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ORIGINAL RESEARCH ARTICLE

Comparing Different Implementation Strategies for Collaborative Dementia Care Management in Terms of Patients' Characteristics, Unmet Needs, and the Impact on Quality of Life and Costs in Germany

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Abstract

Objective To compare the implementation of collaborative dementia care management (cDCM) across two settings regarding patients' characteristics, unmet needs, and the impact on health-related quality of life (HRQoL) and costs.

Methods This analysis was based on data from the DCM:IMPact study, implementing cDCM in a physician network ($n = 22$ practices) and two day care centers (DCC) for community-dwelling persons with dementia over 6 months in Germany. Participants completed comprehensive assessments at baseline and 6 months after, soliciting sociodemographic and clinical characteristics, unmet needs, HRQoL and healthcare resource utilization. Patient characteristics and unmet needs were analyzed descriptively, and the impact of cDCM on costs and HRQoL was assessed using multivariable regression models.

Results At baseline, patients from the physician network ($n = 46$) exhibited more pronounced neuropsychiatric symptoms (NPI mean score 14 versus 10, $p = 0.075$), were more frequently diagnosed with dementia (76% versus 56%, $p = 0.040$), were less likely assigned a care level by the long-term care insurance (63% versus 91%, $p \leq 0.001$) to access formal care services and had more unmet needs (12.8 versus 11.0, $p \leq 0.001$), especially for social care services than DCC patients ($n = 57$). After 6 months, the adjusted means indicated that cDCM implemented in the physician network was more effective [EQ-5D-5L utility score; 0.061; 95% confidence interval (CI) − 0.032 to 0.153] and less costly (− 5950€; 95% CI − 8415€ to − 3485€) than cDCM implemented in DCC.

Conclusions Patients and the healthcare system may benefit more when cDCM is implemented in physician networks. However, patient characteristics indicated two samples with specific conditions and various unmet needs using different ways of accessing healthcare, demonstrating the need for cDCM in both settings, which must be considered when implementing cDCM to integrate the respective sectors efficiently.

Trial Registration German Clinical Trials Register: DRKS00025074. Registered 16 April 2021—retrospectively registered.

1 Introduction

The increasing prevalence of persons living with dementia (PwD) and the associated economic burden challenge healthcare systems globally. Current estimations assume the number of PwD will rise to 153 million worldwide by 2050, while the costs could increase to US$2 trillion by the end of the current decade [1–3]. The latest figures for Germany indicate a forecasted increase from 1.8 million PwD in 2021 to 3.0 million by 2070 [4, 5].

General practitioners (GPs) have been the initial contact persons on the patient's journey. They are responsible for early diagnosis necessary for access to dementia-specific postdiagnostic treatment. However, previous studies already addressed the underdiagnosing of dementia in primary care and its consequences, demonstrating that only 30% and 36% of PwD received recommended and evidence-based dementia-specific medication with antidementia drugs and non-drug treatments, respectively [6–10]. Additionally, studies revealed that almost all PwD and caregivers show unmet healthcare needs, which are, in turn, associated with poor

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Key Points for Decision Makers

Patients from the physician network who received collaborative dementia care management had more pronounced clinically relevant neuropsychiatric symptoms and the highest number of unmet needs but limited access to social and nursing care services.

Despite their direct access to professional nursing care, patients in day care centers also had many identified unmet needs, particularly for medical care, underlining the need in both settings.

Patients who received collaborative dementia care management as an additional healthcare service in the physician network achieved a higher quality of life at lower costs than those who received the intervention in day care centers, supporting the more significant benefit of implementation in physician-based settings.

health outcomes [11]. Several countries introduced strategies and guidelines to improve timely diagnosis and post-diagnostic support e.g., the German government developed a National Dementia Strategy (NDS), underlining dementia as a health priority [12, 13].

The German NDS aims to improve the support for PwD and their relatives by implementing collaborative dementia care management (cDCM) into routine care to overcome the challenges of timely formal diagnosis with guideline-related post-diagnostic support, treatment, and care [12]. This development was accompanied by adoption of cDCM into the nation's S-3 (i.e., highest methodological quality for elaborated consensual recommendations) guidelines for dementia [14]. cDCM is a nonpharmacological intervention provided in the community by dementia-specific qualified nurses who coordinate the treatment and care for PwD and meet their individual needs according to evidence-based guidelines following the DelpHi-Standard [15], which has been proven to be effective, safe, and cost-effective compared to usual care in the DelpHi-MV trial [16–19]. Particularly, PwD living alone and those with high comorbidity benefited most from improved health-related quality of life (HRQoL), lower hospitalizations, and delayed institutionalizations [16, 20].

However, these findings refer to a specific study population and an artificial setting, limiting the results' generalizability. Little is known about the setting with the highest need and best implementability, represented by the highest effectiveness for patients. Additionally, the high degree of organizational fragmentation within (e.g., primary versus secondary care) and between (e.g., medical versus nursing care) healthcare sectors results in different legal and regulatory systems for the provision of health services and their financing, which also leads to the question of which payer (health versus long-term care insurance) reimburses the costs [21]. Hence, a direct comparison of cDCM between settings, such as physician networks including both GPs and specialists or formal care settings, such as ambulatory care or day care, allows the assessment of relative advantage and to determine the differences in the added value, which convey relevant information for health policy decision-making when allocating limited resources.

Past interventions in adult day care centers (DCC) mainly target clinical parameters, such as neuropsychiatric symptoms or caregiver burden, while unmet needs beyond medical needs, such as social integration and legal support, are less considered, underlining the potential for positive effects of cDCM in this setting [22–24]. A previous literature review revealed a lack of specific interventions in DCC targeting various patients, including PwD [25]. PwD attending DCC are characterized by multimorbidity and polypharmacy, and thus the risk of potentially inappropriate medication leading to increased hospitalizations, which indicates the high potential for optimization through collaborative dementia care [26–28]. Additionally, PwD often prefer to live as long as possible in familiar environments. Previous publications have shown inconsistent results regarding the potential for delayed institutionalization through DCC, but cDCM as an additional health service could enhance this potential [29]. Moreover, findings of a German trial investigating a multi-component non-pharmacological intervention in DCC for PwD suggested benefits to the patients and cost-effectiveness for payers compared with usual day care [30, 31].

Therefore, the objective of the present analysis was to compare the implementation strategy of cDCM in a physician network and DCC in terms of enrolled patients' clinical characteristics, unmet needs, as well as the impact of cDCM on health-related quality of life over time and healthcare resource use and costs (cost-effectiveness).

2 Methods

2.1 Study Design

This analysis was based on data from the ongoing multi-center implementation study Dementia Care Management: Implementation into different Care Settings (DCM:IMPact), which aims to translate the proven effective and cost-effective DelpHi-Intervention into various healthcare settings (e.g., physician networks, day care, or community health center) from different sectors to identify the setting with the highest needs, lowest implementation barriers and best achievable effects to subsequently foster a large scale, sustainable, and cross-sectoral translation of cDCM [15, 32]. The cDCM intervention is conducted by dementia-specific qualified nurses (dementia care manager) and was developed and evaluated within the DelpHi-MV trial [15, 17]. The detailed study design and intervention have been described elsewhere [17]. The intervention implementation costs are described in Supplementary Table 1.

The implementation is based on the framework of Mendel et al. [33], which focuses on the dissemination and implementation of interventions in mental health services research, starting the dissemination process with contextual factors, such as structures, resources, and policies that should be reflected in the actual implementation process. The subsequent outcome evaluation should produce the need for adjustment on the intervention level and influence the contextual factors, with the latter in particular determining the most crucial aspect of dissemination. Accordingly, the DCM:IMPact study follows two steps: the individual settings are first examined separately (medical versus nursing care), and on the basis of these findings, cDCM will be enhanced to a cross-sectoral approach to overcome the challenges arising from German healthcare's legal, organizational, and financial fragmentation as contextual factors [33].

So far, one physician network (comprising $n = 22$ participating practices), representing medical care funded by health insurances and two day care facilities, representing nursing care funded by long-term care insurances, were completed in 2023. The participating healthcare providers were located in a rural area in north-eastern Germany. Each setting employed one dementia care manager. In total, $n = 136$ eligible patients met the following criteria: aged ≥ 70 years old, living at home, DemTect < 9 [34], or formal dementia diagnoses according to the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) [35], were informed about the study by the respective healthcare professionals, and provided informed consent approved by the ethical committee of the Chamber of Physicians of Mecklenburg-Western Pomerania—registry number: BB01/2019.

A comprehensive, standardized, computer-assisted face-to-face interview was conducted by the respective dementia care manager at the participants' homes at baseline (t_0) and 6 months after (t_1), and was completed by $n = 100$ PwD. Patients who dropped out of the study were statistically significantly less likely to enroll in DCC [odds ratio (OR) = 0.06; 95% confidence interval (CI) 0.01–0.26; $p < 0.001$) and were less likely to have received a formal dementia diagnosis (OR = 0.20; 95% CI 0.07–0.58; $p = 0.003$). A detailed drop-out analysis is shown in Supplementary Table 2.

2.2 Data

2.2.1 Sociodemographic and Clinical Characteristics

The following demographic data and clinical variables were assessed: age, sex, living situation, cognitive impairment according to the mini-mental state examination (MMSE) [36]; deficits in daily living activities according to the Bayer activities of daily living scale (B-ADL) [37]; depressive symptoms according to the geriatric depression scale (GDS) [38]; behavioral and psychological symptoms according to the neuropsychiatric inventory (NPI) [39], dementia diagnoses according to the ICD-10 diagnoses listed in the GP files, and the care level, assigned by the long-term care insurance for the amount of care and support a patient receives owing to their functional impairment, ranging from 1 to 5, with 1 indicating some problems and 5 indicating extreme problems.

2.2.2 Unmet Needs

As part of the DelpHi-Intervention, an algorithm-based intervention management system (IMS) was developed and embedded in the computer-assisted interview, tested, and evaluated following current dementia-specific guidelines to support the systematic identification of unmet needs [40]. The IMS is an expert decision support system operating on rule-based principles, aligning the unique attributes of PwD to a computerized knowledge base comprising validated questionnaires, tests, and tailored inquiries [11, 40]. An unmet need was either (1) recognized automatically by the IMS and checked for plausibility or (2) added manually by the dementia care manager following the principles of not having double-established services and not violating patients' autonomy [11, 40].

Unmet needs were assigned to the following domains: (1) nursing treatment and care, (2) social counselling and legal support, (3) pharmaceutical treatment and care, (4) social integration and participation, (5) medical diagnosis and treatment, (6) special therapies, (7) others, and (8) caregiver support and education [11, 40]. The domain "others" contains specific needs that the DCM identified without matching the other predefined domains, such as participation in rehabilitation programs [11, 40]. The respective unmet needs were assessed dichotomously (present versus absent) and totaled for each domain, resulting in a count variable. An overview of the questionnaires used and the detailed technical structure of the IMS are published elsewhere [40].

2.2.3 Health-Related Quality of Life

HRQoL was assessed by using the EQ-5D-5L [41, 42] as self- and, if available, as proxy ratings by participating family caregivers. The widely-used EQ-5D-5L is a generic, preference-based, multidimensional instrument with five dimensions (mobility, self-care, pain/discomfort, usual activities, and anxiety/depression) and five levels (no, slight, moderate, severe, and extreme problems) accompanied by a thermometer-like visual analog scale (EQ-VAS) anchored by 0 (worst health) and 100 (best health) to assess health status at the time of assessment [41, 42]. The EQ-5D-5L responses were converted to health utility values using the German value set, anchored at 0 for death and 1 for full health [43]. Additionally, each of the mentioned dimensions was dichotomized (no versus any problem) to differentiate the problems experienced by patients in the physician network and DCC at baseline.

2.2.4 Health Resource Use and Costs

A prevalence-based bottom-up approach was used to first determine the extent of utilization of health resources and then to calculate the costs [44]. Health resource use was assessed retrospectively using the FIMA questionnaire [45] tailored to elderly individuals in the German healthcare system at baseline and 6 months after. Caregiver proxy ratings were captured to improve data validity, precision, and replacement in case of lacking plausibility or feasibility owing to advanced cognitive impairment. Detailed information about frequencies (number of visits, days stayed) or quantities of used medical (physician consultations, in-hospital care, drugs, aids, therapies) and formal care services (ambulatory care, day, and night care) were recorded. Healthcare costs were calculated from the payers perspective by using published standardized unit costs [inflated to 2022 and calculated in euros (€)] [46–48]. Informal care provided by patients' informal caregivers was not included in this analysis. Supplementary Table 3 summarizes detailed information about the monetary valuation of the utilized services.

2.3 Statistical Analysis

Missing data was imputed using multiple imputations by chained equations (mice) separately for the respective healthcare setting. Only data from patients who received the intervention were imputed. Study participants sociodemographic and clinical characteristics, unmet needs, health resource use and costs, and HRQoL were presented using descriptive statistics. *T* tests (metric variables), Fisher exact tests (dichotomous variable), and Chi-square tests (categorical variable, > 2 conditions) were used to test for group differences between the settings (physician network versus DCC). In addition, dependent-sample *t*-tests were conducted for the unadjusted HRQoL and health resource utilization to examine changes within each setting over time.

The incremental cost-effectiveness ratio (ICER) was calculated using the incremental cost per utility value on the basis of the EQ-5D-L gained to directly compare the respective settings cost-effectiveness. A total of $N = 3$ patients who had a health utility of zero died, and thus incurred no costs since the date of death. Healthcare costs and utility scores at follow-up were used as dependent variables, and the healthcare setting was used as a predictor of interest to predict the ICER. Multiple regression models were controlled for age, sex, living situation, and the respective value for healthcare costs (e.g., medication costs, therapy costs, or total costs) or utility scores at baseline. To handle sampling uncertainty in the ICER, nonparametric bootstrapping with 1000 resamples stratified for setting distribution was used to create the cost-effectiveness plane. For sensitivity analyses, quality-adjusted life-years (QALYs) based on the utility values for dyads [patients and participating caregivers (proxies)] were calculated, and cognitive impairment, according to the MMSE and functional impairment represented by the assigned care level through the long-term care insurance (dichotomous: no care level versus any care level) were considered.

Data analyses were on the basis of participants who completed the baseline and follow-up assessment or died after baseline. All statistical analyses were conducted with STATA/IC software, version 16 [49].

3 Results

3.1 Patient Characteristics at Baseline

Table 1 summarizes the participants characteristics at baseline. Patients from the physician network exhibited more clinically relevant neuropsychiatric symptoms (NPI mean score 14 versus 10, $p = 0.075$), were more frequently formally diagnosed with dementia (76% versus 56%, $p = 0.040$), but were less likely to have been assigned a care level by the long-term care insurance (63% versus 91%, $p \leq 0.001$) compared with patients from DCC. Although there were no differences in the average MMSE between both groups (18.5 versus 18.4, $p = 0.925$), patients enrolled in the physician network tended to have milder levels of cognitive impairment according to the MMSE (no indication of dementia: 7% versus 9%; mild: 46% versus 26%; moderate: 35% versus 60%; severe: 13% versus 5%; $p = 0.048$) than patients from DCC. There were no differences in depressive symptoms and functional impairment.

3.2 Unmet Healthcare Needs at Baseline

Table 2 represents the number of unmet needs across the domains and subcategories for each setting. Patients

Table 1 Patient characteristics at baseline

	Physician network (*n* = 46)		Day care (*n* = 57)		*p* value
Demographics					
Age (years), mean (SD)	79.9	(6.9)	80.2	(7.9)	*0.869*[a]
Sex (female), *n* (%)	29	(63.0)	34	(59.7)	*0.839*[b]
Caregiver available, *n* (%)	43	(93.5)	56	(98.3)	*0.322*[b]
Living alone, *n* (%)	16	(34.8)	28	(49.1)	*0.165*[b]
Clinical characteristics					
Cognitive status (MMSE), mean (SD)	18.5	(6.4)	18.4	(5.4)	*0.925*[a]
No indication of dementia, *n* (%)	3	(6.5)	5	(8.8)	***0.048***[c]
Mild dementia, *n* (%)	21	(45.7)	15	(26.3)	
Moderate dementia, *n* (%)	16	(34.8)	34	(59.7)	
Severe dementia, *n* (%)	6	(13.0)	3	(5.3)	
Formal diagnosis of dementia, *n* (%)	35	(76.1)	32	(56.1)	***0.040***[b]
Depression (GDS), mean (SD)	3.3	(2.7)	3.3	(2.5)	*0.995*[a]
Neuropsychiatric symptoms (NPI), mean (SD)	13.6	(12.6)	9.6	(9.5)	*0.075*[a]
Functional impairment (BADL), mean (SD)	3.4	(1.7)	3.9	(2.1)	*0.142*[a]
Any care level, *n* (%)	29	(63.0)	53	(93.0)	≤ ***0.001***[b]
No care level, *n* (%)	17	(37.0)	5	(7.02)	≤ ***0.001***[c]
Care level: 1, *n* (%)	5	(10.9)	1	(1.8)	
2, *n* (%)	10	(21.7)	13	(22.8)	
3, *n* (%)	10	(21.7)	27	(47.4)	
4, *n* (%)	4	(8.70)	11	(19.3)	
5, *n* (%)	0	(0.00)	1	(1.75)	

B- Values in bold indicate $p < 0.05$

ADL Bayer-activities of daily living scale, range 0–10, lower score indicates better performance; *GDS* geriatric depression scale, sum score 0–15, score ≥ 6 indicates depression; *ICD* International Statistical Classification of Diseases and Related Health Problems; *MMSE* mini-mental state examination, range 0–30, higher score indicates better cognitive function; *NPI* neuropsychiatric inventory, score of ≥ 5 indicates clinically relevant symptoms; *SD* standard deviation

[a] Differences in means: *T* test two-tailed

[b] Differences in proportions: Fisher's exact tests

[c] Chi-square tests

from the physician network had more unmet needs than DCC patients (12.8 versus 11.0, $p \leq 0.001$), which was attributed to the domains of nursing treatment and care (4.8 versus 3.5, $p \leq 0.001$), social counselling and legal support (2.2 versus 1.6, $p \leq 0.001$), and social integration (3.3 versus 2.6, $p \leq 0.001$). However, they had fewer pharmaceutical treatment needs (0.7 versus 1.2, $p = 0.018$) owing to lower demand for updated medication plans (9% versus 51%, $p \leq 0.001$), a less frequent need for a formal dementia diagnosis (17% versus 46%, $p = 0.003$), and less special therapy needs, such as geriatric rehabilitation (0.3 versus 0.5, $p = 0.032$), than DCC patients. Additionally, caregivers of DCC patients needed caregiver training and education significantly more often (3% versus 27%, $p \leq 0.001$).

3.3 Impact of cDCM on Health-Related Quality of Life

About 7.8% of the data were missing, primarily for DCC patients and imputed applying the mice approach. At baseline, patients from the physicians network reported a lower HRQoL than DCC patients (EQ-5D-5L, 0.610 versus 0.768, $p \leq 0.001$ and EQ-VAS, 55.2 versus 63.7, $p = 0.020$). Differences at baseline could be traced back to the perceived impairment: patients enrolled in the physicians network were less likely to report problems with self-care (46% versus 75%, $p = 0.004$) and usual activities (50% versus 79%, $p = 0.003$), but more likely to report problems in the dimensions of pain (76% versus 52%, $p = 0.014$) and anxiety/depression (50% versus 32%, $p = 0.073$). At 6 months after baseline,

Table 2 Unmet needs of patients with dementia in a physician network and in day care centers

	Physician network ($n = 46$)	Day care ($n = 57$)	p value
Total, mean (SD)	12.8 (2.6)	11.0 (2.8)	**≤ 0.001**[a]
Nursing treatment and care, mean (SD)	4.8 (1.6)	3.5 (1.5)	**≤ 0.001**[a]
Mobility limitation/risk of fall, *n* (%)	27 (58.7)	29 (50.9)	0.551[b]
Nursing care, *n* (%)	36 (78.3)	34 (59.7)	0.057[b]
Nursing care insurance, *n* (%)	15 (32.6)	18 (31.6)	1.000[b]
Visual /hearing impairment, *n* (%)	14 (30.4)	15 (26.3)	0.665[b]
Pain, *n* (%)	3 (6.5)	2 (3.5)	0.654[b]
Incontinence, *n* (%)	16 (34.8)	12 (21.1)	0.127[b]
Nutritional disorder, *n* (%)	7 (15.2)	2 (3.5)	0.074[b]
Non-pharmacological therapy, *n* (%)	46 (100)	57 (100)	1.000[b]
Foot treatment, *n* (%)	0 (0.0)	1 (1.8)	1.000[b]
Social counseling and legal support, mean (SD)	2.2 (1.0)	1.6 (0.7)	**≤ 0.001**[a]
Power of attorney/legal representative, *n* (%)	15 (32.6)	5 (8.8)	**0.005**[b]
Patient decree, *n* (%)	15 (32.6)	19 (33.3)	1.000[b]
Emergency card for hospital, *n* (%)	22 (47.8)	10 (17.5)	**≤ 0.001**[b]
Identity card for the disabled, *n* (%)	46 (100)	57 (100)	1.000[b]
Pharmaceutical treatment and care, mean (SD)	0.7 (0.9)	1.2 (1.0)	**0.018**[a]
Storage of drugs/drug dispenser, *n* (%)	16 (34.8)	15 (26.3)	0.392[b]
Issue of up-to-date medication plan, *n* (%)	4 (8.7)	29 (50.9)	**≤ 0.001**[b]
Preparation/administering medication, *n* (%)	1 (2.2)	0 (0.0)	0.447[b]
Indication/dose check for substance, *n* (%)	7 (15.2)	16 (28.1)	0.155[b]
Social integration, mean (SD)	3.3 (1.0)	2.6 (0.5)	**≤ 0.001**[a]
Physical activity, *n* (%)	19 (41.3)	32 (56.1)	0.167[b]
Social support/social activities, *n* (%)	46 (100)	57 (100)	1.000[b]
Care aids, *n* (%)	46 (100)	57 (100)	1.000[b]
Medical diagnosis and treatment, mean (SD)	1.2 (1.0)	1.4 (1.0)	0.529[a]
Referral to specialist, *n* (%)	17 (37.0)	14 (24.6)	0.199[b]
In-depth information about dementia, *n* (%)	29 (63.0)	37 (64.9)	1.000[b]
Diagnosis of dementia, *n* (%)	8 (17.4)	26 (45.6)	**0.003**[b]
Special therapies (Geriatric rehabilitation), mean (SD)	0.3 (0.5)	0.5 (0.5)	**0.032**[a]
Others, mean (SD)	0.2 (0.4)	0.2 (0.4)	0.732[a]
Caregiver related unmet needs, mean (SD)	0.5 (0.5)	0.5 (0.8)	0.998[a]
In-depth information about dementia, *n* (%)	13 (30.2)	7 (12.5)	0.043[b]
Mental health and safety consulting, *n* (%)	11 (25.6)	9 (16.1)	0.253[b]
Caregiver training, *n* (%)	1 (2.5)	15 (26.8)	**≤ 0.001**[b]

Values in bold indicate $p < 0.05$

SD standard deviation

[a] Differences in means: *T* test two-tailed

[b] Differences in proportions: Fisher's exact tests

the values converged (EQ-5D-5L 0.768 versus 0.760, $p = 0.854$ and EQ-VAS, 58.6 versus 62.1, $p = 0.0379$) with an increase of HRQoL in physician network patients and a slight decrease of HRQoL in DCC patients. Considering the proxy values, family caregivers stated a lower HRQoL than patients. EQ-5D-5L proxy values significantly differ at baseline (0.485 versus 0.682, $p \leq 0.001$), but both indicated a decrease 6 months later (0.475 versus 0.586, $p = 0.047$). Findings for the health-related quality of life are reported in Table 3. The problems experienced by patients from the respective setting for each domain are summarized in Supplementary Table 4.

3.4 Impact of cDCM on Health Resource Use and Costs

Overall, 8.7% of the data were missing, again primarily for DCC patients, and imputed using mice. At baseline, health resource use was comparable for both groups, except that patients enrolled in the physician network tended to have more physician consultations (9 versus 7, $p = 0.088$) and fewer days in day or night care facilities (10 versus 41, $p \leq 0.001$) than DCC patients. However, 6 months after baseline, physician network patients had statistically significantly fewer medical aids (4.2 versus 5.1, $p = 0.032$), therapy visits (17 versus 36, $p \leq 0.001$), days spent in day or night care facilities (10 versus 66, $p \leq 0.001$), and ambulatory care services visits (24 versus 47, $p = 0.012$) compared with DCC patients. Differences between and within settings over time are summarized in Table 4 and Supplementary Table 5.

3.5 Cost-Effectiveness

Patients from the physician network had a higher HRQoL (adjusted means: 0.797 versus 0.736, $p = 0.195$) and lower health care cost (adjusted means: 7292€ versus 13,242€, $p \leq 0.001$) after 6 months than DCC patients. The statistically significant differences in healthcare costs were attributed to the medical care costs (adjusted means: 5386€ versus 7437€, $p = 0.034$), in particular for medical aids and therapies as well as formal care costs (adjusted means: 1519€ versus 5178€, $p \leq 0.001$), in particular for day or night care and ambulatory care services.

Overall incremental health care costs of −5950€ (95% CI −8415€ to −3485€) and utility scores according to the EQ-5D-5L of 0.061 (95% CI − 0.032 to 0.153) resulted in an ICER of − 97.541€/utility scores gained, indicating that cDCM implementation in the physician network was likely to be more effective and less costly, thus dominating the implementation in DCC.

In the sensitivity analysis, considering the differences in patient characteristics at baseline regarding cognitive and functional impairment both, costs and effects remained stable. However, the analysis of proxy-reported QALYs revealed a reverse effect of cDCM implementation in DCC by 0.011 (− 0.041 to 0.063) gained QALYs compared with

Table 3 Effect of collaborative dementia care management on health-related quality of life of patients with dementia in a physician network and in day care centers

	Baseline			Follow up		
	Physician network	Day care	*p* value[a]	Physician network, *n* = 46	Day care, *n* = 57	*p* value[a]
Patients, *n* = 103	***n* = 46**	***n* = 57**		***n* = 46**	***n* = 57**	
EQ-5D-5L, mean (SD)	0.610 (0.290)	0.768 (0.177)	≤ **0.001**	0.768 (0.256)	0.760 (0.228)	0.854
EQ-VAS, mean (SD)	55.20 (17.93)	63.71 (18.40)	**0.020**	58.59 (19.11)	62.12 (20.93)	0.379
Proxy, *n* = 99	*n* = 43	*n* = 56		*n* = 43	*n* = 56	
EQ-5D-5L, mean (SD)	0.485 (0.35)	0.682 (0.171)	**0.004**	0.475 (0.333)	0.586 (0.216)	**0.047**
EQ-VAS, mean (SD)	51.87 (18.34)	52.34 (18.19)	0.899	43.06 (18.41)	46.99 (20.10)	0.320

SD standard deviation; *EQ-VAS* visual analog scale range 0–100, higher score indicates better quality of life

[a] Differences in means: *T* test two-tailed

Table 4 Healthcare resource utilization of patients with dementia in a physician network and in day care centers

Healthcare resource use, mean (SD)	Baseline			Follow up		
	Physician network, *n* = 46	Day care, *n* = 57	*p* value[a]	Physician network, *n* = 46	Day care, *n* = 57	*p* value[a]
Medical treatments						
Physician, visits	8.6 (5.8)	6.9 (4.5)	0.088	5.2 (3.5)	5.7 (6.2)	0.621
In-hospital, days	4.0 (6.8)	2.4 (5.5)	0.192	2.0 (5.0)	1.7 (4.3)	0.699
Medications, number	9.4 (4.5)	9 (4.1)	0.628	8.8 (4.0)	9.0 (4.1)	0.863
Medical aids, number	4.2 (1.9)	4.7 (2.3)	0.272	4.2 (2.0)	5.1 (2.1)	**0.032**
Therapies, visits	15.1 (20.0)	17.8 (24.6)	0.550	16.7 (22.8)	35.7 (29.7)	**≤ 0.001**
Formal care						
Day/night care, days	10.1 (24.8)	41.2 (40.3)	**≤ 0.001**	10.1 (20.9)	65.8 (48.1)	**≤ 0.001**
Ambulatory care, visits	21.3 (26.1)	28.5 (28.9)	0.194	23.5 (25.7)	46.8 (57.4)	**0.012**

SD standard deviation

[a] Differences in means: *T* test two-tailed

the cDCD implemented in the physician network. Table 5 provides the unadjusted and adjusted means for healthcare costs and HRQoL over both groups. Supplementary Table 6 summarizes the results of the sensitivity analyses. The cost-effectiveness plane is presented in Fig. 1.

4 Discussion

The present study provides substantial evidence about setting-specific variations in patient characteristics, unmet needs, and the impact of cDCM on HRQoL and healthcare costs, demonstrating that cDCM implemented in the physician network was more likely to be cost-effective owing to an utility score improvement and cost reduction compared with cDCM provided in the DCC. The findings further identified two groups of patients with specific characteristics, unmet needs, and access to healthcare complementing each other. Those enrolled in the physician network had relatively mild cognitive impairment, an increased rate of formal dementia diagnoses, more pronounced clinically relevant neuropsychiatric symptoms and tended to have an increased need for social care services. In contrast, DCC patients showed a higher need for medical care but already increased HRQoL at baseline.

The analyses of patient characteristics suggested that there are two different samples with specific conditions that use different ways of accessing the healthcare system. Physician network patients tended to be rather mildly cognitively impaired, were less likely to have problems with

Table 5 Unadjusted and adjusted mean cost and effects of collaborative dementia care management for patients with dementia in a physician network and in day care centers

Costs in Euros [€]	Unadjusted mean			Adjusted mean[a]		
	Physician network Mean (SE) [95% CI]	Day care Mean (SE) [95% CI]	Difference Mean (SE) [95% CI]	Physician network Mean (SE) [95% CI]	Day care Mean (SE) [95% CI]	Difference Mean (SE) [95% CI]
Total healthcare cost	**6719 (712) [5285–8153]**	**12,764 (988) [10,786–14,743]**	**−6046 (1273) [−8570 to −3521]**	**6772 (917) [4951–8592]**	**12,722 (823) [11,089–14,355]**	**−5950 (1242) [−8415 to −3485]**
Medical treatments	**5604 (656) [4283–6925]**	**7260 (693) [5872–8648]**	**−1656 (971) [−3582 to 270]**	**5386 (703) [3990–6781]**	**7437 (630) [6186–8687]**	**−2051 (956) [−3948 to −154]**
Physician treatments	283 (33) [216–350]	369 (64) [240–498]	−86 (78) [−240 to 68]	261 (55) [152–370]	386 (49) [288–484]	− 125 (7) −273 to 23]
In-hospital treatments	1118 (485) [141–2095]	1643 (591) [458–2828]	−525 (790) [−2092 to 1042]	1039 (596) [−143 to 2222]	1707 (534) [648–2765]	−667 (811) [−2276 to 942]
Medications	2238 (151) [1935–2542]	2273 (137) [1999–2548]	−35 (204) [−439 to 369]	2212 (84) [2045–2379]	2294 (76) [2144–2444]	−82 (114) [−308 to 144]
Medical aids	1327 (91) [1144–1511]	1608 (90) [1429–1788]	−281 (129) [−537 to −25]	1365 (67) [1232–1498]	1578 (60) [1458–1697]	−212 (91) [−393 to −32]
Therapies	638 (129) [378–898]	1367 (151) [1065–1669]	−729 (204) [−1133 to −324]	658 (136) [388–929]	1351 (122) [1108–1593]	−692 (184) [−1059 to −326]
Formal care	**1115 (213) [685–1544]**	**5504 (542) [4418–6591]**	**−4390 (634) [−5647 to −3132]**	**1519 (464) [599–2440]**	**5178 (411) [4362–5993]**	**−3658 (658) [−4964 to −2353]**
Day/night care	609 (197) [213–1005]	4498 (527) [3442–5553]	−3889 (613) [−5105 to −2673]	992 (457) [85–1899]	4188 (405) [3385–4992]	-3196 (650) [−4486–-1907]
Ambulatory care	506 (81) [342–670]	1007 (164) [679–1334]	−501 (196) [−890 to −111]	509 (142) [227–792]	1004 (128) [751–1257]	−495 (193) [−877 to −113]
Cost for intervention (cDCM)	520	520	0	520	520	0
Total costs (incl. intervention costs)	**7239 (4829) [5805–8673]**	**13,284 (988) [11,306–15,263]**	**−6046 (1273) [−8570 to −3521]**	**7292 (917) [5471–9112]**	**13,242 (823) [11,609–14,875]**	**−5950 (1242) [−8415 to −3485]**
Utility score (EQ-5D-5L)	**0.768 (0.038) [0.692–0.844]**	**0.760 (0.030) [0.699–0.820]**	**0.009 (0.048) [−0.086 to 0.104]**	**0.797 (0.034) [0.730–0.864]**	**0.736 (0.030) [0.677–0.796]**	**0.061 (0.046) [−0.032 to 0.153]**
	Incremental cost per unit gained		**Physician network dominates**	**Incremental cost per unit gained**		**Physician network dominates**

Bold values indicate only the summed cost categories or utility score visually. The significance can be read from the 95% CI.

CI confidence interval; *SE* standard error

[a] Multiple regression models adjusted for age, sex, and living situation and health care costs (i.e., cost component) or EQ-5D-5L at baseline were applied to calculate adjusted means

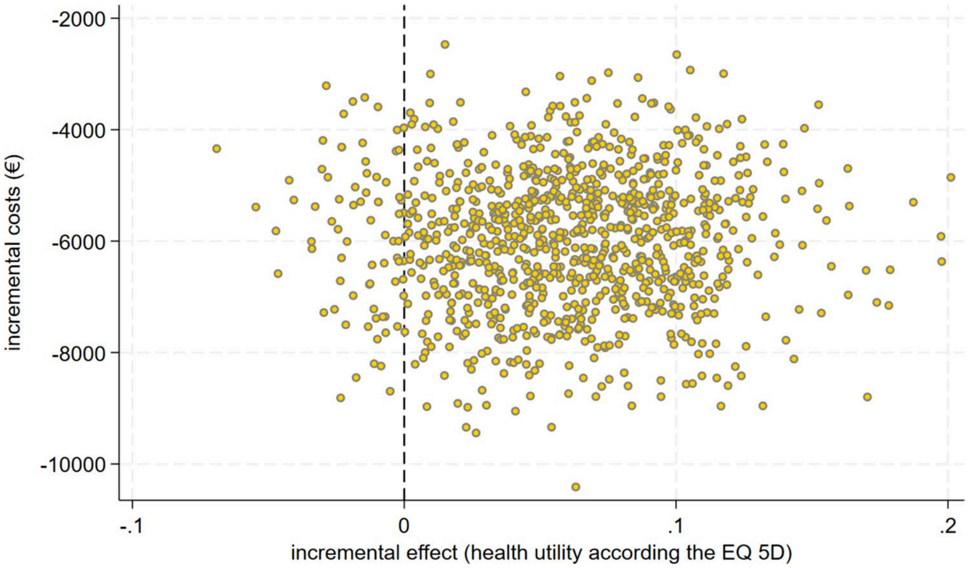

Fig. 1 Incremental cost-effectiveness plane comparing collaborative dementia care management between physician network and day care centers. Estimates are based on regression analyses of incremental costs and effects within 1000 bootstrap sample replications of the initial sample stratified for physician network and day care center patients

self-care and usual activities but more likely to have pain, showed more clinically relevant behavioral and psychological symptoms, such as anxiety and depression, and had limited access to formal care services compared with DCC patients, which could be an indication of an earlier stage of dementia disease. Thyrian et al. [18] pointed out the potential for cDCM in a general practitioner-based setting, demonstrating the effectiveness of reducing neuropsychiatric symptoms in patients with mild cognitive impairment. Furthermore, the more pronounced behavioral and psychological symptoms already present at baseline for patients enrolled in the physician network could suggest that neuropsychiatric symptoms in more progressed patients in DCC could already be relieved by using day care services, giving patients a guided daily routine and giving caregivers time to relax, as demonstrated by Mossello et al. [50]. However, the share of patients in need of care using DCC remains low at 5.6%, which underlines that only a few patients benefit from this access and should be expanded [51]. Therefore, implemented cDCM in primary care physician settings is more likely to reach early-stage dementia patients, initiate and promote access to formal care services, such as day care for suitable patients, and reduce neuropsychiatric symptoms as early as possible in the patient's journey.

A detailed look at the unmet needs also shows that both groups complement each other. Patients from physician networks had improved access to medical services but showed more unmet nursing care, social counselling, legal support, and social integration needs, consequently aligning with Eichler et al. [11]. In contrast, DCC patients already had access to formal care services owing to their level of care but showed significantly higher demand for updated medication plans and the need for a formal dementia diagnosis. The present analysis revealed that patients from physician networks DCC had on average 13 and 11 unmet needs, respectively. This number of unmet needs was significantly higher than in the study by Eichler et al. [11] (on average, nine unmet needs) that used the same instrument but in a less cognitively impaired sample. Overall, the present analysis shows that the number of detected unmet needs was high in both groups, demonstrating the need for cDCM in both settings. These findings should be considered in a targeted implementation to reach patients and their needs, which may be missed when cDCM is introduced in a particular setting to realize the potential of integrated care through cDCM.

Nevertheless, according to the cost-effectiveness analysis, cDCM implemented in the physician network dominated the DCC implementation, achieving incremental HRQoL of 0.061 and cost savings of 5950€, mainly caused by expanded use of medical aids, other therapies, such as occupational therapy, and formal care services by DCC patients. The sensitivity analysis confirms the superiority of cDCM implemented in physician networks except for proxy ratings. The difference in costs could be attributed to better access to social and nursing care services owing to the already existing care level in DCC patients, enabling patients to utilize additional care services that increase healthcare costs without improving HRQoL. The cDCM aims to coordinate the care needed within the existing healthcare structures by recommending and supplying available healthcare services to the patients on the basis of previously identified unmet needs and cooperating with the treating GPs owing to their gatekeeping function to approve additional healthcare services [15]. While costs in DCC are already increasing in the short term, positive effects of the extended use of health services described above on HRQoL could not be observed, as the 6-month study period may not have been sufficient, and the effect could only become visible in the long term. Previous studies suggest this is particularly the case for caregiver and dyad-related outcomes, for which effects are downstream or delayed [19, 52]. The increase in days spent in day and night care following the provision of cDCM suggests that informal caregivers were relieved, which, as a result, may become apparent later. However, sensitivity analysis accounting for QALYs reported by proxies suggests that cDCM implementation in DCC demonstrates stronger effects on HRQoL than the implementation in the physician network, possibly reflecting caregiver relief. This assumption may be supported by the fact that both groups have the same level of caregiver availability, but nearly half of DCC patients live alone, suggesting that employed caregivers are a potentially important subgroup reached by the intervention in DCC. Therefore, further studies with more prolonged or repeated follow-up periods are required after the interventions are implemented in DCC.

The present analysis revealed substantial differences in self-reported HRQoL between both settings already at baseline, as confirmed by the reported proxy ratings. Especially the already higher HRQoL at baseline in DCC patients could have caused a ceiling effect that has limited the ability to improve HRQoL further [53, 54]. Even though the present study did not compare the intervention with usual care in the respective settings, Michalowsky et al. [16] confirmed the cost-effectiveness of cDCM in a physician-based setting, reducing hospitalizations and delaying institutionalization. Additionally, Steinbeisser et al. [30] as well as Straubmeier et al. [31] provided evidence for the cost-effectiveness and effectiveness of a multicomponent non-pharmacological intervention compared with usual day care for PwD in DCC, underlining the potential cross-sectoral benefits of cDCM for patients and payers. However, further research from additional formal care settings beyond DCC is needed to confirm the gained findings.

5 Limitations

The analyses compare two healthcare settings in a rural area in north-eastern Germany on the basis of small sample sizes, which may limit the findings' generalizability. The study participants were not randomized to the respective settings. Therefore, the results could be biased owing to endogenous group differences. However, the results for the cost-effectiveness analysis in particular, were controlled for several variables and remained stable overall even after sensitivity analyses except for the proxy assessment by the family caregiver. Moreover, patients could not choose in which setting they use cDCM as an additional health service, which limits the patient perspective reported in this study. The study also included patients who had screened positive for dementia using the DemTect but had not been formally diagnosed or show no hint for dementia according the MMSE, which could lead to false-positive cases but could also indicate an underdiagnosis that had already been addressed in previous studies [6, 7]. Furthermore, it is already known that the DemTect is more suitable and sensitive than the mini-mental state examination in detecting early stages of dementia [55, 56]. PwD without a formal diagnosis were more likely to drop out, which affects the generalizability of the presented results for patients who screened positive for dementia. The dropout rate was higher among patients in the physicians network since the lockdown measures owing to COVID-19 made it impossible to conduct home visits to patients to complete these cases. Additionally, study staff assessed patient-reported primary data retrospectively at patients' homes, possibly affecting their completeness and accuracy owing to recall bias, especially for the assessed healthcare resource utilization and costs. However, proxy interviews were conducted with healthcare providers and family caregivers to increase data validity and minimize this bias. However, inconsistencies must be considered, with self-reported values being systematically higher than the proxy assessment, particularly for HRQoL [57, 58]. The settings from different healthcare sectors were compared directly so that two implementation alternatives for cDCM were presented in the cost-effectiveness analysis. Therefore, no conclusions based on the present study could be drawn regarding their inferiority or superiority toward usual care. However, the superiority of cDCM over routine care was assumed on the basis of the available studies. The unmet needs reported in the present study only considers unmet needs at baseline. The cDCM's success in covering the previously identified unmet need is part of the process evaluation and further research.

6 Conclusions

Patients who received cDCM as an additional healthcare service in the physician network achieved a higher HRQoL after 6 months at lower costs from the payer's perspective than patients who received cDCM in the DCC, suggesting cDCM implementation in physician-based settings should be prioritized over formal care settings. Patients enrolled in the physician network had the highest unmet needs and more pronounced clinically relevant neuropsychiatric symptoms. However, access to social and nursing care services was limited, which supports the higher demand for cDCM for patients in physician-based settings. A detailed look at unmet needs suggested that DCC patients also had many identified unmet needs despite their direct access to professional nursing care. Implementing cDCM requires setting-specific focal points to integrate the respective sectors more easily and efficiently. Further research is, therefore, needed to gain more insights into additional primary care settings and in-depth knowledge about the acceptance, barriers, and success experienced in various settings.

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Declarations

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Conflict of interest The authors have no relevant financial or nonfinancial interests to disclose.

Ethics approval Ethical approval for this study was obtained by the University Medicine Greifswald's ethics committee (BB 01/2019).

Consent to participate If patients were eligible, the healthcare professionals provided written and oral information about the study and asked for patients' and caregivers' written informed consent (IC). If patients could not provide written informed consent, legal representatives were asked to provide the informed consent on behalf of the patient.

Consent for publication The patients were informed about the storage, evaluation, transmission, and publication of the anonymized data following the Guidelines and recommendations for ensuring good epidemiological practice (GEP). Consent for publication was obtained through written informed consent.

Availability of data and material The data used in the analysis is available upon request from the authors, in compliance with ethical and data protection regulations.

Code availability The author's code used in the present analysis is available upon reasonable request.

Author contributions M.P. performed the analysis and wrote the manuscript; B.M. and W.H. significantly contributed to the manuscript; B.M. significantly contributed to the design and methods used for the analysis and revised the manuscript. All authors read and approved the final manuscript.

References

1. GBD. Dementia Forecasting Collaborators (2022) Estimation of the global prevalence of dementia in 2019 and forecasted prevalence in 2050: an analysis for the Global Burden of Disease Study 2019. Lancet Public Health. 2019;7(2):e105–25.
2. Wimo A, et al. The worldwide costs of dementia 2015 and comparisons with 2010. Alzheimers Dement. 2017;13(1):1–7.
3. Wimo A, et al. The worldwide costs of dementia in 2019. Alzheimers Dement. 2023;19:2865–73.
4. Blotenberg I, Hoffmann W, Thyrian JR. Dementia in Germany: epidemiology and prevention potential. Dtsch Arztebl Int. 2023;120(27–28):470–6.
5. Georges D, et al. Dementia in Germany: epidemiology, trends and challenges. J Health Monit. 2023;8(3):30–48.
6. Eichler T, et al. Rates of formal diagnosis in people screened positive for dementia in primary care: results of the DelpHi-Trial. J Alzheimers Dis. 2014;42(2):451–8.
7. Gjøra L, et al. Prevalence and determinants of diagnosed dementia: a registry linkage study linking diagnosis of dementia in the population-based HUNT Study to Registry Diagnosis of Dementia in Primary Care and Hospitals in Norway. J Alzheimers Dis. 2024;99(1):363–75.
8. Michalowsky B, et al. Healthcare utilization and costs in primary care patients with dementia: baseline results of the DelpHi-trial. Eur J Health Econ. 2018;19(1):87–102.
9. Wübbeler M, et al. Nonpharmacological therapies and provision of aids in outpatient dementia networks in Germany: utilization rates and associated factors. J Multidiscip Healthc. 2015;8:229–36.
10. Wucherer D, et al. Antidementia drug treatment in people screened positive for dementia in primary care. J Alzheimers Dis. 2015;44(3):1015–21.
11. Eichler T, et al. Unmet needs of community-dwelling primary care patients with dementia in Germany: prevalence and correlates. J Alzheimers Dis. 2016;51(3):847–55.
12. Bundesministerium für Familie, S., Frauen und Jugend (BMFSFJ), and Bundesministerium für Gesundheit (BMG). Nationale Demenzstrategie. 2020.
13. Prince MC-HA, Guerchet M, Karagiannidou M. World Alzheimer Report 2016: Improving healthcare for people living with dementia—Coverage, Quality and Costs now and in the Future 2016, World Alzheimer Report 2016: Improving healthcare for people living with dementia—Coverage, Quality and Costs now and in the Future: London
14. DGN e. V. & DGPPN e. V. (Hrsg.), *S3-Leitlinie Demenzen, Version: 4.0 (Stand: 28.11.2023).*
15. Eichler T, et al. Dementia care management: going new ways in ambulant dementia care within a GP-based randomized controlled intervention trial. Int Psychogeriatr. 2014;26(2):247–56.
16. Michalowsky B, et al. Cost-effectiveness of a collaborative dementia care management—results of a cluster-randomized controlled trial. Alzheimers Dement. 2019;15(10):1296–308.
17. Thyrian JR, et al. Life- and person-centred help in Mecklenburg-Western Pomerania, Germany (DelpHi): study protocol for a randomised controlled trial. Trials. 2012;13:56.
18. Thyrian JR, et al. Effectiveness and safety of dementia care management in primary care: a randomized clinical trial. JAMA Psychiat. 2017;74(10):996–1004.
19. Michalowsky B, et al. Clinical outcomes and cost-effectiveness of collaborative dementia care: a secondary analysis of a

cluster randomized clinical trial. JAMA Netw Open. 2024;7(7): e2419282.
20. Rädke A, et al. Who benefits most from collaborative dementia care from a patient and payer perspective? A subgroup cost-effectiveness analysis. J Alzheimers Dis. 2020;74(2):449–62.
21. Nolte E, et al. Overcoming fragmentation in health care: chronic care in Austria, Germany and The Netherlands. Health Econ Policy Law. 2012;7(1):125–46.
22. Kallio EL, et al. Neuropsychological outcome of cognitive training in mild to moderate dementia: a randomized controlled trial. Neuropsychol Rehabil. 2021;31(6):935–53.
23. Lin CF, et al. Impact of day care services on physical and cognitive functions in old people with dementia in a medical center in central Taiwan. Health Qual Life Outcomes. 2021;19(1):170.
24. Tuohy D, et al. A scoping review on the psychosocial interventions used in day care service for people living with dementia. PLoS One. 2023;18(12): e0295507.
25. Fields NL, Anderson KA, Dabelko-Schoeny H. The effectiveness of adult day services for older adults: a review of the literature from 2000 to 2011. J Appl Gerontol. 2014;33(2):130–63.
26. Sadarangani T, et al. Multimorbidity patterns in adult day health center clients with dementia: a latent class analysis. BMC Geriatr. 2022;22(1):514.
27. Scheel J, et al. Predictors of falls and hospital admissions in people with cognitive impairment in day-care: role of multimorbidity, polypharmacy, and potentially inappropriate medication. BMC Geriatr. 2022;22(1):682.
28. Liu AK, et al. Effect of collaborative dementia care on potentially inappropriate medication use: outcomes from the Care Ecosystem randomized clinical trial. Alzheimers Dement. 2022;19:1865–75.
29. Rokstad AMM, et al. The impact of attending day care designed for home-dwelling people with dementia on nursing home admission: a 24-month controlled study. BMC Health Serv Res. 2018;18(1):864.
30. Steinbeisser K, et al. Cost-effectiveness of a non-pharmacological treatment versus "care as usual" in day care centers for community-dwelling older people with cognitive impairment: results from the German randomized controlled DeTaMAKS-trial. Eur J Health Econ. 2020;21(6):825–44.
31. Straubmeier M, et al. Non-pharmacological treatment in people with cognitive impairment. Dtsch Arztebl Int. 2017;114(48):815–21.
32. Platen M, et al. Translation of collaborative dementia care management into different healthcare settings: study protocol for a multicenter implementation trial (DCM:IMPact). J Alzheimers Dis Rep. 2022;6(1):617–26.
33. Mendel P, et al. Interventions in organizational and community context: a framework for building evidence on dissemination and implementation in health services research. Adm Policy Ment Health. 2008;35(1–2):21–37.
34. Calabrese P, Kessler J. Screening for cognitive impairment in dementia—the DemTect procedure. Eur Neuropsychopharmacol. 2000;10:369.
35. World Health O. The ICD-10 classification of mental and behavioural disorders : diagnostic criteria for research. Geneva: World Health Organization; 1993.
36. Kessler J, Markowitsch H, Denzler P. Mini-mental-status-test (MMST) [German Version]. 1 ed. 1990, Göttingen: Beltz Test GmbH
37. Hindmarch I, et al. The Bayer activities of daily living scale (B-ADL). Dement Geriatr Cogn Disord. 1998;9(Suppl 2):20–6.
38. Gauggel S, Birkner B. Validität und Reliabilität einer deutschen Version der Geriatrischen Depressionsskala (GDS). Z Klin Psychol Psychother. 1999;28(1):18–27.
39. Cummings JL. The Neuropsychiatric Inventory: assessing psychopathology in dementia patients. Neurology. 1997;48(5 Suppl 6):S10–6.
40. Eichler T, et al. The benefits of implementing a computerized intervention-management-system (IMS) on delivering integrated dementia care in the primary care setting. Int Psychogeriatr. 2014;26(8):1377–85.
41. EuroQol--a new facility for the measurement of health-related quality of life. Health Policy. 1990; 16(3): 199–208.
42. Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. Ann Med. 2001;33(5):337–43.
43. Ludwig K, Graf von der Schulenburg JM, Greiner W. German value set for the EQ-5D-5L. Pharmacoeconomics. 2018;36(6):663–74.
44. Byford S, Torgerson DJ, Raftery J. Economic note: cost of illness studies. BMJ. 2000;320(7245):1335.
45. Seidl H, et al. FIMA—Fragebogen zur Erhebung von Gesundheitsleistungen im Alter: Entwicklung und Pilotstudie. Gesundheitswesen. 2015;77(01):46–52.
46. Bock JO, et al. Calculation of standardised unit costs from a societal perspective for health economic evaluation. Gesundheitswesen. 2015;77(1):53–61.
47. WIdO (Wissenschaftliches Institut der AOK). *GKV-Arzneimittelindex*. 2018. http://www.wido.de/amtl_atc-code.html. Accessed 16 Sept 2016.
48. WIdO (Wissenschaftliches Institut der AOK), *Heilmittelbericht 2020 Ergotherapie, Sprachtherapie, Physiotherapie, Podologie*. 2020: Berlin.
49. StataCorp., Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC. 2017.
50. Mossello E, et al. Day Care for older dementia patients: favorable effects on behavioral and psychological symptoms and caregiver stress. Int J Geriatr Psychiatry. 2008;23(10):1066–72.
51. Matzk S, et al. Pflegebedürftigkeit in Deutschland. In: Jacobs K, et al., editors. Pflege-Report 2022: Spezielle Versorgungslagen in der Langzeitpflege. Berlin: Springer; 2022. p. 251–86.
52. Balvert SCE, Del Sordo GC, Milders MV. The efficacy of dyadic interventions for community-dwelling people with dementia and their caregivers: a systematic review and meta-analysis. Ageing Res Rev. 2024;96: 102258.
53. Michalowsky B, et al. Comparing the psychometric properties of EQ-5D-3L and EQ-5D-5L proxy ratings by informal caregivers and a health professional for people with dementia. Health Qual Life Outcomes. 2022;20(1):140.
54. Michalowsky B, et al. Acceptability and validity of the EQ-5D in patients living with dementia. Value Health. 2020;23(6):760–7.
55. Kalbe E, et al. DemTect, PANDA, EASY, and MUSIC: cognitive screening tools with age correction and weighting of subtests according to their sensitivity and specificity. J Alzheimers Dis. 2013;34(4):813–34.
56. Kohn N, et al. Vergleich MMST und DemTect: Spezifität und Sensitivität bei primär kognitiven Störungen. Aktuelle Neurol. 2007;34(S2):P672.
57. Griffiths AW, et al. Exploring self-report and proxy-report quality-of-life measures for people living with dementia in care homes. Qual Life Res. 2020;29(2):463–72.
58. Orgeta V, et al. The use of the EQ-5D as a measure of health-related quality of life in people with dementia and their carers. Qual Life Res. 2015;24(2):315–24.