies in the Netherlands. Future research can also reproduce this study to determine the relevance and reflectiveness of the results in other geographical contexts and research domains.

Next, the dissertation focuses on the perspectives of (academic) researchers and research funders. This scope allowed the dissertation to ascertain valuable perspectives from influential decision-makers and stakeholders who are largely responsible for research creation, adaptation, dissemination, and implementation. Chapter 4 explored a range of academic perspectives across institutional levels, featuring researchers with diverse levels of experience—from seasoned professors to starting PhD candidates. Following, Chapter 5 explored variations across public and private sector research funders, each with their own perspectives, values, and governing principles. This decision produced valuable implementation insights, building upon various institutional perspective, to inform strategic planning to strengthen implementation capacity across the Dutch research ecosystem. Choosing to include perspectives from these two stakeholder groups reduced the risk of research bias and enhanced the credibility and validity of findings.

However, this study omitted the direct involvement and contributions from other potential ecosystem stakeholders, such as the end-users of non-pharmacological research (e.g., people with dementia, informal caregivers, care providers), clinicians, home- and community-based care practitioners (e.g., nursing homes), government agencies (municipalities), national government, and insurers. This limitation is particularly salient when considering the concepts of co-creation validity and dissemination validity. Ensuring that the conclusion is cross-verified with a wider array of stakeholders is essential for robust conclusions. Including these viewpoints would provide insights on how end-users and other stakeholders perceive the intentions of funders. Moreover, it would likely yield a more holistic understanding of the respective needs of each stakeholder in the research ecosystem. This approach provides insights into stakeholder alignment, helping to overcome discrepancies. Building on the current findings, future investigations can incorporate these broader perspectives to deepen and refine our understanding of how various actors interact and influence implementation processes.

6.4 THEORETICAL IMPLICATIONS

This PhD dissertation consists of three main projects that each made theoretical contributions to strengthening the usability of implementation science theories, through real-world insights and evidence from the dementia research field. Chapter 2 and 3 identified gaps in systems level implementation evidence that hindered the delivery of non-pharmacological interventions to support informal caregivers of people with dementia. This evidence contributed to guiding research to address the emerging needs for dementia research implementation, shaping Chapters 4 and 5 to build beyond the perspectives of more commonly engaged research end-users (i.e. patients, caregivers, practitioners) and theorize implementation processes at the systems level.

Braithwaite et al. [30] and Whelan et al. [16] have previously highlighted the need for theoretical advancement to understand systems determinants in implementation science, urging researchers to employ systems thinking and complexity science to address implementation complexity. Accordingly, this research employed a systems approach and invited fresh insights from less often engaged implementation stakeholders, including academic researchers and research funders. This unique approach built upon frequently engaged research end-user perspectives included in implementation science literature, such as clinicians and patients. These perspectives further elaborated upon the antecedents and outcomes (i.e. successes and failures) present in the dementia research implementation system. The results from Chapter 2, 3, 4, and 5 presented interlinked findings that thematically converge to build a broader conceptual understanding, contributing to the design, definition, and development of a *research ecosystem* that encompasses and facilitates dementia research use.

Theme 1: *Constructing a research ecosystem conceptual approach to navigate implementation complexity*

The *ecosystem* metaphor conveys a connective model that brings together communities of practice, enabling them to collectively understand and navigate the dynamic complexities of real-world systems. The concept of an *ecosystem* has been leveraged in the fields of strategic management and innovation science to align interests between agents (i.e. individuals, organizations) and enhance collaborative capacity across domains [31]. In wider literature, a research paradigm shift has been noted, gradually moving away from separated disciplines—such as healthcare, policy, and business administration—and systems —such as healthcare, welfare, and education—and toward a more integrated approach [32]. The 'Mode 3 innovation ecosystem' and the 'quadruple helix model of innovation' are conceptual models that demonstrate the value of an *ecosystem* approach by highlighting the need for collective actions between universities, industry, government, and society to achieve wider societal impact from research [33].

In the Netherlands, the National Dementia Strategy (2021 – 2030) [34] has set several priority areas focused on fostering innovation and societal impact through stimulating university-industry collaborations in dementia research. This contributed to the growing convergence of academia, industry, government, and society in the dementia research field. The shift created conditions that enhanced interdependency between stakeholders from each domain, which required more agile and adaptive responses from involved stakeholders. The overarching aim of an *ecosystem* approach is to support the governance and management of multi-actor collaboration and interdependent relationships to foster collective outcomes.

The central theoretical contribution of this PhD dissertation is the proposition of a research ecosystem approach, used to conceptualize the wider implementation setting determinants and guide the use of non-pharmacological dementia research in the Netherlands. Findings from Chapter 3 suggested that the outer setting determinants (barriers) of implementation success for non-pharmacological dementia interventions (for informal caregivers) were largely related to poor integration and connectivity between (academic) researchers, implementation intermediaries (e.g., funders, NGOs, patient associations), and implementation settings (e.g., hospitals, nursing homes, social services). Chapter 4 and 5 also determined that these individual stakeholder groups each contributed to facilitating unique elements of the knowledge implementation funnel. These findings contribute to the nuanced design and development of the *research ecosystem* concept, shaped by theoretical implementation determinants and processes present at the systems level.

In addition, the research ecosystem concept also has potential to weave and integrate knowledge grounded in strategic management and innovation science. This transdisciplinary approach can develop the applicability and relevance of implementation science theories in practice, thereby enhancing the maturation of implementation science [35]. First, strategic management includes knowledge and tools from partnership management and project management, which may provide tools and strategies to address these challenges in the research ecosystem. For example, the RACI chart (responsibility assignment matrix), originating as a project management tool, includes four dimensions to guide role allocation among stakeholders: responsible, accountable, consulted, informed [36]. These conceptual dimensions were designed to align stakeholders and dictate roles and responsibilities in a project or partnership. This tool may be adapted to guide collaborations and partnerships between implementation stakeholder groups facilitate the knowledge implementation funnel processes in the research ecosystem.

Next, the field of innovation management has developed theories and models that enhance the understanding of real-world structures and relational dependencies that interfere with the use of innovations, such as limited collaboration capacity. For instance, Chapter 5 introduced Adner's interdisciplinary *ecosystem as a structure* approach [37], a strategic approach that originated in innovation management to explicate the constructs and actors found in the wider innovation system environment. Within this approach, elements of Bronfenbrenner's ecological systems theory, originating in the field of human development research, were also adapted, and embedded, to understand the structures, processes, and relationships among stakeholder groups across interdependent levels (micro-, meso-, macro-) [38]. Therefore, the *research ecosystem,* proposed by this dissertation, was founded on these transdisciplinary foundational elements to provide crucial guidance for determining the functions, structures, and processes involved in research implementation within a multi-level, converging quadruple helix of innovation.

In the context of these dissertation findings, the research ecosystem concept enables the effective construction and governance of cross-boundary collaborations along the whole "knowledge implementation funnel". This encompasses the individual and collaborative strategies employed by stakeholder groups to facilitate the creation, adaptation, dissemination, and implementation (and scale-up) of knowledge. The boundaries of each phase were guided by the knowledge-to-action framework, commonly used for implementation planning [39]. Implementation science theory-building was leveraged at this stage to dissect complex processes and systems into clear, manageable components. The implementation theory-building approach of Kislov et al. [15] was leveraged to develop program theories (i.e. strategies) from empirical evidence (e.g., experiential knowledge and insights from research ecosystem stakeholders). Determining clear strategies employed at each phase may enable implementation stakeholders to be more agile and responsive to evolving conditions and environmental boundaries of the dementia research ecosystem.

Second, the *structure* dimension of the research ecosystem presented the implementation agents and infrastructure that influence dissemination and implementation activities. In entrepreneurship literature, Isenberg determined that ecosystem stakeholders (i.e. agents) should contribute to the process through diverse roles, such as by developing policy, human capital, infrastructure, professional services, culture, markets, and finance [40]. This approach includes stakeholders that have access to different resources, competencies, and capabilities to promote a well-balanced ecosystem [41]. Similarly, in the research context, implementation agents are identified as the individuals (e.g., community leaders, local champions) and groups (e.g., research teams, funders, intermediaries) involved across the knowledge implementation funnel. Transdisciplinary engagements and collaborations across each phase are essential to overcome issues of complexity-related research silos in research implementation.

In addition, the implementation infrastructure available in this context includes internal and external resources that influence the contextual implementation capacity of each stakeholder group, such as funding mechanisms and implementation workforce (education and training) available in the research ecosystem. The availability and quality of resources and infrastructure in a research ecosystem influence the selection of strategies at each phase of the implementation knowledge funnel. A clear understanding of the traditions, resources, practices, and areas of expertise of each implementation agent within the research ecosystem can guide the allocation of roles and responsibilities and inform the selection of research utilization strategies along the implementation knowledge funnel.

The research ecosystem concept unifies the unique resources and expertise of these stakeholder groups to facilitate research use more effectively. The integrated theoretical development of implementation *process* and *structure* may inform the system-level determinants within existing implementation frameworks, broadening and deepening the coverage and relevance of included constructs. This dissertation revealed that the collaborations and dependencies between groups were inadequately understood and facilitated, contributing to conceptual role ambiguity in the implementation process. Future empirical research may consider building theory to explain the determinants involved to facilitate successful research ecosystem partnerships.

Theme 2: *Strategic positioning and contributions of implementation stakeholders across phases of the knowledge implementation funnel*

The findings from Chapters 3, 4, and 5 were triangulated to identify the potential roles, positions, and contributions of each implementation stakeholder throughout the knowledge implementation funnel. This theme discusses the potential roles and contributions of every research ecosystem stakeholder, outlining who leads each phase and how supporting roles may contribute.

First, the *knowledge creation* phase consists of knowledge inquiry, knowledge synthesis and the development of research knowledge tools and products. In this phase, (academic) researchers are perceived to have a central position in the research ecosystem, responsible for leading and coordinating the collective efforts of research ecosystem stakeholders. Research funders allocated financial resources and provided guidance to align research creation with the National Dementia Strategy. Industry partners provided support by co-creating and validating innovations with (academic) researchers to ensure product compliance and scalability. Implementation settings provided support by engaging end-users (patients, informal care givers, and professionals in health care and welfare) to inform and co-create research with academic researchers. Municipal officials, national associations, and regional networks for elderly care organizations also provided support by guiding research agendas based on their practice insight.

Next, the *knowledge adaptation* phase begins with assessing contextual influences, then co-designing and tailoring research findings into various formats, suitable for diverse, user-specific applications. In this phase, (academic) researchers were also positioned in a central position in the research ecosystem. Funders provided direct knowledge adaptation capacity support by converting research output into evidence-based decision aid tools (e.g., evidence synthesize, technical reports) that support policy reform. Funders provided indirect knowledge adaptation capacity support by providing theory-of-change training, enhancing the skillset of researchers to adapt and communicate knowledge. Industry partners developed research-based software products that broadens academic research usability. Implementation settings provided researchers with access to end-user feedback, through patient panels and specialized working groups, to refine research usability and reduce end-user barriers. These implementation settings may include health, education, and welfare settings to enhance the reach and impact of adapted research findings. Patient representative groups and regional networks also provided research teams with access to mixed patient population to advise the (cultural) adaptation of research innovations.

Following, the *knowledge dissemination* phase includes the transfer and exchange of knowledge beyond the boundaries of the research origin. This involves disseminating knowledge to the intended recipients, such as implementation settings and patients. In this phase, (academic) researchers were also positioned in a central position in the research ecosystem, and other stakeholder groups had a supporting role. For instance, funders conducted knowledge dissemination directly by translating research findings into decision-aid support and brokering knowledge with industry and policy stakeholders. Funders also made indirect contributions to the dissemination process by providing incentives (e.g., subsidies), mandates (e.g., Open Access publications), and guidance (e.g., impact frameworks). Researchers and research funders connected with private sector partners and knowledge institutes (e.g., Vilans, Pharos) to disseminate research findings to broader audiences, including businesses and private donors. Associations provide dissemination support by accrediting education and training programs and updating professional guidelines. Collaborative networks also contribute to spread evidence-based practices.

Knowledge implementation phase can be divided into two sub-phases: *internal implementation and external implementation (scale-up).* Internal implementation is led by the implementation setting (practitioners, managers, leaders), and the determinants and strategies are encompassed by organizational boundaries. Implementation settings may be in the health, welfare, and education settings, delivered through public or private services. Health settings may include hospitals, primary healthcare clinics, community health centers, long-term care facilities, and telehealth platforms. Welfare service settings may include municipality-based social service agencies and community welfare centers. Education settings may include primary or secondary schools, universities, vocational training centers, or online learning platforms. Findings from Chapter 3 may provide insight on the nuanced contextual determinants and strategies employed by stakeholders (practitioners, managers), within the boundaries of the implementation setting, influencing the implementation outcomes in this phase.

In addition, external implementation (scale-up) was initiated by the (academic) researchers with close support from research funders, industry partners, and participatory knowledge infrastructures (e.g., professional networks) [42]. Funders provided direct contributions at this sub-phase through brokering research products to implementation partners (e.g., municipal services) or leveraging innovation structures (e.g., accelerators) to advance dementia research market accessibility and commercialization. Industry partners developed and managed business plans, provided legal and operational support, and ensure compliance with current with the latest regulatory guidelines (e.g., GDPR, Medical Device Regulation). Participatory knowledge infrastructures also assist in the implementation scaling process by fostering researcher (and research ecosystem) connectivity and continuity through consortia, academic collaborative centers, and professional networks.

Given the findings from this PhD dissertation, the theoretical conceptualization and development of a knowledge implementation funnel may be used to imagine the contributions of each implementation stakeholder throughout the complex phases involved in the research-to-practice trajectory. However, the research ecosystem conceptual approach pairs the knowledge implementation funnel with a second dimension: research ecosystem capacity building. This dimension encompasses several structures that bolster and enable the effective operationalization of the varied strategies employed throughout the knowledge implementation funnel.

Theme 3: *Strategic research ecosystem structural capacity-building to support knowledge implementation funnel outcomes*

This dissertation determined an additional dimension in the research ecosystem concept, proposing three broad conceptual areas of capacity-building to enhance outcomes at each phase of the knowledge implementation funnel: individual professional capacity, intermediary capacity, and ecosystem collaborative capacity.

Capacity-building for individuals in the research ecosystem involves developing personal and professional skills, knowledge, and behaviors to optimize an individual's ability to improve outcomes at each phase of the knowledge implementation funnel. This capacity-building area seeks to strengthen *human capital*, contributing to the evolution and expansion of the research and innovation labor force, through *training and education* for research ecosystem stakeholders. These theoretical developments closely align with the evolving *Industry 4.0* trends, which emphasize the need for new competencies and training to align academic and industry interests to adequately prepare the labor force [43]. Findings from this dissertation revealed an emerging demand for implementation expertise and identified potential opportunities to transform the competencies, capabilities, and readiness of (academic) researchers and research funders.

Next, intermediary capacity-building involves developing external intermediary structures and organizations that support research ecosystem stakeholders across the knowledge implementation funnel, such as legal, regulatory, and valorization services. The value and contributions of the intermediaries in the research ecosystem can be explained by *resource dependence theory,* which has been used to study the nature of dependency between firms in an innovation ecosystem and to explain the *co-evolution* of science (universities) and industry (businesses) [44]. The findings from this dissertation suggested that these intermediary structures and organizations may be positioned to provide resources that contribute knowledge-intensive services (i.e. technical expertise), promote network cohesion (e.g., ecosystem building), and broker knowledge across sectors.

Lastly, ecosystem collaborative capacity-building involves developing structural strategies that organize and manage the contributions and resources of diverse research ecosystem stakeholders and intermediaries, thereby facilitating a more integrated approach to research utilization. This builds upon a *knowledge-based* approach that explains the value of forming inter-organizational alliances and collaborations to leverage each partner's unique resources (e.g., expertise, networks) to improve shared outcomes [45]. As external priorities shift toward research implementation and societal impact, research paradigms and practices have evolved, converging on the quadruple helix model of innovation [33]. This model demonstrates the co-evolution of academia, industry, practice, and civil society, emphasizing the emergence of an increasingly inter-reliant ecosystem of stakeholders with diverse interests and agendas. Given this paradigm shift, ecosystem collaborative capacity-building may leverage knowledge-based view to conceptually guide the construction, organization, management, and sustainment of research ecosystem collaboration and co-evolution to improve outcomes across phases of the knowledge implementation funnel.

6.5 PRACTICAL IMPLICATIONS

This dissertation identified shifts in the practices and policies that steer non-pharmacological dementia research (and innovation) in the Netherlands. This dissertation also produced evidence that signaled how implementation science may be leveraged to support practice and policy. The results from this dissertation provided evidence to explicate the context and strategies involved in non-pharmacological dementia research use. Resultantly, these findings determined that the current labor force and infrastructure were limiting structures of the research ecosystem, that hinder the use of dementia research and proposed potential solutions.

Findings revealed that both (academic) researchers and research funders require enhanced competencies to address the emerging demands of the National Dementia Strategy, particularly in the realm of research implementation. (Academic) researchers need advanced training in facilitating co-design and co-creation processes for effective knowledge creation and adaptation, mastering scientific communication for efficient knowledge dissemination, and developing skills in project and partnership management to ensure successful knowledge implementation and scaling. Similarly, research funders would benefit from training in designing robust implementation and impact evaluations, as well as in facilitating research valorization to strengthen the link between academic research and industry.

In addition, targeted training and education initiatives can significantly bolster collaborative capacity. The creation of transdisciplinary training programs—such as those focusing on project and partnership management—and the development of PhD industry secondment opportunities for (academic) researchers are pivotal in enhancing both individual and collective capacities. Funders also play a crucial role in building the research ecosystem's collaborative capacity by establishing professional networks and associations, such as the Netherlands Implementation Collective, which foster connections among individuals and teams responsible across the knowledge implementation funnel.

Next, the findings from this dissertation identified challenges in navigating public-private partnerships in non-pharmacological dementia research. This may include learning networks, academic collaborative centers, disease-related/care networks, consortia, knowledge portals, and living labs [42]. Such infrastructure promotes connectivity between (academic) researchers and other stakeholders in the research ecosystem, enabling regular connection, collaboration, and partnership to enhance the reach and impact of dementia research output beyond usual implementation settings. Connections between research and practice may also be supported by national knowledge institutes, such as Vilans (long-term care), Movisie (welfare), Trimbos (mental healthcare), Nivel (health services research) and Pharos (health inequalities). Innovation and market valorization structures, such as technology transfer offices and health innovation accelerators, may also be used to support research use in public-private partnerships. Overall, these findings contributed to steering research and innovation growth and productivity of the non-pharmacological dementia research field.

6.6 FUTURE DIRECTION AND CONCLUSION

This PhD dissertation generated key insights that leverage implementation science to accelerate the reach and uptake of non-pharmacological dementia research. These findings underscore the complex nature of implementation, revealing that significant gaps remain despite the evolving evidence. The novel contributions from the perspectives of (academic) researchers and research funders obtained from this dissertation provide nuanced insights that informed the theoretical underpinnings of a unifying research ecosystem concept, which holds significant potential for theoretical and practical applications in research and innovation. The research ecosystem concept provides theoretical guidance to understand the components and intricate complexities of implementation, building and bridging implementation science with other disciplines. This dissertation proposes three potential research areas that would advance the use of implementation science in non-pharmacological dementia research.

First, implementation of home- and community-based health research is still largely an enigma, and the current literature is only beginning to address the variations between implementation settings. Further research is essential to demystify community-level implementation. Multi-source, multi-method case studies may elucidate how each group of community-level stakeholders can improve the integration of research findings. This may be achieved by adopting methodologies, such as retrospective impact pathway mapping and implementation evaluation of completed projects funded by research funding agencies. Future research may also employ design thinking methodologies to map out key stakeholders and system nodes in non-pharmacological dementia research. These case studies would serve to build theoretical implementation pathways, identify the ecosystem determinants, determine dissemination and implementation strategies, and validate (and potentially extend) the findings of this dissertation. The theoretical knowledge from this dissertation and future studies may be used to inform the development guideline for strategic role allocation and implementation planning, such as the Community-Engaged

Research Dissemination framework [46] used by previous research groups to guide community dissemination efforts.

Second, this dissertation determined capacity building and connectivity for the dementia research ecosystem as a major future research area. The contributions from this dissertation may be used to support the aims and objectives of the Dutch national “DEMPACT” research consortium. Officially launched in February 2024, DEMPACT is a 5-year Dutch research consortium that aims to strengthen the scientific and societal impact of dementia research through fostering public-private partnerships and knowledge brokering across the research, industry, and the practice domains of healthcare, welfare, and education. The findings in this dissertation contribute theoretical and practical insights and advice to steer future research direction for each domain. These findings may enable each stakeholder group to adopt implementation science knowledge to improve their respective knowledge implementation funnel contributions and outcomes. Accordingly, further investments may be directed at strengthening (academic) researchers, who may receive science communication training to improve knowledge dissemination outcomes, and project management training to coordinate implementation practices. Research funders may also contribute implementation science training and educational resources through professional networks and associations.

Lastly, this dissertation determined an urgent need for a transdisciplinary approach to advance implementation science to address challenges in non-pharmacological dementia research use. A potential approach is integrating knowledge from public management and innovation management to refine implementation theory and improve outcomes. This involves integrating public management’s focus on capacity development with innovation management’s insights on product, organizational, and process innovations, thereby accelerating research-to-practice transitions. Future investigations may develop conceptualizations of an integrated implementation system that unifies research ecosystem stakeholders’ values and outcomes across health, welfare, and education systems and across public and private sectors. This may be facilitated by using contribution mapping to design and evaluate integrated implementation pathways. This approach was developed to examine the processes and actors to assess anticipatory efforts (‘contributions’) that aim to enhance alignment in partnerships [47]. This may illuminate new determinants for implementation partnerships and advance the field's understanding of research impact. This practice invites transdisciplinary perspectives to determine and effectively integrate the potential contributions and resources provided by each stakeholder group within this research ecosystem. This approach not only bridges theoretical divides but also enhances practical outcomes by ensuring that diverse perspectives are harmonized in the pursuit of common public goals.

In conclusion, this dissertation produced substantial insights into *how* implementation science may potentially accelerate the use of non-pharmacological dementia research. The various dimensions of implementation science have been discussed, with each dimension used to explicate, understand, and propose solutions to mitigate the influences of system challenges to research implementation. The dissertation may be used to inform real-world practice developments, enhancing the impact from the field of dementia research. The results may also have wider implications for the field of implementation science by presenting opportunities to advance its maturity through interdisciplinary and transdisciplinary knowledge. Bridging multiple fields using an ecological systems-thinking (research ecosystem) approach could advance the solutions of real-world, health related, implementation challenges.

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Appendices

Appendix 1 | Additional files from Chapter 2 and 3 (Results overview)

Table 1. Full results overview

EBI Title	Author(s), Year / Country of study origin	Implementation Clusters (1-9)	ERIC Taxonomy Discrete Strategies (1-73)	Implementation Outcomes
eHealth: *Electronic health interventions (eHealth) are uniquely delivered through various digital/technological mediums (e.g., computer, internet, with or without human interaction) and can provide education, counseling, and supportive elements of other types of interventions.* ***Example:*** *iSupport provides education and support for caregivers on a digital platform, equipped with an integrated caregiver network, accessible in remote areas*				
Caring for Carers of People with Dementia study	Banbury et al. (2019) / Australia	1 – Use evaluative and iterative strategies	4	Acceptability Appropriateness Penetration Sustainability
		2- Provide interactive assistance	33, 8	
		3 – Use evaluative and iterative strategies	51, 63	
iSupport	Baruah et al. (2020) / India	No implementation strategies identified	n/a	Acceptability Appropriateness Penetration
	Teles et al. (2020) / Portugal	3 – Adapt and tailor to context	51	Appropriateness Penetration
		5 – Train and educate stakeholders	19, 29, 31	
	Xiao et al. (2020) / Australia	3 – Adapt and tailor to context	51, 63	Acceptability Appropriateness
		5 – Train and educate stakeholders	29	
Partner in Balance	Boots et al. (2017) / the Netherlands	1 – Use evaluative and iterative strategies	5	Acceptability Appropriateness Feasibility Penetration Sustainability
		2- Provide interactive assistance	33	
		3 – Adapt and tailor to context	51	
		4 – Develop stakeholder interrelationships	6, 52	
		5 – Train and educate stakeholders	71, 43, 16, 55, 19, 31	
		6 – Support clinicians	59	
		7 – Engage consumers	69	
		9 – Change infrastructure	12	
InLife	Dam et al. (2019) / the Netherlands	1 – Use evaluative and iterative strategies	46	Acceptability Adoption Appropriateness Penetration
		2- Provide interactive assistance	8	

		3 – Adapt and tailor to context	63	Sustainability
		5 – Train and educate stakeholders	31	
		7 – Engage consumers	69	
		9 – Change infrastructure	12	
eMR-ABC	Frame et al. (2013) / USA	1 – Use evaluative and iterative strategies	26	Adoption Appropriateness Sustainability
		3 – Adapt and tailor to context	51	
		5 – Train and educate stakeholders	71	
		6 – Support clinicians	32	
		9 – Change infrastructure	12	
Alzheimer's Caregiver Support Online (AlzOnline)	Glueckauf and Loomis (2003) / USA	1 – Use evaluative and iterative strategies	5, 46, 4, 18	Appropriateness Penetration Sustainability
		2- Provide interactive assistance	33	
		3 – Adapt and tailor to context	51, 63	
		4 – Develop stakeholder interrelationships	6, 38	
		5 – Train and educate stakeholders	29, 43, 31	
		9 – Change infrastructure	11	
iGeriCare (Clinician's perspective)	Levinson et al. (2020) / Canada	1 – Use evaluative and iterative strategies	4	Acceptability Adoption Appropriateness Penetration Sustainability
		4 – Develop stakeholder interrelationships	38	
		5 – Train and educate stakeholders	19, 31, 43, 29	
Tele.TanDem	Meichsner et al. (2018) / Germany	2- Provide interactive assistance	33	Acceptability Feasibility
		3 – Adapt and tailor to context	51	
		5 – Train and educate stakeholders	29, 31, 55	
		9 – Change infrastructure	13	
RAM (Remote Activity Monitoring)	Mitchell et al. (2017) published in (2020) / USA	2- Provide interactive assistance	33, 54	Acceptability Appropriateness Penetration Sustainability
		3 – Adapt and tailor to context	51	
		9 – Change infrastructure	11, 12	

Cuidate Cuidador	Pagan-Ortiz et al. (2014) / USA	1 – Use evaluative and iterative strategies	18, 4	Acceptability Appropriateness Penetration
		2- Provide interactive assistance	8	
		3 – Adapt and tailor to context	51, 63, 67	
		4 – Develop stakeholder interrelationships	52	
		5 – Train and educate stakeholders	29, 43, 31	
		7 – Engage consumers	69	
mastery over dementia (MoD)	Pot et al. (2015) / The Netherlands	1 – Use evaluative and iterative strategies	5	Acceptability Appropriateness Penetration
		2- Provide interactive assistance	33	
		5 – Train and educate stakeholders	29, 43, 31, 55, 19	
		6 – Support clinicians	59	
		7 – Engage consumers	39	
		9 – Change infrastructure	12, 13	
Partner in Sight (PsyMate)	van Knippenberg et al. (2017) / The Netherlands	3 – Adapt and tailor to context	51, 63	Acceptability Appropriateness Penetration
		5 – Train and educate stakeholders	19, 71, 43	
		7 – Engage consumers	50	
		9 – Train and educate stakeholders	11, 12	
FamTechCare	Williams et al. (2020) / USA	1 – Use evaluative and iterative strategies	26	Acceptability Appropriateness Adoption Feasibility
		2- Provide interactive assistance	8, 33	
		5 – Train and educate stakeholders	31, 43	
		6 – Support clinicians	21, 59	
		9 – Change infrastructure	11	
Respite care: *Respite care provides caregivers with temporary relief through day care services* ***Example:*** *Adult day service (ADS) provides a safe environment for people with dementia and provides support resources for caregivers.*				
Adult day care – On Lok project / Program of All-Inclusive Care for the Elderly (PACE)	Beisecker et al. (1996) / USA	No implementation strategies identified	n/a	Acceptability Penetration
Caring for the Caregiver	Brandao et al. (2016) / Portugal	No implementation strategies identified	n/a	Acceptability Penetration
		6 – Support clinicians	59	Acceptability

Adult day service (ADS)	Gaugler (2014) / USA	7 – Engage consumers	39, 50	Appropriateness
		9 – Change infrastructure	13	
Adult day service Plus (ADS Plus)	Gitlin et al. (2019) / USA	1 – Use evaluative and iterative strategies	4, 5, 18, 23, 26, 56	Fidelity Implementation Cost
		2- Provide interactive assistance	33	
		3 – Adapt and tailor to context	63	
		4 – Develop stakeholder interrelationships	35, 57	
		5 – Train and educate stakeholders	71, 15, 19, 43, 29, 31	
		6 – Support clinicians	59	
		8 – Utilize financial strategies	2	
Adult Day Care (Respite Programming)	Roberts and Struckmeyer (2017) / USA	No implementation strategies identified	n/a	Acceptability Appropriateness Implementation Cost Sustainability
Psychoeducation: *Psychoeducation interventions primarily provide education for caregivers regarding the physiological stages of dementia, care planning, behavior management and self-care (e.g., managing anxiety and depression).* ***Example:*** *START (StrAtegies for RelaTives) consists of 8-week, 187ementia187d, individual psychological intervention designed for carers of people with dementia consisting of education about dementia, strategies to identify/manage behavior challenges, and planning for future needs.*				
The booklet, Information for Families and Friends of People with Severe and End Stage Dementia	Chang et al. (2010) / Australia	1 – Use evaluative and iterative strategies	4	Acceptability Appropriateness Penetration
		4 – Develop stakeholder interrelationships	36, 52	
		5 – Train and educate stakeholders	29	
START (StrAtegies for RelaTives)	Foley et al. (2020) / UK	3 – Adapt and tailor to context	63, 51	Acceptability Appropriateness Feasibility
		4 – Develop stakeholder interrelationships	35	
		5 – Train and educate stakeholders	19, 43	
		8 – Utilize financial strategies	1	
		9 – Change infrastructure	13	
	Sommerlad et al. (2014) / UK	5 – Train and educate stakeholders	43, 31	Acceptability Appropriateness Sustainability
		9 – Change infrastructure	13	
Tele-Savvy for Dementia Caregivers / The Savvy Caregiver Program	Griffiths et al. (2015) / USA	1 – Use evaluative and iterative strategies	4, 46	Acceptability Appropriateness Fidelity Penetration
		2- Provide interactive assistance	33	

		5 – Train and educate stakeholders	19, 31, 43, 29	Sustainability
		7 – Engage consumers	50	
		9 – Change infrastructure	11	
	Kovaleva et al. (2017) / USA	3 – Adapt and tailor to context	63	Acceptability Appropriateness Penetration Sustainability
		5 – Train and educate stakeholders	19, 55, 29, 43, 31	
ANSWERS	Judge et al. (2010) / USA	1 – Use evaluative and iterative strategies	26, 27, 5, 56	Acceptability Appropriateness Fidelity
		3 – Adapt and tailor to context	51	
		4 – Develop stakeholder interrelationships	57	
		5 – Train and educate stakeholders	19, 31, 71	
		9 – Change infrastructure	13	
REACH II	Lykens et al. (2014) / USA	1 – Use evaluative and iterative strategies	4, 26, 27	Acceptability Appropriateness Penetration Sustainability
		2- Provide interactive assistance	54, 8	
		3 – Adapt and tailor to context	51	
		4 – Develop stakeholder interrelationships	52, 47, 6	
		5 – Train and educate stakeholders	73, 71, 43, 31	
		6 – Support clinicians	21, 59	
		9 – Change infrastructure	12	
REACH into Indian Country	Martindale-Adam et al. (2017) / USA	1 – Use evaluative and iterative strategies	61, 56, 26	Acceptability Appropriateness Adoption Implementation Cost Penetration Sustainability
		2- Provide interactive assistance	33	
		3 – Adapt and tailor to context	51, 63	
		4 – Develop stakeholder interrelationships	72, 6, 40, 35	
		5 – Train and educate stakeholders	71, 29, 31, 15	
		6 – Support clinicians	30	
		7 – Engage consumers	37, 69	
		8 – Utilize financial strategies	34, 2, 70, 42	
		9 – Change infrastructure	44, 13, 22, 62	
Star-C	McCurry et al. (2015) / USA	1 – Use evaluative and iterative strategies	5, 56, 14	Acceptability Appropriateness Adoption Feasibility
		2- Provide interactive assistance	33	

		3 – Adapt and tailor to context	63	Fidelity Penetration Sustainability
		4 – Develop stakeholder interrelationships	35, 7, 40, 52	
		5 – Train and educate stakeholders	19, 29, 31, 43, 71	
		8 – Utilize financial strategies	34	
		7 – Engage consumers	69	
Medway Carers Course	Milne et al. (2014) / UK	2- Provide interactive assistance	33	Acceptability Appropriateness Sustainability
		4 – Develop stakeholder interrelationships	6	
		5 – Train and educate stakeholders	29, 19, 31, 43	
		6 – Support clinicians	59, 21	
CARES Dementia Basics Program	Pleasant et al. (2016) / USA	4 – Develop stakeholder interrelationships	52	Acceptability Appropriateness Penetration
		5 – Train and educate stakeholders	43, 31	
		7 – Engage consumers	50	
		9 – Change infrastructure	13, 22	
Taking Care of YOU: Self-Care for Family Caregivers Toolkit	Smith and Graves (2020) / USA	1 – Use evaluative and iterative strategies	4	Acceptability Appropriateness Penetration
		2- Provide interactive assistance	33	
		4 – Develop stakeholder interrelationships	64	
		5 – Train and educate stakeholders	19, 29	
Exercise: *Exercise interventions primarily consist of physical activities aimed to enhance the participants physical capacity.* ***Example:*** *TACIT trial provided tai chi exercises to participants under the supervision of a professional trainer who provides safe guidance*				
TaiChI for people with 189ementia (TACIT trial)	Barrado-Martin et al. (2019) / UK	1 – Use evaluative and iterative strategies	4, 56	Acceptability Appropriateness Penetration
		2- Provide interactive assistance	33	
		3 – Adapt and tailor to context	63, 51	
		4 – Develop stakeholder interrelationships	57	
		5 – Train and educate stakeholders	31, 16, 29, 19	
		9 – Change infrastructure	12	
		2- Provide interactive assistance	33	Acceptability Appropriateness

	Barrado-Martin et al. (2020) / UK	4 – Develop stakeholder interrelationships	57	Penetration
		5 – Train and educate stakeholders	55, 31, 43	
		9 – Change infrastructure	11, 12	
Reducing Disability in Alzheimer Disease (RDAD) program	Prick et al. (2014) / The Netherlands	1 – Use evaluative and iterative strategies	56	Acceptability Appropriateness Feasibility Penetration Sustainability
		3 – Adapt and tailor to context	63, 51	
		4 – Develop stakeholder interrelationships	52	
		5 – Train and educate stakeholders	19, 31	
		6 – Support clinicians	30	
		7 – Engage consumers	69	
		8 – Utilize financial strategies	49	
		9 – Change infrastructure	13	
Care coordination and case management: *Care coordination and case management interventions provide caregivers with care consultants who support with case management, care planning, referrals to resources, and continuity of care for people with dementia.* ***Example:*** *Partners in Dementia Care is a care-coordination program integrating healthcare (Veteran Affairs medical centers) and community services (Alzheimer's Association chapters) and supporting veterans with dementia and their caregivers.*				
Cleveland Alzheimer's managed Care Demonstration	Bass et al. (2003) / USA	1 - Use evaluative and iterative strategies	27, 4	Acceptability Appropriateness Feasibility Penetration
		2- Provide interactive assistance	33	
		3 - Adapt and tailor to context	63	
		4 - Develop stakeholder interrelationships	52	
		5 - Train and educate stakeholders	55, 71, 19, 15, 43	
		6 - Support clinicians	59, 21, 30	
		7 - Engage consumers	39	
		8 - Utilize financial strategies	49, 66, 34	
Partners in Dementia Care	Bass et al. (2014) / USA	2- Provide interactive assistance	8	Acceptability Implementation Cost Penetration Sustainability
		4 - Develop stakeholder interrelationships	52, 6, 36, 72, 24	
		5 - Train and educate stakeholders	73, 19, 71	
		6 - Support clinicians	59, 30, 21	
		7 - Engage consumers	50, 41	
		8 - Utilize financial strategies	66	

		9 - Change infrastructure	22, 12, 13	
Aged Care Assessment Teams	Bruce and Patterson (2000) / Australia	No implementation strategies identified	n/a	Acceptability Appropriateness Penetration Sustainability
Community Outreach Education Program (COEP)	Connell and Kole (1999) / USA	1 - Use evaluative and iterative strategies	4, 56	Acceptability Penetration Sustainability
		4 - Develop stakeholder interrelationships	47, 52, 17, 24, 64, 6, 38, 40, 48	
		5 - Train and educate stakeholders	29, 15	
		6 - Support clinicians	30, 59	
		7 - Engage consumers	37, 69	
		8 - Utilize financial strategies	1, 34	
		9 - Change infrastructure	13	
Healthcare Professional Support	Laparidou et al. (2018) / UK	2- Provide interactive assistance	33	Acceptability Penetration
		4 - Develop stakeholder interrelationships	24, 52, 36, 64	
		6 - Support clinicians	59, 21	
SUSTAIN program	Mavandadi et al. (2017) / USA	1 - Use evaluative and iterative strategies	4	Acceptability Appropriateness Penetration Sustainability
		2- Provide interactive assistance	33	
		3 - Adapt and tailor to context	51, 63	
		4 - Develop stakeholder interrelationships	52	
		5 - Train and educate stakeholders	29, 43, 31, 55	
		8 - Utilize financial strategies	34	
		9 - Change infrastructure	13	
Occupational therapy: *Occupational therapy interventions consist of training for activities of daily living and reminiscence, life story work or cognitive stimulation therapy, for the cognitive, emotional, occupational, and functional aspects of dementia* ***Example:*** *'VALID - Occupational Therapy' consists of 10 tailored sessions with an occupational therapist, providing personalised goal-setting, based upon assessment findings, then supported practice and strategy use to achieve goals.*				
Community Occupational Therapy in Dementia (COTiD) program	Burgess et al. (2020) / UK	1 - Use evaluative and iterative strategies	4	Acceptability Appropriateness Penetration
		3 - Adapt and tailor to context	51	
		5 - Train and educate stakeholders	19, 43	
		7 - Engage consumers	50	
		9 - Change infrastructure	13	

VALID - Occupational Therapy	Field et al. (2019) / UK	1 - Use evaluative and iterative strategies	4, 18	Acceptability Appropriateness Penetration
		3 - Adapt and tailor to context	63, 51	
		4 - Develop stakeholder interrelationships	52	
		5 - Train and educate stakeholders	19	
		6 - Support clinicians	21	
Environmental skill-building program (ESP)	Gitlin et al. (2010) / USA	1 - Use evaluative and iterative strategies	4, 18, 56	Acceptability Adoption Appropriateness Feasibility Fidelity Implementation Cost Penetration Sustainability
		3 - Adapt and tailor to context	63	
		4 - Develop stakeholder interrelationships	17, 6, 25	
		5 - Train and educate stakeholders	20, 73, 43, 71	
		8 - Utilize financial strategies	49, 70	
Multi-component interventions: *Multicomponent interventions possess various types of interventions bundled into one program.* ***Example:*** *New York University Caregiver Intervention (NYU-CI) consists of counseling meetings, caregiver consultancy, ad hoc calls, e-mail/telephone communication, information/referral, support groups.*				
REACH	Burgio et al. (2001) / USA	1 - Use evaluative and iterative strategies	27, 5	Feasibility Sustainability
		2- Provide interactive assistance	53	
		3 - Adapt and tailor to context	63, 51, 68	
		4 - Develop stakeholder interrelationships	57, 52	
		5 - Train and educate stakeholders	29, 31, 71, 43	
		8 - Utilize financial strategies	34, 1	
		9 - Change infrastructure	12, 22	
REACH OUT (Offering Useful Treatments) - Adaptation of REACH II for use in Area Agencies on Aging	Burgio et al. (2009) / USA	1 - Use evaluative and iterative strategies	27	Acceptability Adoption Appropriateness Feasibility Fidelity Penetration Sustainability
		2- Provide interactive assistance	33, 8	
		3 - Adapt and tailor to context	63, 51	
		4 - Develop stakeholder interrelationships	47, 24, 6, 40, 64, 25	
		5 - Train and educate stakeholders	31, 16, 71, 43, 55	
		9 - Change infrastructure	12, 11	

REACH-TX (a community-based translation of REACH II)	Cho et al. (2019) / USA	1 - Use evaluative and iterative strategies	4, 56	Acceptability Feasibility Penetration Sustainability
		4 - Develop stakeholder interrelationships	47, 52	
		5 - Train and educate stakeholders	71, 55, 15, 43, 31, 29	
iMCSP	Droes et al. (2019) / the Netherlands	1 - Use evaluative and iterative strategies	4, 18	Acceptability Appropriateness Implementation Cost Penetration Sustainability
		4 - Develop stakeholder interrelationships	24, 6, 35, 7	
		5 - Train and educate stakeholders	19, 71	
		7 - Engage consumers	69	
		8 - Utilize financial strategies	1	
Care of Persons with Dementia in their Environment (COPE) integrated in Connecticut Home Care Program for Elders (CHCPE)	Fortinsky et al. (2016) / USA	1 - Use evaluative and iterative strategies	4, 18, 5, 26	Fidelity Penetration Sustainability
		2- Provide interactive assistance	33, 54, 53	
		3 - Adapt and tailor to context	63	
		4 - Develop stakeholder interrelationships	52, 6	
		5 - Train and educate stakeholders	43, 29, 31, 16	
		6 - Support clinicians	21, 32, 30, 59	
		9 - Change infrastructure	11, 12	
NYU Caregiver-Adult Child Intervention	Gaugler et al. (2018) / USA	2- Provide interactive assistance	33	Acceptability Appropriateness Feasibility
		5 - Train and educate stakeholders	43, 19	
		7 - Engage consumers	50	
Unforgettable (interactive museum program)	Hendriks et al. (2018) / The Netherlands	1 - Use evaluative and iterative strategies	61, 4	Acceptability Fidelity Sustainability
		3 - Adapt and tailor to context	63, 51	
		4 - Develop stakeholder interrelationships	57, 6, 24, 72, 36	
		5 - Train and educate stakeholders	43, 71	
		6 - Support clinicians	59, 30	
		7 - Engage consumers	41	
RDAD	Menne et al. (2014) / USA	1 - Use evaluative and iterative strategies	5, 56	Appropriateness Feasibility Penetration Sustainability
		3 - Adapt and tailor to context	51, 63	
		4 - Develop stakeholder interrelationships	57, 64, 52	

		5 - Train and educate stakeholders	31, 19, 71, 43, 29	
Savvy Caregiver + REACH II	Meyer et al. (2018) / USA	2- Provide interactive assistance	33	Acceptability Adoption Appropriateness Penetration Sustainability
		4 - Develop stakeholder interrelationships	38	
		5 - Train and educate stakeholders	19	
		7 - Engage consumers	39, 41	
multicomponent non-pharmacological interventions (NPIs)	Milders et al. (2016) / UK	1 - Use evaluative and iterative strategies	5, 56	Acceptability Appropriateness Fidelity Implementation Cost Penetration Sustainability
		3 - Adapt and tailor to context	51, 63	
		4 - Develop stakeholder interrelationships	57, 64, 52	
		5 - Train and educate stakeholders	31, 19, 71, 43, 29	
REACH VA	Nichols et al. (2011) / USA	2- Provide interactive assistance	33	Acceptability Appropriateness Penetration Sustainability
		4 - Develop stakeholder interrelationships	6	
		5 - Train and educate stakeholders	71, 43, 31	
		6 - Support clinicians	59	
		8 - Utilize financial strategies	34	
	Nichols et al. (2016) / USA	1 - Use evaluative and iterative strategies	4, 56, 61, 14	Acceptability Adoption Feasibility Fidelity Penetration Sustainability
		2- Provide interactive assistance	8	
		4 - Develop stakeholder interrelationships	47, 17, 35	
		5 - Train and educate stakeholders	29, 19, 43, 31, 71	
		6 - Support clinicians	59	
		7 - Engage consumers	69, 37	
		8 - Utilize financial strategies	34, 49	
		9 - Change infrastructure	22, 44	
New York University Caregiver Intervention (NYUCI) - Minnesota Family Memory Care	Mittelman and Bartel (2014) / USA	4 - Develop stakeholder interrelationships	52, 35, 48	Acceptability Appropriateness Penetration Sustainability
		5 - Train and educate stakeholders	19, 71	
		6 - Support clinicians	59	
		7 - Engage consumers	69	
		8 - Utilize financial strategies	1, 34, 49	
		9 - Change infrastructure	12	

SHARE Program	Orsulic-Jeras et al. (2016) / USA	1 - Use evaluative and iterative strategies	4	Acceptability Appropriateness Feasibility Fidelity Penetration
		2- Provide interactive assistance	33	
		5 - Train and educate stakeholders	19, 59, 71, 55, 31 , 43	
		6 - Support clinicians	59	
New York University Caregiver Intervention (NYUCI) - Minnesota Family Memory Care	Paone (2014) / USA	1 - Use evaluative and iterative strategies	27	Acceptability Adoption Fidelity Implementation Cost Penetration Sustainability
		2- Provide interactive assistance	33	
		4 - Develop stakeholder interrelationships	65	
		5 - Train and educate stakeholders	55	
		6 - Support clinicians	59	
		7 - Engage consumers	69	
		8 - Utilize financial strategies	1, 34	
		9 - Change infrastructure	11, 22	
Maine Savvy Caregiver	Samia et al. (2014) / USA	1 - Use evaluative and iterative strategies	61	Acceptability Adoption Appropriateness Fidelity Penetration Sustainability
		4 - Develop stakeholder interrelationships	64, 24, 52, 35, 36, 6	
		5 - Train and educate stakeholders	29, 71, 73	
		7 - Engage consumers	69	
		8 - Utilize financial strategies	1	
		9 - Change infrastructure	22	
REACH II - implemented in Scott & White Family Caregiver Program (a non-profit collaborative healthcare system)	Stevens et al. (2012) / USA	1 - Use evaluative and iterative strategies	23, 56, 4	Acceptability Adoption Fidelity Implementation Cost Penetration Sustainability
		2- Provide interactive assistance	33	
		3 - Adapt and tailor to context	51, 63	
		4 - Develop stakeholder interrelationships	52, 47, 24, 35, 6, 48, 64	
		5 - Train and educate stakeholders	43, 19, 71, 29	
		6 - Support clinicians	30, 32, 59	
		7 - Engage consumers	50, 39	
		8 - Utilize financial strategies	1	
		9 - Change infrastructure	13	
Israeli NYUCI		4 - Develop stakeholder interrelationships	6, 36, 57, 24	Appropriateness Adoption

	Werner et al. (2020) / Israel	5 - Train and educate stakeholders	71, 29	Penetration Sustainability
		8 - Utilize financial strategies	34, 1	
		9 - Change infrastructure	22	
Support interventions: *Support interventions provide psychological, social and emotional support to caregivers, facilitated in a safe environment by professionals.* ***Example:*** *Meeting Center Support Program (MCSP) included educational meetings, support groups, social activities, and individual consultations.*				
Meeting Center Support Program (MCSP/MEETINGDEM)	van Haeften-van Dijk et al. (2015) / The Netherlands	1 - Use evaluative and iterative strategies	4, 5, 18, 56	Adoption Feasibility Penetration Sustainability
		3 - Adapt and tailor to context	51	
		4 - Develop stakeholder interrelationships	35, 36, 64, 65, 6, 52, 35, 38, 47	
		5 - Train and educate stakeholders	73, 19, 20, 71	
		6 - Support clinicians	59	
	van Mierlo et al. (2017) / The Netherlands	No implementation strategies identified	n/a	Adoption Penetration Sustainability
	Mazurek et al. (2019) / Poland	1 - Use evaluative and iterative strategies	61	Acceptability Appropriateness Feasibility Penetration
		2- Provide interactive assistance	33	
		3 - Adapt and tailor to context	63, 51	
		4 - Develop stakeholder interrelationships	35, 57, 38, 47, 17, 52	
		5 - Train and educate stakeholders	43, 19, 55, 71	
		7 - Engage consumers	37, 39	
		8 - Utilize financial strategies	34	
		9 - Change infrastructure	13	
	Meiland et al. (2005) / The Netherlands	1 - Use evaluative and iterative strategies	23	Adoption Penetration Sustainability
		3 - Adapt and tailor to context	63	
		4 - Develop stakeholder interrelationships	35, 6, 52, 24, 64, 47	
		5 - Train and educate stakeholders	19, 55, 43	
		7 - Engage consumers	39	
		9 - Change infrastructure	13	
DemenTalent		1 - Use evaluative and iterative strategies	5, 27, 4	Adoption Feasibility

	van Rijn et al. (2019) / The Netherlands	4 - Develop stakeholder interrelationships	35, 57, 6, 52	Penetration Sustainability
		5 - Train and educate stakeholders	71	
		7 - Engage consumers	39	

Table 2. Barriers and facilitators to implementation

CFIR Domains	Barriers to implementation	Facilitators to implementation
eHealth [58-72] *Implemented in and/or delivered by community-based aged care organization (e.g., dementia day care centers), university medical centers (i.e. research teams), and/or ambulatory mental health care institutions.*		
I. Intervention Characteristics	• **Appropriateness:** Technical issues with intervention components; poor connectivity, unintuitive user experience/interface (e.g., illegible font, no functional real-time chat box with access to facilitator feedback, unnecessary and confusing tools and functions); existing video communication tools insufficient for health education sector • **Acceptability:** Difficulty level of language used unsuitable for end-users; privacy and ethical concerns; intervention rigidity limited tailoring; unsuitable length of intervention (session and program) duration	• Real-time information/alert/notifications and direct instant access to human facilitator (coach) to provide tailored, individualized support; engaging topical forums allow users to share/exchange questions; accessible resources/library • Multi-modal delivery of information (e.g., centralized internet-based platform with information, paired with print-out copies, written in simple language, presented in clear font); video and audio (verbal) guidance/instructions facilitated use • Caregivers (with sufficient digital literacy) appreciate virtual on-demand access and timing flexibility
II. Outer Setting	• Participants faced time constraints (due to caregiving obligations); users' lack of awareness of the program availability and preparedness to participate (e.g., poor technological literacy; inflexible schedule); improper timing of intervention (e.g., too early/too late in PwD care trajectory) • Lack of integration with existing dementia/aged care services (lack of integration support from local government agencies) • Traditional healthcare settings (e.g., hospitals) unable to adopt intervention and can only be implemented as a community-based resource (e.g., FamTechCare) • Poor physical infrastructure in geographical region (internet connectivity); widespread sociocultural resistance to adopt internet-based interventions	• **Logistics:** Active dissemination through network events and leveraging network partners' channels (e.g., locally trusted intermediaries and clinicians' existing caseload; social networks/social media) • **Personal factors:** Applying a consumer-directed care model for implementation; high digital literacy rates within target demographic and trust toward implementing agencies (e.g., health-professional-led integrated network model)
III. Inner Setting	• Systems unprepared to deliver care to caregivers; caregiver support is administratively filed under PwD care (complicated when PwD is unregistered)	• **Streamlined administrative processes** (e.g., caregiver registered independent from PwD, insurance compensation, integrated online support)

	• Internal financial cutbacks limit intervention adoption and internal capacity (e.g., staff members lack time needed to review/approve the intervention and learn/train)	• **Human resources:** Well-prepared/educated staff; engaged leadership • Sustainable financing mechanisms from foundation/government grants • Directly engaging intervention initiators/vendors in implementation (staff training) process
IV. Characteristics of Individuals	• Unfit digital literacy in caregivers and staff members • Primary implementation agent (e.g., physicians) do not identify with or recommend the intervention	• Primary implementation agent identifies with program and developers (intervention source) (e.g., internally developed interventions are more familiar and more likely to be recommended)
V. Process	• User recruitment challenges (end-user restrictions, limited reach due to insufficient international search engines, caregivers were not registered with PwD) • Resistance from network members (need for multi-modal engagement strategy targeting organizations, clinicians, trainees and caregiver) • Cost of promotion and sustainment; high user attrition rates • Lack of systematic planning with end-users and audit/feedback mechanisms across implementation trajectory	• User recruitment facilitated through partnering with network agency (leveraging partners' channels), hiring external marketing agencies, creating public awareness/outreach campaigns, and promoting speaking engagements (conferences/seminars/expos) • Using social media marketing strategies to disseminate and strategically target reach and evaluate implementation outcome indicators via site analytics (website traffic, visitor retention) • Iterative changes made to intervention components based on user feedback
Respite care [96-100] *Implemented in and/or delivered by day care centers operated by nursing homes and/or community centers, may be located physically in an existing clinic or repurposing alternative infrastructures (i.e. Church).*		
I. Intervention Characteristics	• Cost of intervention (attendance fees and unsustainable financing mechanisms) • Intervention programming unsuitable for users (e.g., nutrition plan, lack of dementia-specific accommodation)	• Respite care had a positive atmosphere compared to nursing homes (philosophy surrounding staff training, schedule flexibility and care routine); one-on-one interaction and individualized support sparked position affect and engagement
II. Outer Setting	• Lack of transportation to facility; tedious administrative process to apply for respite vouchers (i.e. recurring [re-]application paperwork) • Poor service advertisement: need for "business-like approach in marketing" to attract users • Insufficient financing mechanisms (e.g., respite care vouchers lack comprehensive coverage and are limited	• Information sources include home health workers, Alzheimer's helpline, support groups and legal aid services; health professionals recommend respite care service to patients • Local community integration and participation in activities/events to build awareness and trust • Allocated respite vouchers may subsidize service payments

	by budgets) and high out-of-pocket expenditure for caregivers	
III. Inner Setting	• Staff shortage as a barrier to use • **Infrastructure:** safety concerns, inadequate space, improper atmosphere and environment (furniture)	• Staff knowledge, qualifications, empathy and sensitivity were facilitators
IV. Characteristics of Individuals	• Perceived misalignment between staff and organizational mission	• Staff individual competency and ability to balance meeting PwD wishes and delivering intervention components (maintaining fidelity); staff assumed multifaceted roles (PwD server and caregiver, liaison with family members)
V. Process	• Poor service advertising and lack of client engagement	• Engagement facilitated by widespread promotion and "business-like" approaches to dissemination
Care coordination and case management [85-90] *Implemented in and/or delivered by primary care practitioners, Veteran Affairs medical center (healthcare organization) (USA) and partnering Alzheimer's Association chapter (community service organization).*		
I. Intervention Characteristics	• Underutilized components include health information/education, care planning and coordination, emotional support • Fragmented care continuity and access support reduces intervention use (e.g., caregivers were left to contact community support agencies independently) • Inconsistent quality and accuracy of prescribed information	• Care consultants co-created health plans with dyads, provided tools to enhance dyad competence and self-efficacy, delivered accurate information about local community services and reduced care fragmentation by connecting dyads to other complementary service agencies. • Flexible, tailored (multi-modal), manualized care coordination/support improved access and user engagement; scheduling telephone calls ensures caregiver availability and access for rural caregivers
II. Outer Setting	• Health system (pathways and information) fragmentation: lack of timely referral pathway and mechanism between GP (i.e. gatekeepers) and intervention agency; GP lack information/awareness • Lack of local hospital system involvement: Initiators were viewed as 'outsiders' and 'competitors' instead of collaborators; GP were not involved as implementation partners	• Inter-agency partnerships between initiators and intermediaries are main facilitators to implementation; embedding interventions into existing services via networks improve sustainment (e.g., PDC); external agencies (licensure and training institute) disseminate innovation; • Overarching national agenda (e.g., Older Americans Act) encouraging interventions that streamline service continuity by linking healthcare services to community services; interventions that facilitate GP referral to community services initiated and sustained by the government (e.g., ACAT Australia) • Local intermediary (e.g., Alzheimer's Association) chapters services regional caregivers and provide cross-system

		support to GP, academic institutions, and other stakeholders.
III. Inner Setting	• Resistance for change from local hospital systems (due to physicians' time restrictions) and lack of financial investment in adopting intervention	• Implementing agency staff training was facilitated through formal education sessions (service-delivery protocol, care coordination information system explanation); additional funding for staff education provided by government grant to support community outreach programs established in partnership with external research centers and academic institutions.
IV. Characteristics of Individuals	• PwD personal diagnosis avoidance leads to lower diagnostic rates	None identified
V. Process	• Unanticipated challenges (e.g., nursing strike, natural disaster (snow, storm)) and geographic/logistic complications (e.g., transportation limitations) impeded implementation process	• Care consultation was facilitated by using standardized protocols for service delivery, including structured initial assessment, identifying problems/challenges, and developing tailored strategies (care plan); • Recruitment sample was drawn from hospital medical records that indicated dementia diagnosis or memory loss; consulting local community leaders (e.g. clergy members) facilitated fostering networks appropriate implementation planning • Embedding and sustainment was facilitated with support from care coordinators that worked with both the intervention site and partnering agencies/intermediaries.
Psychoeducation [73-84] *Implemented in and/or delivered by Veteran Affairs Medical Centers (USA), research/clinical centers, social workers, and community-based outpatient clinics, with integrative support from regional government agencies (e.g., Administration on Community Living (USA)).*		
I. Intervention Characteristics	• Unsuitable intervention delivery (e.g., long duration of session and length of program; abrupt end of intervention and losing access to resources was an issue) • Courses were not (time) flexible for caregivers; least useful course content surrounded 'drug treatments' and 'spirituality'	• Useful interventions (e.g., relaxation CDs, educational booklets/videos/courses, group courses) had easy to read, multi-modal delivery that allowed users access flexibility (time, location) • Intervention adaptation/translation funded by foundation grants
II. Outer Setting	• Limited community resources create financing difficulties • Barriers to reach include lack of outreach to community healthcare providers and paid advertisements	• **Timing of intervention:** Caregivers prefer the intervention delivered at the time of dementia diagnosis (or soon after) to be well-prepared/informed

	(resulting in limited awareness of services); intermediaries were not fully and actively involved.	• **Contracting external agencies**: Intervention initiators contract local agencies (e.g., Veteran Affairs) and intermediaries (e.g., Alzheimer's Association) to implement program as part of regular services to scale-up service provision; existing staff members are trained; use existing administrative infrastructure (billing/workload codes) to reimburse services • National/local government agenda mandate public organizations to implement intervention in existing services as regular care, embedded through academic-public partnerships
III. Inner Setting	• Staff hesitant to adopt intervention as regular care (increased workload; change in role/function)	• Resources that facilitated implementation include partnering agencies, 24/7 telephone helplines, case managers, resource centers (e.g., Aging & Disabilities Resource Center) • Staff training facilitated by live webinars, consultation calls, and intervention certification programs • Existing staff members were re-trained to deliver new intervention as regular care as their skills are suitable to adopt the "highly compatible" and "readily integrated" intervention
IV. Characteristics of Individuals	• Staff competencies in identifying caregivers of PwD who are unregistered	• Staff members are comfortable in their role and are able to iteratively modify the delivery of services to accommodate implementation in the community setting
V. Process	• Engagement hindered by ineffective dissemination mechanisms	• Involve local religious/social influencers ("implementation leaders/champions") to establish validation and credibility and accelerate local buy-in • Intervention sustainment facilitated by iterative adaptations to interventions according to demand (e.g., funding shortage required reconfiguration of STAR-C) and user feedback (e.g., language used, training modality) while maintaining intervention fidelity
Support interventions [91-95] *Implemented in and/or delivered by independently established memory clinics (NL), nursing homes, community centers, and daycare centers.*		
I. Intervention Characteristics	• Saturated "market" ("surplus") reduced demand for new interventions serving	• Support intervention provided at a conveniently accessible location by a small permanent (multi-disciplinary) team

	similar functions (with no clear advantage) and minimized their value - Name of intervention: Titles with “dementia” may contain negative association and poor reception	of professionals; flexible nature of intervention is advantageous compared to institutionalization (which has less capacity, longer wait-lists, increasing care fragmentation) - Clear participant inclusion criteria reduced unexpected challenges by establishing uniform groups
II. Outer Setting	- Poor existing health system (e.g., referral pathway, post-diagnostic support, health financing mechanisms) and resource limitations; ineffective reimbursement schemes determined by user attendance (staffing challenges) - Poor relationship between initiator and regional network stakeholders/referrers (GP/welfare organizations); misalignment between partnering organizations - Lack of clarity about structural financing of interventions and sustainability due to national agenda volatility resulting from changes in political parties; fragmented funding (and need for re-application) impedes implementation process	- Interventions facilitated in proximity to local community centres (church, welfare centre) with recognition and support/collaboration (referrals, sustainment) from regional networks, local champions and influencers were more successful - Obtaining financial support from sponsors or care administrations to fund programs; access to multiple sources of financing (reimbursements) and government-initiated incentive schemes (‘waiting list subsidy scheme’, ‘tailor-made care funds’, and the ‘informal care subsidy scheme’) or national legislations (or municipality funding) that establish structural funding to claim finances from. - Collaboration protocols and formal contracts were facilitators to referrals, placements, execution and partnership continuation/sustainment
III. Inner Setting	- Organizations resist adoption if externally-developed interventions are perceived as competition or deemed unsuitable for services provided - Difficulties financing projects implemented in welfare organizations in the interim given inflexible budgets and inflexible organizational structure - Low implementation capacity in adopting organizations: human resource (rigid staff, lack of knowledge about dementia-specific needs, lack of leadership motivation and pioneering spirit, role uncertainty within management team and staff turnover) and financing limitations (no financing for people without formal diagnosis, insufficient finances to compensate contracted staff hours)	- Internal team maintains intensive contact with external partners to facilitate execution - Repurposing existing financing mechanisms within organizations accelerates implementation - Staff training and refresher courses facilitated by an external consultant supported implementation - Motivated leaders who sought out cooperative partnerships and were readily responsive to bottlenecks

IV. Characteristics of Individuals	• End-user skepticism causes resistance • Organizations resist existing interventions to “reinvent the wheel”	• Enthusiasm from end-users toward the organization and initiators facilitated implementation • Staff competencies (open attitude, motivated) facilitated implementation
V. Process	• Lack of suitable location (high costs, unsuitable atmosphere, inconvenience) and insufficient pre-implementation environmental assessment risked unanticipated challenges • Need for stronger evidence base before network agencies will adopt interventions • Network support (collaboration) gradually decreased over time (e.g., support received during initiation phase decreased in execution phase) and user recruitment became difficult due to lack of publicity • Service capacity was insufficient, and wait-lists became long • Interventions lack promotion (via pharmacies, GP) and public awareness about the components	• Using a step-wise implementation procedure facilitates implementation planning (preparation, execution, continuation); planning by assessing local/regional (demographic) need for intervention and establishing formal agreements with pre-established networks and partners; following (adaptive) project plans • Establishing the intervention in an existing facility with similar practices is more efficient and establishes confidence in users; using • Enthusiastic initiators/champions within organizations; program coordinator should be professionally up-to-date and possess management experience; hiring external consultant/agencies to facilitate staff training • Engagement and recruitment of users facilitated by partnering agencies/intermediaries (e.g., Alzheimer’s Café), and personalized materials (flyers/newsletters) and media
Exercise [101-103] *Implemented in and/or delivered by professional trainers in sizeable and safe venues, accessible by car and public transportation, or practiced at home with support from video recordings.*		
I. Intervention Characteristics	• Caregivers unable to independently access intervention (difficult location and scheduling) • Unsuitable information delivery (content was unclear and difficult to understand; content did not fit in the recommended timeframe) • Action plan, coping plan and clock were not useful components	• Multi-modal delivery of clear information (e.g., photos and videos of exercise) facilitated use; support of human facilitator/instructor who provided positive reinforcement/feedback and iteratively adapted intervention components to meet users’ circumstances (e.g., difficulty level of exercise) • Home visits and home-exercise logs supported independent performance
II. Outer Setting	• Caregivers did not fill their action plan and found the intervention “too intensive”; limited free time and physical capacity hindered intervention use	None identified
III. Inner Setting	None identified	None identified

IV. Characteristics of Individuals	• Users lacking sense of self-efficacy in performing exercises at home without guidance (e.g., video instruction material) and perceived skepticism toward intervention efficacy	• Routinization of exercise facilitated sustainment
V. Process	• Recruitment of users through advertisements and personal letters to caregivers were ineffective; barriers included participation burden and lack of caregiver time	• Recruitment was facilitated using an information leaflet (information regarding balance, fall prevention, Tai Chi and implication of involvement for dyad), key facts sheet and participant information sheet.
Occupational therapy [104-106] *Implemented in and/or delivered by NHS memory services (UK), community mental health services, or in the caregiver's home (by trainers).*		
I. Intervention Characteristics	• Intervention components are not cost-effective within the implementing agency (e.g., agency revenue and therapist salaries are based on patient contact; need to balance training needs and patient contact)	• Individualized face-to-face OT sessions, setting realistic goals with a clear (practical) roadmap, and follow-up check-ins facilitated use • Introducing OT gradually at early stages following dementia diagnosis is optimal and supporting dyads in the adjustment period
II. Outer Setting	• Outcomes are influenced by personal factors (e.g., dyad readiness for intervention); introducing OT immediately after diagnosis may confuse caregivers • Lack of health financing and system infrastructure (e.g., patients were mainly referred to OT for other comorbid chronic conditions contributing to functional decline and home safety issues; referral for OT for dementia diagnosis should not be declined)	• Dyads preferred interventions provided by government agencies (local health system); • Using existing health financing infrastructure (e.g., Medicare Part A & B) and adapting intervention to fit reimbursement ("billing") criteria while maintaining fidelity facilitates implementation
III. Inner Setting	• Lack of available resources (e.g., equipment) hindered intervention outcomes • Lack of appropriate, cost-efficient fidelity monitoring mechanisms that fit agency culture	• Organizational readiness facilitates implementation through changing the role and function of existing staff/administrators (transformative agency leadership, training early adopters) • Internal structures should be available (e.g. supervisory structure, training support/referral, client tracking, billing infrastructure)
IV. Characteristics of Individuals	• Negative dyad relationship dynamic/quality influences OT outcomes • Dyad's lack of perceived need for OT and lack of availability to participate	• Caregiver self-efficacy and perceived competency improved with support from OT; positive attitude toward intervention facilitated willingness to try

V. Process	• Engagement hindered due to lack of perceived need for OT • Translation of intervention components was labor intensive	• Engaging long-term staff members, familiar with organizational structure/policy/clients, as early adopters; reflect on training of trainers • Perform in-depth assessment of practice site characteristics and reimbursement requirements; understand mutable and immutable components of intervention and training (for fidelity)
Multi-component intervention [40-57] *Implemented in and/or delivered by nonprofit community-based organizations focused on services for older adults and caregivers, hospital-sponsored service program for seniors, clinics and nursing facility/assisted living-based program, and Alzheimer's Association chapter.*		
I. Intervention Characteristics	• Assessment and monitoring components (e.g., videotaping client behavior) may be intrusive to daily residential use • Complexity of intervention (length of program duration, time consuming) and unsuitable components (reading material difficulty level, font size/color, visuals) deter users • Lack of implementation manual increases training difficulties due to intervention complexity	• Treatment and implementation manuals, time-flexible structured training (with human facilitator), certification, ongoing monitoring and feedback (progress notes, caregiver notebook), cultural/language inclusivity, accounting for polypharmacy in PwD, psychological support (support groups), and caregiver-focused co-created material, delivered through accessible (multi-modal) mechanisms, facilitated implementation • Removing/refining intervention components but maintaining program fidelity and efficacy (e.g., shortening length of sessions or duration of program iteratively)
II. Outer Setting	• Caregivers face time constraints, leading to underutilization of interventions; components within intervention unsuitable for users' conditions • Scaling up is hindered by larger agencies' complexity (e.g., Veteran Affairs), including size of organization, number of facilities, large catchment areas • Lack of diverse partnerships beyond ageing network	• Collaborative agencies within regional network support implementation: leverage strengths of each separate agency; each have a role in implementation (e.g., training, staffing, analyzing outcomes); communication between initiators and community agency facilitated sustainment with local funding agency • Training and scaling-up was facilitated by external private company and academic institutions; embedding intervention as part of regular services within intermediary agencies supported scale-up; partnering with faith-based institutions supported engagement and recruitment; • Legal reform in ageing policy facilitates caregiver-oriented interventions, extending financial coverage and benefits to caregivers of PwD; interventions with government (state/municipality)

		recognition and support had more successful continuation and scale-up
III. Inner Setting	• Staff were unprepared (lack of dementia care training/competencies; unclear intervention budget plan; staff turnover; large caseloads; difficulties convincing staff of intervention value) • Poor fit between existing services/organizational capacity/culture (including allocating finances/infrastructure/human resources) and intervention components; workload credit and billing codes influenced implementation	• Staff/Trainers received clear manual and instructions; refresher sessions were also provided; staff enthusiasm toward intervention facilitates continuation; sufficient time contracted to train staff and deliver intervention components • Administration must buy into the intervention; modifying interventions to fit organization infrastructure/resources and routine facilitates sustainability; good cultural fit between intervention and implementing agency
IV. Characteristics of Individuals	• Overburdened caregivers could not participate in interventions • Lack of trust in government-related institutions deterred participation • Trainer turnover hindered program maintenance; existing need for timely certification process	• Staff/counsellor competency and personalized approach to care facilitated use • Sense of community ownership and culturally adapted intervention facilitated uptake and continuation
V. Process	• Monitoring fidelity using video cameras is intrusive in naturalistic settings • Sustainment and continuation difficult due to staff turnover and user drop-out • RCT results may not reflective of real-world demands and outcomes • Lack of dissemination and user recruitment; localized recruitment limited use and awareness	• Translating intervention to fit wider demographic; co-designing components with advisory committee and users to improve suitability • Exploring and engaging local partners facilitated implementation, dissemination and scale-up; partnering with cross-sectoral agencies and leveraging individual strengths enhance outcomes; continuous promotion across implementation trajectory

Table 3. Implementation strategies and mechanisms reported

Type of Intervention	Most frequently employed discrete strategies (cluster/strategy)	Example of mechanism reported
Multi-component [40-57]	Cluster 5 / ERIC 43 (Make training dynamic)	• Caregiver notebook included educational materials, interactive modules, and worksheets that corresponded with original intervention, but computerized telephone system was also sued to deliver information [42]
	Cluster 5 / ERIC 71 (Use train-the-trainer strategies)	• External agency (DAZ) built to train adopting agencies in the intervention components, to scope local partners and needs, and to select professional project leaders [43] • Trainers were instructed to apply a person-centred approach and individualized activities to the PwD and caregiver [49]
	Cluster 2 / ERIC 33 (Facilitation)	• Interventionist provides individualized problem-solving skills based on problems identified using the caregiver notebook [50] • Counselor creates safe and comfortable environment to enable dyads to discuss and plan at their own pace [53]
	Cluster 4 / ERIC 52 (Promote network weaving)	• Caregivers were recruited by partner agencies (flyers, public service announcements, community outreach, email, website programming) [55] • Partnership with Area Agency on Ageing to translate intervention into non-profit integrated health system [56]
eHealth [58-72]	Cluster 3 / ERIC 51 (Promote adaptability)	• Digitalizing existing forms (e.g., Healthy Aging Brain Care Monitor) to collect and centralize patient information [64] • Website was provided alongside a toll-free telephone service to enhance access to intervention [65]
	Cluster 5 / ERIC 31 (Distribute educational materials)	• Intervention consisted of multimedia e-Learning lessons, resources, weekly educational emails, monthly livestream events [66] • Internet platform contains information for caregivers on dementia, intervention costs/privacy/registration process [70]
	Cluster 5 / ERIC 29 (Develop educational materials)	• iSupport intervention, developed by the World Health Organization, provided online self-help and caregiver skills training [60, 61] • Spanish-language content for caregivers was developed by translators [69]
Psychoeducation [73-84]	Cluster 5 / ERIC 19 (Conduct ongoing training)	• START provides 8-week, manualized training for caregivers of PwD [74], and Tele-Savvy reformatted the in-person Savvy Caregiver curriculum into a [digital] 7-week program [77]
	Cluster 5 / ERIC 29 (Develop educational materials)	• REACH VA materials (photographs) were locally modified to reflect diversity [80] • Medway Carers Course was developed by specialist psychologists responding to clinical need for care focused on PwD and relatives [82]

	Cluster 5 / ERIC 43 (Making training dynamic)	• Training was facilitated through treatment manual, role playing, structured practice with behavioral problem solving plans using videos [81] • Workshop included training on the resource book, role playing and group discussions of various situations [79]
	Cluster 5 / ERIC 31 (Distribute educational materials)	• Resource notebook was provided by counselors [79]; information was distributed verbally or written on printed handouts [82]
Care coordination and case management [85-90]	Cluster 4 / ERIC 52 (Promote network weaving)	• Partnership added care consultation from Alzheimer's Association [intermediary] to usual care offered to members of Kaiser Permanente [hospital] [85] • Establishing formal partnership between VA medical center and Alzheimer's association chapters [86]
	Cluster 4 / ERIC 24 (Develop academic partnerships)	• COEP was conducted in collaboration with the Michigan Alzheimer's Disease Research Center at the University of Michigan in Ann Arbor [88] • Informal caregivers were recruited with support from University of Lincoln [89]
	Cluster 6 / ERIC 59 (Revise professional roles)	• Staff from local Dementia and Specialist Older Adult Mental Health Services were sought to deliver intervention [89] • Care consultation delivered by [Alzheimer's] Association staff members who are master's prepared social workers [85]
	Cluster 6 / ERIC 30 (Develop resource sharing agreements)	• Care coordinators from different organizations worked as a team, supported by a shared electronic Care Coordination Information System [86]
Support interventions [91-95]	Cluster 4 / ERIC 35 (Identify and prepare champions)	• Planning implementation by selecting an easily accessible location with a small and permanent team of professionals [94] • Nursing home-based PwD day care centers made transition to community day care with caregiver support according to Meeting Centres Support Program [91]
	Cluster 4 / ERIC 6 (Build a coalition)	• Group consisted of manager of day care centre, transition supervisor from academic university, and researcher and consultant with experience delivering intervention in real-world settings [91] • Involve network of care and welfare referrers [95]
	Cluster 4 / ERIC 47 (Obtain formal commitments)	• Initiative group, project group and all relevant collaborating organizations signed cooperation agreement [91] • Community engagement and collaboration with existing local care and welfare organizations [94]
	Cluster 4 / ERIC 52 (Promote network weaving)	• Collaborating across sectors and between health and social organizations; cooperating organizations include local Alzheimer's Associations, mental health organizations, general practitioners, home care organizations, case managers, and local caregiver support organizations [91]

Respite care [96-100]	Cluster 6 / ERIC 59 (Revise professional roles)	• Staff members assumed multi-faceted care rolls (e.g., serving meals, collaborating with family members, providing intensive ADL) [98] • Staff members act as research liaisons and provide feedback for program evaluation [99]
Exercise [101-103]	Cluster 2 / ERIC 33 (Facilitation)	• Classes were led by fully trained Tai Chi instructors who provided home-based support and real-time feedback during classes to correct the participant’s poses and movements [102]
	Cluster 5 / ERIC 31 (Distribute educational materials)	• Booklets with exercise instructions (with explanatory photos and text) were distributed [101, 102]
	Cluster 5 / ERIC 19 (Conduct ongoing training)	• Exercise training for caregivers ran over 4 weeks [102] to gradually become familiar with exercise movements through individual coaching [103]
	Cluster 9 / ERIC 12 (Change record systems)	• Action plans and coping plans were developed for caregivers to record their exercise progress [101, 102]
Occupational therapy [104-106]	Cluster 1 / ERIC 4 (Assess for readiness)	• Meaningful activities are identified through narrative interviews [104] [105] • Structured observation of activities [105]
	Cluster 1 / ERIC 18 (Conduct local needs assessment)	• Evaluate local needs through home visits and monitoring activity outcome [105, 106]
	Cluster 3 / ERIC 63 (Tailor strategies)	• Adapt intervention to fit the physical and social environment, apply caregiver management approaches (including prioritizing caregiver concerns), and be considerate of PwD functionality [106] • Personal goal setting based on assessment findings [105]
	Cluster 3 / ERIC 51 (Promote adaptability)	

Appendix 2 | Additional files from Chapter 4 (Interview guide)

Table 1. Interview guide

Questions	Details
General questions	• Can you please tell us about a research project that you're most proud of? ◦ Was it successful? What made this successful? • Can you provide examples of projects that have had a significant impact on policy, practice, or the community?
RQ 1 (What strategies were used by the Alzheimer Centers to facilitate creation and adaptation of research findings into research products?)	• Could you tell me about a research project that has produced knowledge products that are used in a real-world practice setting, such as guidelines, films, brochures? • Can you elaborate on how these products were created? Who was involved? • Did you receive any formal support from structures within the Alzheimer center or informal (uncontracted) support from your own network? • How did you enhance usability and relevance of the knowledge products for end-users? Did you include the practitioners or patients in this process?
RQ 2 (What strategies were employed to disseminate research products?)	• When you get some amazing research results, how do you decide where and how to share it with the public? • How do you identify and target different audiences for your knowledge dissemination activities? • Can you tell me about a dissemination plan you've made and how you experienced these knowledge sharing activities? • Can you share a bit about the tools or strategies you use to reach a wider audience with your research findings? • What communication channels do you utilize to disseminate research findings? • How do you measure the impact and effectiveness of your knowledge dissemination efforts?
RQ 3 (What strategies were used to facilitate the implementation of research products?)	• How do you foster collaboration with researchers, policymakers, and practitioners to facilitate knowledge use? Are there any notable partnerships that have been instrumental in your center's success? • In your previous or ongoing projects, what implementation (and scale-up) activities have been undertaken? Who is responsible for motivating change? • How do you encourage implementation/scale-up initiatives and knowledge sharing? • How do you monitor the progress and effectiveness of your implementation plans?

Appendix 3 | Additional files from Chapter 5 (Interview guide)

Table 1. Data Collection tool (Interview guide)

Relating to Aim 1: What main activities and strategies were performed by public and private funders of dementia care research to facilitate research dissemination and implementation?
1) [Release of research/Dissemination] How do funders enhance research output usability for the general public? (e.g., simplified language, establishing information hub/repository, press briefings, media exchange?) 2) [Knowledge exchange activities] What are activities (or infrastructures) that funders conduct (or utilize) to bring inter-agency stakeholders together to share knowledge and act upon research findings to create societal impact? 3) [Implementation] Are there formal funding schemes (e.g., financing instruments) to support awardees (research or other) to undertake implementation projects (e.g., clinical guideline implementation projects)? a. What implementation requirements are explicit in grants? b. What are implementation steps required by applicants? c. How are they expected to be reported to funders? d. How do you monitor these requirements? 4) [Building capacity/infrastructure] Are there specific awards or funding schemes that support building capacity for dissemination or implementation activities? 5) [Implementation research] How do funders provide support for implementation science research (e.g., determining and comparing implementation strategy effectiveness)
Relating to Aim 2: What related organizational and external challenges did public and private funders encounter in facilitating research dissemination and implementation?
1) What challenges do funding agencies experience when engaging external organizations, such as resistance from healthcare providers and other implementing agencies, to create research impact? 2) What infrastructure or mechanisms are in place to facilitate co-financing of healthcare research initiatives, and what challenges arise in this process? 3) What challenges do funders have to disseminate research knowledge? How would you like to receive the research knowledge (results) so it is more appropriate to share? 4) How do government policies affect the implementation and support of healthcare research initiatives funded by academic research funders? 5) What external environmental factors, such as healthcare networks and industry trends, impact the funding and execution of healthcare research projects?

SUMMARY

Population ageing is a growing issue that increases the prevalence and burden of challenges associated with dementia. The global incidence rate of dementia is projected to rise from approximately 57.4 million in 2019 to an estimated 152.8 million by 2050. Non-pharmacological dementia research findings and innovations present scalable care solutions to support the needs of the ageing population. These are defined as *knowledge or innovations (e.g., diagnostic tools, digital health applications) that directly or indirectly improve patient health outcomes along the dementia care trajectory, without the use of chemical agents.* In 2022, the World Health Organization published the *A blueprint for dementia research* report that included fifteen clear strategic goals that signal the need for global action to improve the use and scale of dementia research in practice and policy. In accordance with this global action plan, the Netherlands established their National Dementia Strategy (2021 – 2030) that steered the national research agenda toward prioritizing the use of research in practice. However, this emerging demand for non-pharmacological dementia research implementation is hindered by implementation complexity. This calls for solutions to improve implementation practices, such as by adopting knowledge and guidance from the field of implementation science. Accordingly, this PhD dissertation investigated three research questions to determine how implementation science can be applied to accelerate the translation of non-pharmacological dementia research to practice.

Research question 1: What is already known in the scientific literature about the dissemination and implementation of home- and community-based interventions for informal caregivers of people living with dementia? (Chapter 2 and 3)

Chapter 2 presents a systematic scoping review protocol, focusing on the scope of evidence available on the dissemination and implementation of home- and community-based interventions for informal caregivers of people living with dementia. This protocol introduces a novel approach that combines various dimensions of implementation science theories to produce an evidence synthesis, generating deeper and more comprehensive

understanding of the implementation process. **Chapter 3** presents the results from this review, focusing on the implementation determinants (i.e. barriers and facilitators to implementation), strategies, and outcomes reported across the 67 included articles. A central determinant to implementation success is the wider health system infrastructure readiness, such as existing professional networks. Additionally, training and education strategies appeared as the most common type of implementation strategies used for this group of interventions in this implementation setting. Findings also suggest a gap in evidence and insight into the outer implementation setting, which includes the wider policies, regulations, networks, and infrastructure that encompasses the implementation setting (organization). This may be clarified through obtaining insights from less frequently engaged stakeholder groups that are also involved in the dissemination and implementation of non-pharmacological research. This result steers the design and development of the following empirical studies in this dissertation.

Research question 2: What are strategies employed by Dutch academic researchers to create, adapt, disseminate, and implement dementia research? (Chapter 4)

Chapter 4 presents an empirical study that identifies the research utilization strategies, employed by Dutch (academic) dementia researchers. Semi-structured interviews were conducted with 29 participants, each directly responsible for conducting and supporting research across five academic research centers (Alzheimer Centers). Using an abductive data analysis approach, explicit strategies are identified in each of the four phases in the proposed knowledge implementation funnel: *knowledge creation, knowledge adaptation, knowledge dissemination, and knowledge implementation.*

First, knowledge creation is facilitated through close engagement and co-creation with research end-users (clinicians, patients), private sector partners, and patient representative groups. Next, knowledge adaptation is enhanced by training (academic) researchers to communicate findings using theory-of-change models, translate knowledge for non-academic stakeholders, and collaborating with private sector partners to enhance usability. Third, knowledge dissemination is facilitated through cross-sector partnerships with private sector partners and national knowledge institutes (e.g., Vilans, Pharos) to spread findings through employing marketing strategies and developing clinical guidelines, respectively. Lastly, knowledge implementation is facilitated by building cross-sector partnerships for research valorization, scaling research innovation as routine practice in existing organizations, and obtaining alternative financing to support implementation and sustainment.

Chapter 4 explicates these strategies to reduce research implementation ambiguity, enabling (academic) dementia researchers, and the Alzheimer Centers, to facilitate strategic planning for capacity-building and resource allocation. In relation to capacity-building, one approach is to build valuable individual competencies to overcome the unique barriers that influence research utilization outcomes, such as co-creation, cross-sector communication, and project management. Another approach is to build and sustain partnerships with external implementation partners, such as private sector intermediaries (e.g., valorization centers), collaborative networks, and national knowledge institutes. In relation to resource allocation, the study identifies the variations in research areas and the resources available across the five Alzheimer Centers, presenting insights that may inform strategic decision-making for dissemination and implementation in and across each organization. Findings from **Chapter 4** also suggest that research funders have an influence on the research utilization activities of (academic) researchers in the Netherlands, inspiring the following empirical study in **Chapter 5.**

Research question 3: What are strategies (and related challenges) of public and private research funders to accelerate the dissemination and implementation of funded non-pharmacological dementia research? (Chapter 5)

Chapter 5 identifies the strategies and challenges of public (e.g., ZonMw) and private (e.g., Alzheimer Nederland) Dutch dementia research funders to facilitate the dissemination and implementation of research results obtained through their funded programs. Semi-structured interviews were conducted with 20 participants, all employed by public or private dementia research funding agencies in the Netherlands. Findings were obtained through an abductive data analysis approach, revealing that research funders employ strategies for *dissemination, implementation support, and research ecosystem capacity-*

building. Dissemination and implementation activities of research funders may be direct or indirect. Indirect strategies require funders to provide *incentive, mandate, or guidance* for dissemination and implementation through their funding requirements, such as by providing theory of change models to guide researchers. Direct strategies enable funders to achieve the intended dissemination and implementation support outcome without involving any intermediaries, such as by generating media content or facilitating outreach events. This distinction provides further conceptual clarity to guide the selection of strategies that facilitate research dissemination and implementation process planning and execution. Lastly, *research ecosystem capacity-building* strategies include building large scale research governance models (e.g., consortium), providing implementation science training programs and establishing professional connective networks.

Chapter 5 also determines several persistent challenges experienced by research funders. Dissemination is hindered if research teams underutilize available dissemination channels (e.g., newsletters, blog posts, media), leading to low engagement with the public. Implementation support is hindered by role ambiguity between researcher teams and funding organizations and low engagement between researchers and valorization structures (e.g., technology transfer office) connected to funders. Lastly, research ecosystem capacity-building is hindered by the limited implementation infrastructure (e.g., implementation support workforce; structural financing for implementation) and conflicting value systems in public-private partnerships. These findings may inform the development of future strategic planning for research funders and influence design of innovation and research policy to support cross-sector partnerships.

Notably, **Chapter 5** also introduces the *research ecosystem* concept that aims to make sense of the unique roles and contributions of public and private research funders. Public and private sector values, infrastructure, and resources influence the decisions and contributions to non-pharmacological dementia research dissemination and implementation. A prime example of public-private partnerships in research implementation is the use of public-private co-funding mechanisms in dementia research consortium projects to circumvent regulations that may stifle innovation. The findings

provide guidance to support public and private research funders with designing strategic plans and build collaborative capacity.

Chapter 6 summarizes the main findings from each chapter of this dissertation and provides a deeper discussion over the theoretical and practical contributions of the proposed *research ecosystem.* This is achieved by expanding the conceptual boundaries of this model to encompass and unify the perspectives of (academic) dementia researchers and dementia research funders. In addition, this chapter expands upon the phases of the proposed knowledge implementation funnel and potential approaches to build individual and collaborative implementation capacity in this research ecosystem. In conclusion, this PhD dissertation offers robust, multi-dimensional evidence that advances the implementation of dementia research. By employing an implementation science perspective to develop a theoretical framework for capacity-building, it paves the way for the accelerated translation of non-pharmacological dementia interventions into practice.

SAMENVATTING

De prevalentie van dementie zal naar verwachting stijgen van ongeveer 57,4 miljoen in 2019 naar 152,8 miljoen in 2050. Bevindingen en innovaties uit niet-farmacologisch dementieonderzoek bieden opschaalbare zorgoplossingen die inspelen op de behoeften van mensen met dementie en hun mantelzorgers. Deze innovaties refereren naar kennisproducten (bijvoorbeeld diagnostische instrumenten, digitale gezondheidsapplicaties) die direct of indirect bijdragen aan de verbetering van de gezondheid van mensen met dementie, zonder gebruik te maken van geneesmiddelen. In 2022 publiceerde de Wereldgezondheidsorganisatie het rapport *A blueprint for dementia research*, waarin vijftien strategische doelstellingen zijn opgenomen die de wereldwijde noodzaak onderstrepen om dementieonderzoek beter te benutten in beleid en praktijk. In lijn hiermee heeft Nederland de Nationale Dementiestrategie (2021–2030) opgesteld, waarmee de nationale onderzoeksagenda werd bijgestuurd om het gebruik van onderzoeksresultaten in de praktijk te prioriteren. De groeiende vraag naar de vertaling van niet-farmacologisch dementieonderzoek wordt echter bemoeilijkt door de complexiteit van het implementatieproces. In dit proefschrift zijn drie onderzoeksvragen onderzocht met als doel te bepalen hoe implementatiewetenschap kan bijdragen aan het versnellen van de vertaling van niet-farmacologisch dementieonderzoek naar de praktijk.

Onderzoeksvraag 1: Wat is reeds bekend in de wetenschappelijke literatuur over de verspreiding en implementatie van thuis- en gemeenschapsgerichte interventies voor informele mantelzorgers van mensen met dementie? (Hoofdstuk 2 en 3)

Hoofdstuk 2 presenteert een protocol voor een systematische scoping review, gericht op de beschikbare kennis over de verspreiding en implementatie van thuis- en gemeenschapsgerichte interventies voor informele mantelzorgers van mensen met dementie. Dit protocol introduceert een vernieuwende benadering die verschillende dimensies van implementatietheorieën combineert. Deze aanpak leidt tot een diepgaande en alomvattende analyse van het implementatieproces via een synthese van evidentie.

Hoofdstuk 3 presenteert de resultaten van deze review, gericht op de implementatiedeterminanten (barrières en bevorderende factoren), strategieën en uitkomsten uit de 67 geïncludeerde artikelen. Een belangrijke determinant voor succesvolle implementatie betreft de paraatheid van de bredere infrastructuur van het gezondheidssysteem, waaronder bestaande professionele netwerken. Voor deze determinant bleken opleidings- en educatiestrategieën de meest toegepaste implementatiestrategieën. De bevindingen wijzen ook op een kennislacune met betrekking tot de externe implementatiecontext, zoals beleid, regelgeving, netwerken en infrastructuur die de organisatieomgeving mede vormgeven... Inzichten van minder vaak betrokken belanghebbenden, die niettemin een rol spelen in de verspreiding en implementatie van niet-farmacologisch onderzoek, kunnen mogelijk bijdragen aan de verduidelijking van deze externe context. Deze bevindingen vormden het uitgangspunt voor de opzet van de empirische studies in de volgende hoofdstukken.

Onderzoeksvraag 2: Welke strategieën gebruiken Nederlandse academische onderzoekers bij het creëren, aanpassen, verspreiden en implementeren van dementieonderzoek? (Hoofdstuk 4)

Hoofdstuk 4 presenteert een empirisch onderzoek naar de strategieën die Nederlandse (academische) dementieonderzoekers gebruiken om onderzoeksresultaten te valoriseren. Hiervoor zijn semi-gestructureerde interviews afgenomen bij 29 deelnemers die direct betrokken zijn bij de uitvoering of ondersteuning van onderzoek binnen de vijf academische Alzheimercentra's. Op basis van een abductieve data-analyse zijn expliciete strategieën geïdentificeerd binnen elk van de vier fasen van de voorgestelde kennisimplementatie-funnel: kenniscreatie, kennisadaptatie, kennisverspreiding en kennisimplementatie.

Ten eerste wordt kenniscreatie bevorderd door nauwe samenwerking en co-creatie met eindgebruikers (waaronder clinici en patiënten), private partners en patiëntvertegenwoordigers. Ten tweede wordt kennisadaptatie vergroot door onderzoekers te trainen in het communiceren van onderzoeksresultaten met behulp van theory-of-change modellen, het vertalen van kennis naar niet-academische doelgroepen en samenwerking met private partners Ten derde wordt kennisverspreiding ondersteund door cross-partnerschappen met onder meer private partijen en nationale kennisinstituten (zoals Vilans en Pharos), de inzet van marketingstrategieën en het ontwikkelen van klinische richtlijnen. Tot slot wordt kennisimplementatie gefaciliteerd door valorisatiegerichte samenwerkingen, de integratie van onderzoeksinnovaties in reguliere praktijken binnen bestaande zorgorganisaties en het verkrijgen van alternatieve financiering ter ondersteuning van de implementatie en borging

Hoofdstuk 4 verduidelijkt de geïdentificeerde strategieën om de ambiguïteit rondom de implementatie van onderzoek te verminderen. Hiermee krijgen (academische) dementieonderzoekers en Alzheimercentra handvatten om strategisch te plannen voor capaciteitsopbouw en gerichte toewijzing van middelen. Een benadering is het ontwikkelen van individuele competenties van onderzoekers, zoals co-creatie, intersectorale communicatie en projectmanagement, waarmee belemmeringen voor onderzoeksvalorisatie kunnen worden overwonnen. Een andere benadering is het aangaan en onderhouden van partnerschappen met externe implementatiepartners, zoals valorisatiecentra, samenwerkingsnetwerken en nationale kennisinstituten. Ten aanzien van middelenverdeling toont dit onderzoek de variaties in onderzoeksgebieden en beschikbare middelen tussen de vijf Alzheimercentra. Deze inzichten kunnen bijdragen aan strategische besluitvorming rond verspreiding en implementatie, zowel binnen als tussen organisaties. Tot slot suggereren de bevindingen uit hoofdstuk 4 dat onderzoeksfinanciers invloed uitoefenen op de activiteiten van (academische) onderzoekers betreffende kennisvalorisatie, wat aanleiding gaf voor het volgende empirisch onderzoek in hoofdstuk 5.

Onderzoeksvraag 3: Welke strategieën (en bijbehorende uitdagingen) hanteren publieke en private financiers om de verspreiding en implementatie van gefinancierd niet-farmacologisch dementieonderzoek te versnellen? (Hoofdstuk 5)

Hoofdstuk 5 onderzoekt de strategieën en uitdagingen van de Nederlandse publieke (bijv. ZonMw) en private (bijv. Alzheimer Nederland) financiers van dementieonderzoek met betrekking tot de verspreiding en implementatie van onderzoeksresultaten uit hun financieringsprogramma's. Hiervoor zijn semi-gestructureerde interviews afgenomen bij 20 medewerkers van deze financieringsorganisaties. Uit de data-analyse blijkt dat financiers strategieën toepassen voor verspreiding, implementatieondersteuning en capaciteitsopbouw binnen het onderzoeksecosysteem. Verspreiding en implementatie worden zowel direct als indirect ondersteund. Indirecte strategieën omvatten het beïnvloeden van verspreiding en implementatie via subsidievoorwaarden, zoals het aanbieden van theory-of-change of impact-modellen. Directe strategieën stellen financiers in staat om zonder tussenkomst van derden het beoogde resultaat te behalen, bijvoorbeeld door het ontwikkelen van mediacontent of het organiseren van outreach-evenementen. Dit onderscheid draagt bij aan conceptuele helderheid bij het selecteren van strategieën voor planning en uitvoering van verspreiding en implementatie. Tot slot richten capaciteitsopbouwstrategieën zich op de ontwikkeling van grootschalige consortia, het aanbieden van training in implementatiewetenschap en het opzetten van professionele netwerken.

Hoofdstuk 5 benoemt ook verschillende aanhoudende uitdagingen die ervaren worden door onderzoeksfinanciers. Verspreiding wordt belemmerd wanneer onderzoeksteams beschikbare kanalen (zoals nieuwsbrieven, blogs, media) onderbenutten, wat leidt tot beperkte publieke betrokkenheid. Ondersteuning van implementatie wordt beperkt door rolonduidelijkheid tussen onderzoeksteams en financiers, evenals geringe betrokkenheid van onderzoekers bij valorisatiestructuren (zoals technology transfer offices) die aan financiers zijn verbonden. Capaciteitsopbouw binnen het ecosysteem wordt belemmerd door een beperkte implementatie-infrastructuur (waaronder personele middelen voor implementatie en structurele implementatiefinanciering). Daarnaast spelen tegenstrijdige waardesystemen binnen publiek-private samenwerkingen een rol. Deze bevindingen kunnen bijdragen aan strategische planvorming bij financiers en beleidsontwikkeling gericht op innovatie en cross-sectorale samenwerking.

In het bijzonder introduceert hoofdstuk 5 het concept van het onderzoeksecosysteem om beter inzicht te krijgen in de specifieke rollen en bijdragen van publieke en private onderzoeksfinanciers. Waarden, infrastructuur en middelen vanuit beide sectoren beïnvloeden de besluitvorming en bijdragen aan de verspreiding en implementatie van niet-farmacologisch dementieonderzoek. Een voorbeeld van publiek-private samenwerking binnen implementatieonderzoek is het gebruik van co-financieringsmechanismen in onderzoeksconsortia, waarmee regelgeving wordt omzeild die anders innovatieve toepassingen kan belemmeren. De bevindingen bieden handvatten aan voor financiers bij het ontwikkelen van strategische plannen en het versterken van hun samenwerkingscapaciteit.

Hoofdstuk 6 vat de kernbevindingen van de voorgaande hoofdstukken samen en biedt een diepgaandere reflectie op de theoretische en praktische bijdragen van het voorgestelde onderzoeksecosysteem. Daarbij is de conceptuele reikwijdte van het model verder ontwikkeld door de perspectieven van (academische) dementieonderzoekers en onderzoeksfinanciers te integreren. Dit hoofdstuk gaat tevens dieper in op de verschillende fasen van de voorgestelde kennisimplementatie-funnel en verkent mogelijke benaderingen om zowel individuele als gezamenlijke implementatiecapaciteit binnen het ecosysteem te versterken. Dit proefschrift levert daarmee robuust en multidimensionaal bewijs dat bijdraagt aan de implementatie van dementieonderzoek. Door vanuit het perspectief van de implementatiewetenschap een theoretisch raamwerk voor capaciteitsopbouw te ontwikkelen, wordt een basis gelegd voor de versnelde vertaling van dementie-interventies naar de praktijk.

ABOUT THE AUTHOR

Eden Meng Zhu was born on 27th November 1996 in California, United States of America. She received a Bachelor of Science in Global Health and Social Medicine from King's College London (United Kingdom) in 2017. Following, she received a Master of Public Administration from Tsinghua University (China) in 2019, focusing on sustainable development and health policy. Her passion for global health inspired her to pursue opportunities in the World Health Organization and United Nations Development Program. In these organizations, she encountered opportunities to support with various national and international health challenges, such as the increasing need for long-term care in China and the urgent global demand for COVID-19 response. These experiences shaped her perspective and values as a professional in this field, inspiring her to develop her knowledge, training, and expertise in a PhD program.

In 2020, Eden started as a PhD candidate at Erasmus School of Health Policy & Management (Erasmus University Rotterdam), based in the Health Services Management & Organization section. She employed evidence synthesis and qualitative research methodologies to explore how using implementation science can improve the implementation of dementia research in the Netherlands. In addition to conducting research, she has also organized and led guest lectures and educational workshops, based on the research findings from her PhD project, in the USA (Stanford University), China (NYU Shanghai), Singapore (National University of Singapore), and the Netherlands (Utrecht University). She has also served as a Board member in the 'Erasmus PhD Association Rotterdam' (2021-2023) and 'Young ESHPM' (2023-2024).

PORTFOLIO

Name Eden Meng Zhu
Period July 2020 – April 2025

Peer-reviewed publications
Zhu, E.M., Buljac-Samardžić, M., Ahaus, K. *et al.* Transforming dementia research into practice: a multiple case study of academic research utilization strategies in Dutch Alzheimer Centres. *Health Res Policy Sys* 23, 3 (2025). https://doi.org/10.1186/s12961-024-01266-9
Zhu, E.M., Buljac-Samardžić, M., Ahaus, K. *et al.* Implementation and dissemination of home- and community-based interventions for informal caregivers of people living with dementia: a systematic scoping review. *Implementation Sci* 18, 60 (2023). https://doi.org/10.1186/s13012-023-01314-y
Zhu EM, Buljac-Samardžić M, Ahaus K, et al. Implementation and dissemination of home and community-based interventions for informal caregivers of people living with dementia: a systematic scoping review protocolBMJ Open 2022;12:e052324. doi: 10.1136/bmjopen-2021-052324

Publications in progress
Zhu, E.M., Buljac-Samardžić, M., Ahaus, K. et al. Bridging research and practice for dementia care: strategies and challenges of public and private funders in the dissemination and implementation of dementia research

Conferences	**Contribution**	**Year**	**Location**
European Implementation Event	Poster/Discussion	2025	Newcastle upon Tyne, United Kingdom
Alzheimer Europe	Oral presentation	2024	Geneva, Switzerland
Global Evidence Summit	Poster presentation	2024	Prague, Czech Republic
Alzheimer Association International Conference	Poster presentation	2024	Pennsylvania, USA (virtual)
Alzheimer Association International Conference	Poster presentation	2023	Amsterdam, the Netherlands
European Implementation Event	Poster presentation	2023	Basel, Switzerland
5th UK Implementation Science Research Conference	Poster presentation	2022	London, United Kingdom
4th UK Implementation Science Research Conference	Poster presentation	2021	London, United Kingdom

Additional activities	Contribution	Year	Location
Guest speaker at NYU Shanghai	Seminar	2024	Shanghai, China
Guest lecturer at UMC Utrecht	Lecture	2024	Utrecht, the Netherlands
Implementation science workshop	Workshop (oral presentation)	2024	Utrecht, the Netherlands
Guest speaker at Stanford University School of Medicine	Seminar	2024	California, USA
Implementation science workshop and webinar at NUS Yong Loo Lin School of Medicine	Workshop/webinar	2024	Singapore
yESHPM	Board member	2022 – 2023	Rotterdam, the Netherlands
Erasmus PhD Association Rotterdam (EPAR)	Board member	2020 - 2022	Rotterdam, the Netherlands

Courses	Institute
Implementation Science in Global Health 2024	UMC Utrecht
Shut up and write	ISS
Self-presentation	ISS
Making your research proposal work for you	ISS
How to finish you PhD in time	ESHPM-EGS
Searching, finding, and managing your literature	ISS
Brush up your research design	ISS

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