Contemporary Clinical Trials 83 (2019) 97–108

Contents lists available at ScienceDirect

Contemporary Clinical Trials

journal homepage: www.elsevier.com/locate/conclintrial

Embedding caregiver support in community-based services for older adults: A multi-site randomized trial to test the Adult Day Service Plus Program (ADS Plus)

Laura N. Gitlin[a,*], Katherine Marx[b], Daniel Scerpella[c], Holly Dabelko-Schoeny[d], Keith A. Anderson[e], Jin Huang[f], Laura Pizzi[g], Eric Jutkowitz[h], David L. Roth[i], Joseph E. Gaugler[j]

[a] Drexel University, 1601 Cherry Street, 10th Floor, Room 1092, Philadelphia, PA 19102, United States of America
[b] Johns Hopkins School of Nursing, Center for Innovative Care in Aging, 901 N. Broadway, Room 214, Baltimore, MD 21205, United States of America
[c] Johns Hopkins School of Nursing, Center for Innovative Care in Aging, 901 North Broadway, 2nd Floor, Baltimore, MD 21205, United States of America
[d] College of Social Work, 207 Stillman Hall, 1947 College Rd N., Columbus, OH 43210, United States of America
[e] University of Montana, School of Social Work, 014 Jeannette Rankin Hall, 32 Campus Drive, Missoula, MT 59812-4392, United States of America
[f] Johns Hopkins School of Medicine, Center on Aging and Health, 2024 East Monument Street, Baltimore, MD 21205, United States of America
[g] University Ernest Mario School of Pharmacy, Center for Health Outcomes, Policy, and Economics, 160 Frelinghuysen Road – Suite 417, Piscataway, NJ 08854, United States of America
[h] Brown University School of Public Health, Department of Health Services, Policy & Practice, BoxG-S121 (6), 121 S Main Street, Providence, RI 02912, United States of America
[i] Johns Hopkins School of Medicine, Center on Aging and Health, 2024 East Monument Street, Baltimore, MD 21205, United States of America
[j] University of Minnesota, School of Nursing, 308 SE Harvard St, Minneapolis, MN 55455, United States of America

ARTICLE INFO

Keywords:
Dementia
Neuropsychological behaviors
Family caregiving
Activities
Occupational therapy
Psychosocial intervention

ABSTRACT

There are over five million people in the United States living with dementia. Most live at home and are cared for by family. These family caregivers often assume care responsibilities without education about the disease, skills training, or support, and in turn become at risk for depression, burden, and adverse health outcomes when compared to non-dementia caregivers. Despite over 200 caregiver interventions with proven benefits, many caregivers lack access to these programs. One approach to enhance access is to embed evidence-based caregiver support programs in existing community-based services for people with dementia such as adult day services (ADS). Here we describe the protocol for an embedded pragmatic trial designed to augment standard ADS known as ADS Plus. ADS Plus provides family caregivers with support via education, referrals, and problem-solving techniques over 12 months, and is delivered on-site by existing ADS staff. Embedding a program in ADS requires an understanding of outcomes and implementation processes in that specific context. Thus, we deploy a hybrid design involving a cluster randomized two-group trial to evaluate treatment effects on caregiver wellbeing, ADS utilization, as well as nursing home placement. We describe implementation practices in 30 to 50 geographically and racially/ethnically diverse participating sites.

Clinical trial registration #: NCT02927821

1. Introduction

Of over five million people in the United States with dementia, most live at home and are cared for by > 16 million family caregivers [1]. Care responsibilities increase with disease progression and range from coordinating care and transitions; communicating with different healthcare providers; managing medications and medical needs; assisting with basic self-care and instrumental tasks; managing challenging behaviors and functional declines; and assuring home safety, security and quality of life. Most families assume responsibilities without education about the disease, skills training, or support, and, in turn become at risk for depression and burden and adverse health outcomes compared to non-dementia caregivers [8,11,12,17,29].

Despite over 200 caregiver programs tested in efficacy trials with

* Corresponding author.
E-mail addresses: Lng45@drexel.edu (L.N. Gitlin), kmarx1@jhu.edu (K. Marx), dscerpe1@jhu.edu (D. Scerpella), dabelko-schoeny.1@csw.osu.edu (H. Dabelko-Schoeny), keith.anderson@mso.umt.edu (K.A. Anderson), j.huang@jhu.edu (J. Huang), laura.pizzi@rutgers.edu (L. Pizzi), jutkowitz@brown.edu (E. Jutkowitz), droth@jhu.edu (D.L. Roth), gaug0015@umn.edu (J.E. Gaugler).

https://doi.org/10.1016/j.cct.2019.06.010
Received 2 November 2018; Received in revised form 7 June 2019; Accepted 19 June 2019
Available online 22 June 2019

proven benefits [21], families and health providers continue to have limited knowledge of and access to these programs [22]. Determining ways to enhance caregiver access to evidence-based programs is a public health imperative and a research recommendation of National Research Summits and reports [41].

One approach to enhance access is to embed evidence-based caregiver support programs in existing community-based services for people with dementia such as adult day services (ADS). ADS provide opportunities for people with dementia to participate in meaningful activities in a safe and supervised environment while affording caregivers respite from caregiving demands and/or maintain employment [14,18]. In 2016, there were approximately 4600 ADS in the United States providing care to about 286,300 individuals [30], and the service need is growing. However, family caregivers using ADS do not typically receive support addressing their own needs and care challenges. Research also has not consistently demonstrated that ADS reduces caregiver burdens [15].

We designed and evaluated an augmentation to standard ADS, ADS Plus. ADS Plus provides family caregivers with support over 12 months. Delivered onsite and by existing ADS staff, ADS Plus integrates components from previously proven programs including the NIH REACH (Resources for Enhancing Alzheimer's Caregiver Health) initiative [3] and Project COPE [25,26]. ADS Plus provides caregivers with disease education, referral/linkages, emotional support, self-care strategies, and skills to manage caregiver-identified challenges including functional decline, behavioral symptoms, and care coordination [20,39].

Embedding a program in ADS requires understanding outcomes and implementation processes in that context. Thus, we deploy what is referred to as a hybrid design [13] to evaluate treatment effects on caregiver wellbeing, ADS utilization, and nursing home placement, and to describe implementation practices in geographically and racially/ethnically diverse participating sites. Our approach of embedding an evidence-based caregiver program in a community-based service may serve as a model for scaling evidence and increasing caregiver access to needed services.

2. Study design

We previously evaluated the ADS Plus program in a pilot study involving 129 caregivers in three large ADS programs in one geographic region (Philadelphia, PA). Two sites ($n = 67$) received ADS and the augmentation, ADS Plus (intervention sites); and one site ($N = 62$) involved participation in usual ADS only (control site). At 3-months, caregivers receiving ADS Plus reported fewer depressive symptoms ($p = .016$), improved efficacy managing behaviors ($p = .013$) and enhanced well-being ($p = .001$) compared to caregivers at the control site. At 12 months, ADS Plus caregivers continued to report less depression ($p = .005$) and enhanced efficacy managing behaviors ($p = .007$) and used ADS on average 37 days more than caregivers in the control site ($p = .003$). In addition, there were 50% fewer nursing home placements of persons with dementia by caregivers participating in ADS Plus ($n = 8$) than control group ($n = 17$) caregivers. These findings supported moving forward with a larger, multi-site study involving a more geographically and racial/ethnically diverse study sample (the pilot included 66.8% white and 28.1% African American; [20]).

Building on this previous work, we sought to test the ADS Plus program on a larger scale. We present here our study protocol that involves 50 ADS sites across the United States and 300 family caregivers. We are deploying a hybrid design involving a cluster randomized two-group trial to evaluate program effectiveness and mixed methodologies to evaluate program implementation processes. Our study design (shown in Fig. 1) falls along the continuum of pragmatic trials (https://www.precis-2.org/) in that it contains key design features relevant to embedded pragmatic trials. These are: the intervention is embedded in the setting in which it is intended to be delivered; eligibility criteria are broad to reflect the census of families using ADS; the study relies on ADS staff to inform family caregivers of the study and their possible participation; data routinely collected by ADS including days using ADS and nursing home placement reflect key trial outcomes; and for ADS intervention sites, staff members who are indigenous to the site are selected to be interventionists and are trained to deliver ADS Plus to family caregivers who volunteer for the study.

Our study considerably advances the implementation science of caregiver interventions in that it employs rigorous cluster and re-randomization techniques, compares ADS Plus to usual ADS care, evaluates economic benefits, and uses mixed methodologies to examine implementation processes; all central features to support wide-scale implementation of ADS Plus if we are able to replicate its effectiveness. Table 1 outlines the key novel features of our study design.

As shown in Fig. 1, sites are randomized to deliver routine ADS and provide caregivers of clients using ADS with the ADS Plus program (intervention sites); or to sites that deliver ADS services as usual (control sites). A total of 300 caregivers will be enrolled across all sites and interviewed at baseline, and then 3, 6 and 12 months from study enrollment by the two research sites (Johns Hopkins University and University of Minnesota). Caregivers enrolled in the intervention sites receive ADS Plus following their baseline interview and meet on-site with staff interventionists for up 3 months and then in person, or by telephone or email for up to 12 months.

To evaluate implementation processes, caregivers and staff from the ADS Plus sites will participate in additional interviews at 6 and 12 months to examine their experiences within the program using closed and semi-structured questions. The 3-month follow-up interview serves to keep caregivers connected to the study, capture outcomes to minimize missing data if there should be attrition, and to assure we have accurate contact information (telephone, address).

At the conclusion of the trial, staff at intervention sites are asked to participate in semi-structured interviews to ascertain implementation barriers and supports, as well as to glean the level of acceptability of the caregiver supportive program. Study design elements are described below in more detail.

2.1. Research aims

2.1.1. Primary aims

Our study has two primary aims. The first is to evaluate the effectiveness of ADS Plus to improve caregiver well-being and reduce depressive symptoms compared to routine ADS use at 6 months, the main trial endpoint. Our hypothesis (#1) is that caregivers enrolled in ADS Plus, compared to those in control group sites receiving routine ADS only, will report improvements in their well-being and depressive symptoms.

Our second aim is to evaluate the maintenance effects of ADS Plus at 12 months on caregiver well-being and depressive symptoms. Our hypothesis (#2) is that caregivers who receive the ADS Plus program will maintain benefits gained at 6 months out to 12 months.

2.1.2. Secondary aims

We also plan to pursue aims secondary to the main trial outcomes. First, we will evaluate whether caregivers receiving the ADS Plus program are more likely to maintain relatives in ADS and less likely to place their relative with dementia in residential settings compared to those in routine ADS over 12 months. We hypothesize (#3) that by 12 months, residential placement rates will be lower, and ADS use higher among persons living with dementia whose caregivers receive the ADS Plus program when compared to caregivers in usual ADS care.

Another secondary aim is to estimate ADS Plus costs and assess whether it results in net financial benefits when compared to usual ADS at 6 and 12 months. We hypothesize (#4) that when evaluating both societal (i.e., Medicare and Medicaid) and payer (government) perspectives, ADS Plus costs will be offset by savings in direct healthcare service costs and indirect caregiver productivity loss costs.

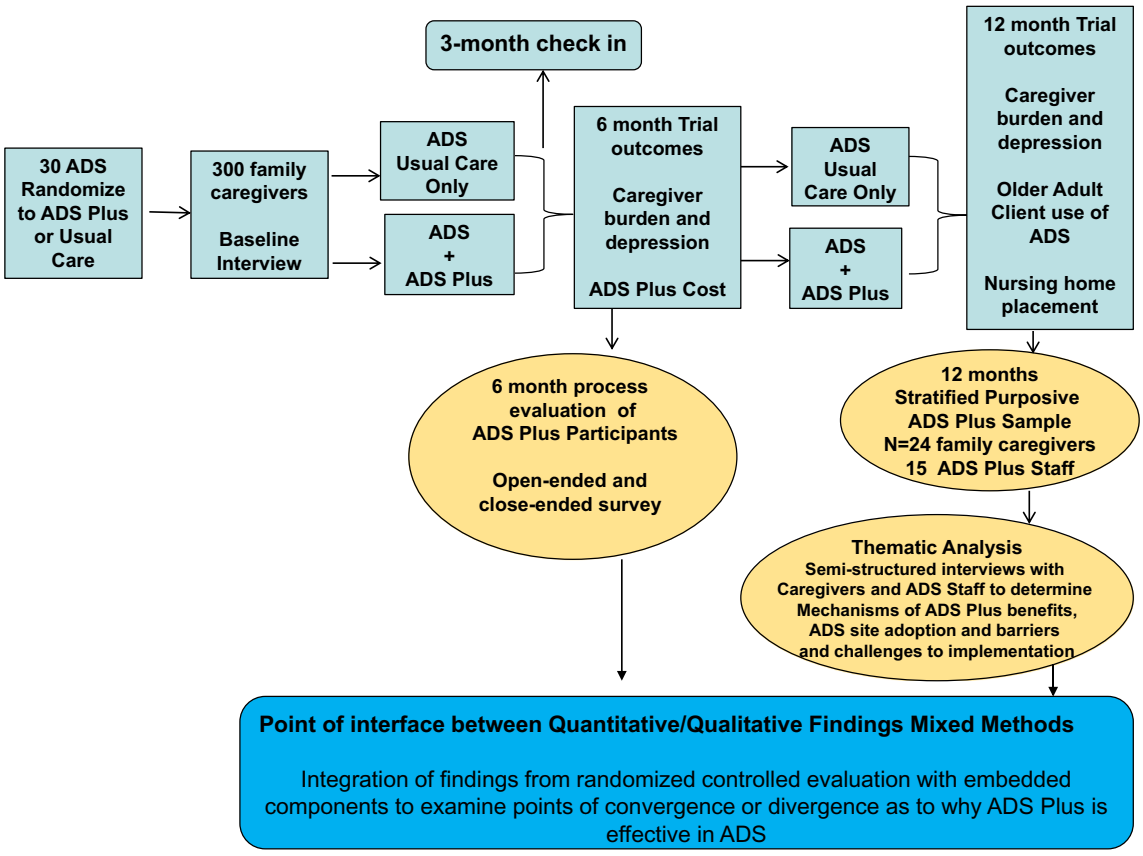

Fig. 1. ADS Plus Design Study.

Table 1
Novel features of the hybrid pragmatic trial design.

- Design elements:
  - o Use of a usual care control group to evaluate the added value of augmenting adult day services (ADS) with systematic caregiver support
  - o Hybrid design combining effectiveness and implementation research aims
  - o Cost-effectiveness measures and associated analyses including evaluation of the willingness of families to pay for supportive services from which to derive an economic model for sustainability
  - o Use of ADS staff to inform families of the research study
  - o Cluster design with randomization and re-randomization to achieve
- Measurement
  - o Data collection on key outcomes (ADS use, nursing home placement) collected by ADS sites as routine care
  - o Combination of quantitative and qualitative questions to evaluate outcomes and implementation processes
- Intervention elements
  - o For intervention sites, use of ADS staff to provide the ADS Plus program
  - o Flexible delivery schedule to fit caregiver schedules and needs
  - o Caregiver-centric; caregivers identify which care challenges they want to address
  - o Use of ADS Plus Prescriptions that provide strategies tailored to particular caregiver-identified challenges

Yet another secondary aim is to evaluate the effects of ADS Plus on behavioral symptoms of persons living with dementia and caregiver efficacy in and upset with managing these symptoms. Our hypothesis (#5) is that caregivers in ADS Plus will report higher rates of efficacy and lower levels of upset compared to caregivers in routine ADS from baseline to 12 months, and that the persons living with dementia whose caregivers participate in ADS Plus will have a greater reduction in the frequency and severity of behavioral symptoms in this time frame.

2.1.3. Exploratory aim

To further understand treatment effectiveness, we will examine whether certain caregivers benefit more than others (moderation effects). We will examine whether ADS Plus differentially effects spouses compared to non-spouses, and women compared to men in order to understand the ideal target population for this program and if adaptations are needed to boost benefits for others. We will also explore mediational pathways to determine if improved self-efficacy and/or fidelity to the intervention protocol by staff interventionists implementing ADS Plus explain in part any derived benefits at 6 and 12 months (Table 2).

2.2. Conceptual framework

The ADS Plus Program draws upon a basic stress process model advanced by the NIH REACH (Resources for Enhancing Alzheimer's Caregiver Health) initiatives [38,40]. The model suggests that factors such as care needs of older adults, behavioral symptoms, and/or caregiver health serve as primary, external stressors for caregivers.

Table 2
Main study hypotheses.

#1 - Caregivers enrolled in ADS Plus, compared to those in control group sites receiving routine ADS only, will report improvements in their well-being and depressive symptoms.
#2 - Caregivers who receive the ADS Plus program will maintain benefits gained at 6 months out to 12 months.
#3 - By 12-months, residential placement rates will be lower and ADS use higher among persons living with dementia of those caregivers who receive the ADS Plus program compared to caregivers in usual ADS.
#4 - Using a societal (i.e., Medicare and Medicaid) and payer (government) perspectives, ADS Plus costs will be offset by savings in direct and indirect costs.
#5 - Caregivers in ADS Plus will report higher rates of efficacy and lower levels of upset compared to caregivers in routine ADS from baseline to 12 months and that persons living with dementia whose caregivers participate in ADS Plus will have a greater reduction in the frequency and severity of behavioral symptoms in this time frame.

Caregivers evaluate whether these external demands pose potential threats to the older adult and/or themselves, and if so, whether they have sufficient coping mechanisms to manage such threats. Caregivers who perceive external demands as threatening and their coping resources as inadequate tend to experience burden [35]. According to the model, the appraisal of stress contributes to negative emotional, physiological, and behavioral responses that may place caregivers at risk for poor health, diminished wellbeing, and depression. The goal of ADS Plus is to minimize external stressors by addressing unmet needs and enhancing caregiver coping and hands-on skills. Having education, support and adaptive coping skills can reduce distress. ADS Plus supports positive intra-psychic factors (self-efficacy related to care responsibilities) and introduces effective and appropriate coping approaches along with hands-on skills training to effectively mediate well established relationships between objective stressors of caregiving and outcomes for caregivers and persons living with dementia [2,38].

To understand organizational and contextual factors that may impinge upon implementation effectiveness and the extent of their impact, we draw upon the concept of a force field [31]. A force field suggests that for any behavioral or organizational change, there are positive (driving) and negative (restraining) valences promoting a change or deterring change in an organization or context. Applied to ADS, identifying positive and negative factors that support or challenge adoption of ADS Plus would be important to understand. A force field analysis enables: 1) identification of factors that support and deter organizational change; 2) evaluation of the strength of the impact of each identified factor; and 3) targeting factors to either strengthen, reduce or modify their impact. Fig. 2 illustrates a force field analysis; we have identified five factors (a priori) as driving forces supporting implementation of ADS Plus, and five factors that we have identified as restraining factors or which threaten implementation. We will be able to advance a refined understanding of these forces, their level of impact as well as the potential strategies that might strengthen or mitigate their impact.

2.3. Site selection

To identify ADS sites interested in participating in this study, an invitation was distributed to the members of the National Adult Day Service Association in 2014 and later to all LeadingAge ADS members in 2016. These outreach efforts resulted in 73 programs located throughout the United States expressing interest in participating in the study. From these, 30 sites were initially identified. Due to low enrollment, we subsequently identified an additional 20 new sites for a total of 50 sites that meet these criteria: a) have sufficient size or capacity (minimum of 50 clients), b) ≥50% of attending clients have a dementia diagnosis, c) have sufficient staff to client ratio to enable one staff member to serve as research coordinator and another to provide ADS Plus (if site is randomized to deliver the intervention), and d) are not-for-profit nor part of a national chain.

We continue to involve the 43 sites from the original 73 identified sites that were not selected for study involvement in various activities including participation in our Translational Advisory Board (described below), panel discussions at professional meetings and brief surveys about their operations and use of evidence-based programs. These activities inform our understanding of implementation challenges and potential facilitators of evidence-based programs in adult day services.

2.4. Randomization of sites

We are employing a cluster randomized trial design, with caregivers nested within ADS site and site serving as the unit of randomization. Cluster randomization is the preferred scientific method for this pragmatic trial. Because ADS Plus will be delivered by on-site staff to multiple caregivers within each site, randomization at the individual participant level could lead to significant contamination between treatment and control conditions within a site.

Prior to randomization, we collected site-level data including size (or capacity), ownership structure, location (urban, suburban, rural), and summary characteristics of the client population served at each site (e.g., % with dementia diagnosis, % minority). Initially, we sought to randomize 50 sites to 25 intervention and 25 control conditions. Notable and problematic imbalances on at least a few site-level characteristics could easily occur by chance in a single randomization. We thus chose to use a re-randomization approach to achieve these important methodological goals [34,46]. The balance match weighted (BMW) design is an innovative re-randomization procedure that was particularly well-suited to our goals [46]. Using the BMW approach, we

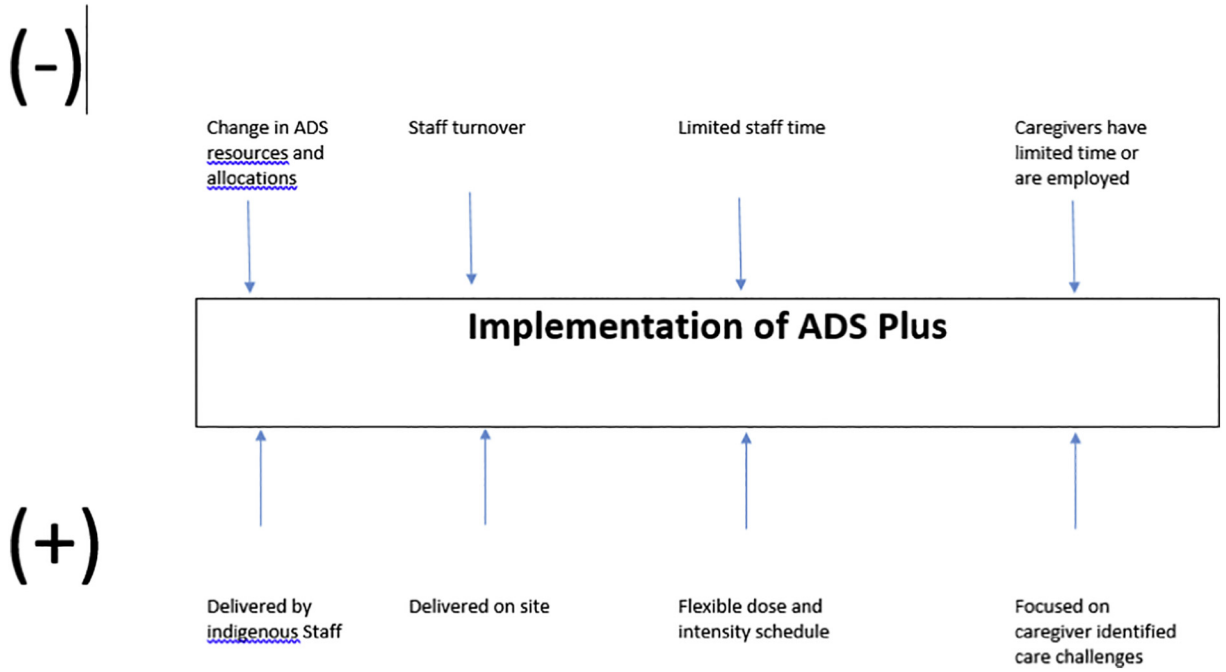

Fig. 2. Force Field Analysis of Driving (+) and Restraining (−) Factors of ADS Plus Program Implementation.

finalized the list of important covariates for which we desired matching or balancing across intervention and control sites, generated 20 lists of random assignments for 30 sites into intervention and control conditions, calculated propensity scores of intervention assignment as a function of the covariates, and selected the random assignment list that minimized the propensity score differences between intervention and control sites.

Eight sites opted out of the trial after randomization but before participant recruitment, and other sites had difficulty achieving participant enrollment goals. Consequently, 7 additional sites were subsequently assigned to intervention (5) or control (2) conditions based on their propensity scores from the BMW propensity scores, and later, 20 additional sites were assigned to intervention (12) or control (8) conditions based on a randomized minimization procedure. In total, 57 sites were assigned in the trial with 32 assigned to intervention and 25 assigned to the control condition. Forty-nine sites (26 intervention, 23 control) were retained and actively enrolled participants. This results in even greater control over potential covariate influences and provide somewhat greater power to detect an ADS Plus intervention effect [34].

2.5. Sample size

The appropriate number of ADS programs and caregivers for the proposed, multilevel quantitative analysis was determined using power analysis procedures that take into account the nested hierarchical design of the study. In this framework, we specified the following: the intraclass correlation coefficient (ICC) of the amount of within-site clustering of the outcome data that is expected, a suitable level of statistical power (e.g., probability of 0.80 to reject a null hypothesis that is false), and the expected difference between ADS Plus and control groups. These considerations were used to determine the number of ADS sites and the number of caregivers per ADS site to enroll. In the power analyses, we varied the ICC from 0.05 to 0.09 based on previous experience with long-term care intervention research [5,7]. We sought to identify the number of sites and the overall sample size that would be sufficient to detect a group difference of 0.50 standard deviation units for two primary caregiver outcomes. This is the classic “medium” effect size [9], is consistent with effect sizes we observed in our pilot ADS Plus [20] and other intervention work, and is considered an appropriate benchmark to evaluate effectiveness of a caregiver intervention in comparison to a usual care control condition. Using these specifications, an anticipated retained sample of 300 family caregivers (accounting for 43% attrition) is more than sufficient to detect statistically significant differences between ADS programs that implement the ADS Plus and control sites.

As to the mixed methods, post-randomized trial phase, a sample size of 20–30 participants is suggested as appropriate for qualitative analysis of semi-structured interviews; thus, our inclusion of 20 family caregivers and 15 staff are sufficient for the proposed evaluation [10,42].

2.6. Inclusion and exclusion criteria for family caregivers

Caregivers are eligible to participate in the study if they fit the following criteria: a) their relative (fictive kin, spouse, family member) is enrolled in one of the participating ADS sites; b) they expect to use ADS for a minimum of 1 week for 6 months; c) they have primary responsibility for the care of a client who has a diagnosis of Alzheimer's disease or a related disorder; d) are English speaking; e) have a telephone and willing to participate in 4 telephone interviews (baseline, 3 month brief check-in; 6 and 12 month follow-ups); and f) are 21 years of age or older (male or female). While more than one family member may provide care to the ADS client, we plan to enroll the family member who is designated as the responsible party or who enrolled their relative into ADS. The caregiver in the ADS Plus program may bring other family members to a session if they choose.

Caregivers are excluded if they or the person with dementia 1) has been hospitalized > 3 times in the past year; 2) is in active treatment for a life-threatening illness; or 3) is involved in another caregiver support/service trial. These criteria are designed to minimize attrition and exclude caregivers too ill themselves to benefit from ADS Plus or who are at high mortality risk or of the person with dementia.

In accordance with our pragmatic focus, our inclusion criteria are purposively broad to reflect the real-world case mix of caregivers using ADS such that any caregiver with an older relative (> 60 years) enrolled in a participating ADS may be eligible for study inclusion.

2.7. Recruitment of family caregivers

We seek to enroll up to 15 caregivers per ADS site. A 43% attrition rate is projected based on the ADS Plus pilot and our other caregiver trials [3,16,25,26]. This will yield a total of 300 retained participants (150 caregivers in ADS Plus sites; 150 caregivers in ADS usual care sites). Recruitment and enrollment will occur over a 27 to 28-month period with 11 caregivers enrolled per month.

Each participating site assigns a designated staff member to serve as research liaison. The research liaisons participate in 4 h of paid training (via webinar) to learn about study procedures, scripts for describing the study and outreach efforts to their family caregivers that are ethical and not coercive. Research liaisons are responsible for informing family members of the study via recruitment letters and flyers approved by the Johns Hopkins University (JHU) Institutional Review Board (IRB). Caregivers expressing study interest either contact the study team directly by calling a dedicated study telephone line; or sign a JHU IRB approved “consent to be contacted” form which is then faxed or emailed to the JHU study team by the ADS research liaison. The JHU study team then contacts the caregiver by telephone within a week of receipt of their information, explains study procedures, and if of interest, obtains telephone assent to screen for eligibility. If the caregiver is eligible, assent is obtained to conduct a baseline interview (typically of one-hour duration). The interview is conducted either immediately at the conclusion of screening or at a time convenient for the caregiver but within 1 week of the screening.

Utilization of liaisons within each ADS protect the privacy of family caregivers prior to their enrollment. Data concerning the percent of persons not eligible and refusals (e.g., basic background information of clients and family members; reasons for not participating) are collected by JHU staff on those caregivers contacting the study team. All family caregivers receive $15 for each completed telephone interview (baseline, 3 months, 6 months, and 12 months). Additionally, we have developed incentives for sites to continuously engage in outreach to families. This includes offering $500 to the first site from which 15 caregivers are enrolled, $50 for every 3 participants enrolled per site, the provision of ongoing coaching calls to share effective recruitment outreach activities, and a quarterly newsletter reporting enrollment progress.

2.8. Measures

A summary of measures and their function (descriptive, covariates, outcomes, implementation processes) in the study are detailed in Table 3.

Here we highlight the two primary outcome measures. For the primary study endpoint (change in depressive symptoms), we use the 20-item Center for Epidemiological Studies Depression Scale (CES-D). The CES-D measures symptoms defined by the American Psychiatric Association’ Diagnostic and Statistical Manual (DSM-V) for a major depressive episode. For each item, caregivers indicate extent of symptomatology in the past week (0 = rarely/never to 3 = most or all of time). Scores will be summed across items with higher total scores indicating greater depressive symptomatology. Scores ≥16 represent clinical symptomatology.

Table 3
Summary of Measures, Their Purpose and Testing Occasion.

Domain (purpose)	Measure	Description	Number of items	Respondent	Testing occasion
Background (descriptive/possible co-variate)	US Census and other sources	Client gender, race/ethnicity, age, living arrangement, income, education,		Caregiver	T1
Client health conditions	National Long-Term Care Survey.	dichotomous checklist	26-item	Caregiver	T1
Client physical dependence	Caregiver Assessment of Function (CAFU)	CG proxy report of client's dependence (a little to complete help) (alpha =0.90)	16 Items	Caregiver	T1, T3, T4
Client cognitive status (descriptive/ possible co-variate)	IQ Code	High reliability, validity via Telephone; assesses cognitive decline and dementia. CGs indicate extent person changed from 10 years ago in domains (score = 1–5).	16-item	Caregiver	T1
Client behavioral symptoms Secondary Outcome	Neuropsychiatric Inventory brief questionnaire (NPI-Q).	CG rates presence of symptoms in past month (yes/no), severity 1–3 (score 0–36)., and CG distress from 1 to 5 (score 0–60; higher scores = more severity or distress). The NPI-Q has an interscale correlation of 0.91 for severity.	14 symptoms – if present then frequency, severity, and distress are also asked	Caregiver	T1, T2, T3, T4
Background	US Census and other sources	gender, race/ethnicity, age, living arrangement, income, employ-ment status, education, relationship to client, duration of care		Caregiver	T1
CG health conditions	National Long-Term Care Survey.	Dichotomous checklist	26 items	Caregiver	T1
Depressive symptoms (primary endpoint)	Center for Epidemiological Studies Depression Scale (CES-D)	Sensitive to change; Cut off for depression > 16 (alpha = 0.91). It is sensitive to change and has strong psychometric properties.	20-items	Caregiver	T1, T2, T3, T4
CG well-being (primary endpoint)	Perceived Change for Better Index	Assesses perceived change (gotten worse (a little, a lot), stayed the same, or improve (a little or a lot) in 3 areas: affective wellbeing, somatic (fatigue, sleep, overall health), ability to manage day-to-day care). It is sensitive to change and has strong psychometric properties.	21 Items	Caregiver	T1, T2, T3, T4
Caregiver upset & burden (secondary outcome)	NPI-Q	-For each NPI-Q behavior, CG rates upset (0 = no upset to 4 = very upset) and has an interscale correlation of 0.92.	Up to 16 items	Caregiver	T1, T2, T3, T4
Vigilance	From REACH II	Ability to leave the client alone in a room, time spent providing care, time on duty, time for caregiver	5 items	Caregiver	T1, T2, T3, T4
CG socio-emotional support (mediator)	Developed by Pearlin and colleagues.	Socio-emotional support of family caregivers or degree of emotional closeness and cohesion towards social network	8-items	Caregiver	T1, T3, T4
Caregiver stress (secondary outcome)	Kingston Caregiver Stress Scale	Measures stress from three different sources: caregiving, family, and financial issues. Dementia care. Designed for family caregivers of persons with dementia. Has high reliability and validity	10 Items	Caregiver	T1, T2, T3, T4
Relationship Closeness (mediator)	Relationship Closeness Scale	4-point Likert scale measures the caregiver's level of agreement with 6 statements.	6 items	Caregiver	
Days attending ADS (Secondary outcome)	ADS Census Records			ADS Director	T1, T3, T4
Residential placement (Secondary outcome)	Family caregiver report and through follow-up with ADS sites.	Type and timing of residential care placement (e.g., entry into a 24-hour residential care setting for at least 90 days, including family care/adult foster care, assisted living, or nursing home) and death rates. Prior research shows that caregiver report compares favorably to other data collection strategies (e.g., claims data).		ADS Director	T1, T3, T4
Program-level variables	Beale coding system. This is for geographic location; i.e., urban, rural, etc.	Number of clients, staffing (turnover, number of direct care staff hours per client per day; number of registered nurse hours per client per day), certification status, profit status (e.g., non-profit, for-profit, religious-affiliated, government entity), and whether ADS is part of a chain (e.g., 2 or more jointly owned adult day programs). ADS programs will also be classified by urban/rural location		ADS Directors	Baseline Survey to Directors
Service utilization	Resource Utilization in Dementia (RUD)	Questionnaire relevant to non-dementia caregiving for measuring patient and caregiver healthcare service use in clinical trials		Caregiver	T1, T3, T4
	Services Utilization and Resources Survey (SURF)	Service use and length of stays will be established by CGs. Since economic aim entails measuring actual costs in year in which they occurred, future costs do not need to be discounted.			
Willingness to Pay	Investigator developed	Assuming you had the funds, how much would you be willing to pay for a service that…	1 Item	Caregiver	T1, T2, T3, T4

Note: CG = caregiver; ADS = adult day services.

Fig. 3. ADS Plus Program Timeline.

For caregiver well-being, we use the 13-item Perceived Change for the Better Index that measures caregiver appraisals of self-improvement or decline in distinct areas. For each item, caregivers rate change (1 = "got much worse" to 5 = "improved a lot") over the past month in three domains: managing care challenges (5 items); affect including anger, stress (4 items), and somatic symptoms including energy, sleep quality (4 items). We will compute mean scores representing an average response across the 13 items and for each domain with higher scores indicating improvement. To evaluate clinically significant changes, we will recode responses (0 = no change; > 0 = improvement; < 0 = worsening) and graph domain scores.

2.9. Intervention protocol

ADS Plus consists of five key components: taking care of self, education, validation and support, referral and linkage, identification of care challenges, skill building and strategies. Each component is tailored to caregiver-identified unmet needs and challenges in providing care at home. The intervention unfolds over 12 months and in three phases as shown in the time line in Fig. 3.

Phase I (months 1–3) is the most intensive involving up to 8 sessions of approximately one hour each. These sessions are preferably conducted in-person and at times convenient to caregivers (e.g., at drop off or pick up of the client or at another time that works for them and the staff interventionist). The first two sessions occur within a two-week timeframe and involve focused interviewing and systematic assessment of caregiver needs and challenges. The assessment is designed to understand the family caregiver's routines, daily care challenges, and knowledge about dementia as well as identify up to three to five immediate care challenges the caregiver would like to work on with the interventionist to learn different management and coping strategies. An investigator developed tool, Caregiver Assessment of Management Problems – Revised (CAMP-R), asks caregivers their level of difficulty (a lot difficult, somewhat difficult, not difficult at all) in managing each identified area from a list reflecting three domains: daily basic and instrumental activities of daily living of the client, behavioral symptoms, and caregiver-centered concerns (e.g., own health, home safety, respite needs, managing other responsibilities and so forth; [24]). For each area that a caregiver expresses some to a lot of difficulty managing, a follow up question is asked concerning the importance of learning new strategies (very important, somewhat important, not important at all) [19]. The interventionist then lists the areas that are specified by the caregiver as difficult to manage and for which learning new strategies is indicated. From this list, the caregiver and interventionist identify 3 to 5 areas to target in the first three months and the order in which they will be addressed. For each identified area, caregivers are then asked their level of upset with the area (1 = no upset to 10 = very upset). The assessment process provides a roadmap from which a "care" plan is developed that includes: 1) identification of the 3 to 5 specific problem areas to work on and their priority order; 2) schedule of contacts for next 3 months; 3) agreed upon mechanisms for working together (face-to-face; email; telephone) and 4) type of education materials and referrals and linkages that will be needed. Also, in these first two sessions, basic stress reduction techniques are provided to and practiced with the caregiver.

Sessions three through eight occur approximately two weeks apart over the 3-month period. Each of these contacts involve the following components: 1) review of stress reduction techniques; 2) education related to identified problem areas; 3) referral and linkage if needed to address targeted problem areas; 4) problem solving and brainstorming regarding targeted problem areas and the creation of the ADS Plus prescription for each care challenge that lists key strategies tailored to the problem area; 5) review of the prescriptive strategies provided in the previous sessions; 6) reinforcement of taking care of self as a priority; and 7) on-going validation and support. At the conclusion of 3 months (8th session), a reassessment is conducted to determine whether each targeted problem area has been resolved (level of difficulty managing), as well as caregiver upset and confidence (1 = no confidence to 10 = a lot of confidence). Caregivers also receive the Gitlin and Piersol *Caregiver Guide to Managing Dementia* (2014) that provides checklists of nonpharmacological strategies for common behavioral and psychological symptoms along with helpful information about using activities and managing common health challenges (pain, hydration, constipation and so forth).

In Phase II (months 4–6), the interventionist follows up with the caregiver every other week for up to six occasions either in person or by telephone or email depending upon the caregiver's needs and preferences. During these sessions, strategies offered previously are reinforced, education and support are continuously provided, and new challenges are identified and tackled following a similar approach as in the first three months (brainstorming, problem-solving, education, ADS Plus prescription, practice of new strategies). At six months, a reassessment is conducted to determine if targeted problem areas have been resolved, their level of difficulty, as well as the caregiver's level of upset and confidence with each targeted area as well as for new problem areas that may have emerged.

In Phase III of ADS Plus (months 7–12), the interventionist follows up with the caregiver on a monthly basis, either in person, by telephone, or email to determine how the caregiver is managing and if new challenges have emerged that he/she wishes to address. Caregivers are also encouraged to contact the staff interventionist to schedule an appointment during this time if needed. At 12 months (conclusion of program), a reassessment is conducted to determine if targeted problem areas identified throughout the year are resolved, and level of difficulty, upset and confidence with each. Fig. 4 graphically displays the intervention flow.

2.9.1. Interventionists

The ADS Plus program is delivered by an ADS staff member, selected by his or her site director, who meets these qualifications: 1) have a minimum of one year experience in ADS and/or working with the caregivers of older adults with complex conditions; and 2) have a variety of professional backgrounds including care management, nursing, social work, occupational therapy or counseling. The ADS Plus

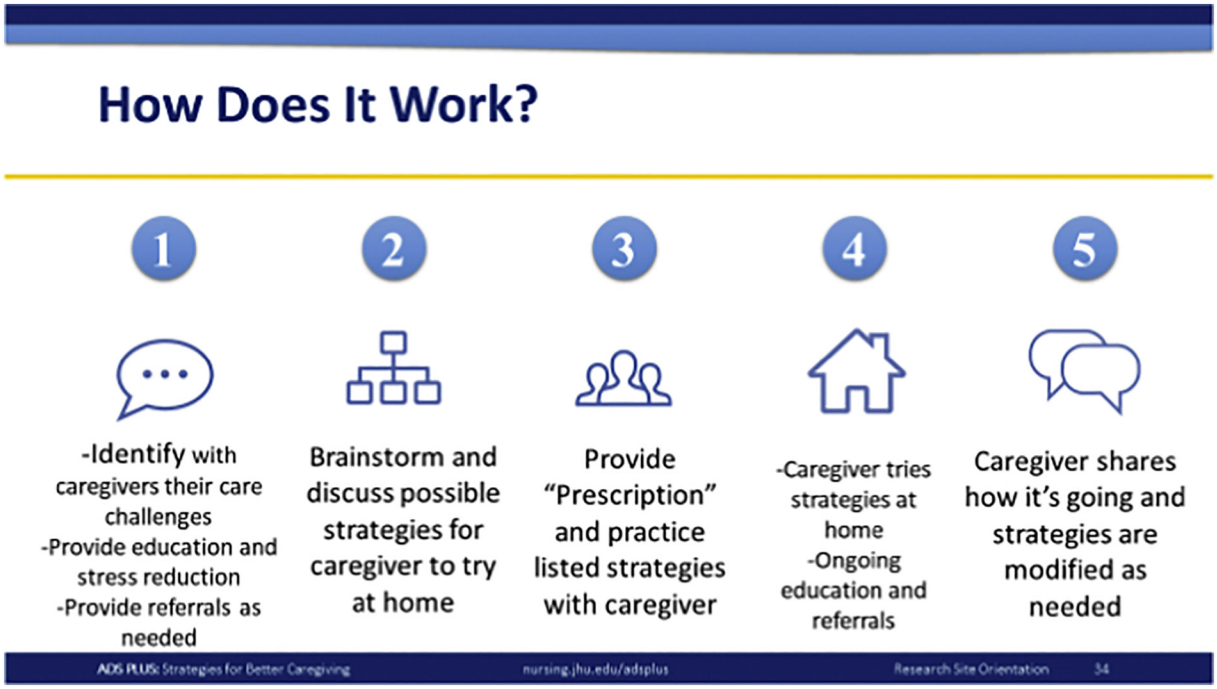

Fig. 4. Flow of ADS Plus.

sites providing the intervention designate a site interventionist as well as a backup interventionist who participate in training. Training consists of readings, viewing 16 brief videos with each describing a component of the intervention and two webinars of two-hour duration each followed by monthly coaching calls upon implementing the program.

Once a caregiver has completed the baseline interview, the JHU research team informs the site interventionist of the caregiver's eligibility and provides contact information for that person. The site interventionist begins ADS Plus within 10 days from the baseline interview. Upon completion of each session (in person, telephone, and/or email > 15 min), a delivery assessment form is completed by the interventionist through the REDCap online data entry system [28]. This form indicates date, time and areas covered (education, skills training, stress reduction, referral and linkage, taking care of self) for each completed session.

3. Fidelity

Our plan for fidelity balances the need for oversight with the realities of a pragmatic trial. A pragmatic trial imposes significant challenges to traditional fidelity monitoring approaches. For example, field conditions and practice exigencies in adult day service sites do not support the use of audiotaping treatment sessions (a common strategy to monitor delivery in efficacy trials). Also, in keeping with a pragmatic trial, we seek to provide sites simple mechanisms for monitoring fidelity that could potentially be used by adult day service staff following the completion of the trial and if ADS Plus is found to be effective.

Conceptually, we are guided by Lichstein, Riedel, and Grieve's [32] model that specifies three areas to consider for enhancing, monitoring, and measuring fidelity: treatment delivery (e.g., program is delivered by interventionists as it is intended), treatment receipt (e.g., program is received by caregivers); and enactment (caregivers use treatment strategies) [5,47].

Table 4 outlines our fidelity considerations for each of these elements. To enhance delivery, we provided a treatment manual, training videos, live webinars, and continuous coaching sessions. To monitor and measure delivery, staff interventionists complete a "delivery assessment form" using an online data entry modality (REDCap). Adapted from the NIH REACH initiative and other caregiver trials, the form asks interventionists to indicate dose, intensity, delivery mode (e.g., telephone, email, face-to-face), treatment component (education, referral and linkage, taking care of self, skills training and support and validation) addressed and caregiver receptivity of session content. Also, qualitative interviews will be conducted with staff at the conclusion of a site's participation in the study to evaluate the ease of using delivery forms and adherence to its completion following completion of each session to determine if this form can serve as a fidelity approach for sites to use upon trial completion.

To enhance receipt, interventionists use the following techniques: brainstorming and joint problem solving to engage caregiver (versus prescriptive or didactic approach); providing written strategies (ADS Plus Prescription) that are introduced and then practiced through role play; and provision of education and skills that are tailored to the specific needs identified by caregivers. We will measure receipt using a semi-structured interview approach with caregivers at 6 months. The interview will ask whether caregivers found the first 6 months of the intervention helpful in addressing their care challenges, whether they believe they and their family member benefited from the intervention, and other similar questions assessing receipt of different components of the intervention. Similarly, enactment will be measured by asking caregivers, as part of semi-structured 6 and 12-month interviews, their use of strategies and perceptions of program benefit. .

We also plan to audiotape interviews (baseline, 3, 6, and 12-month) and review 10% that are randomly selected using checklist monitoring forms developed expressly for the content and protocol expectations of interviews.

4. Data collection and analysis

Data are collected at baseline, 3-, 6- and 12-months. All interviewers undergo standardized training in interviewing caregivers. Data from interviews are collected electronically via REDCap and data will be exported into statistical software packages such as SPSS, Excel or CSV for analysis.

Descriptive analyses and univariate comparisons of the treatment and control group conditions will be conducted. A series of chi-square

Table 4
Summary of enhancement, measurement and monitoring fidelity strategies.

Fidelity Component	Enhancement	Measurement	Monitoring
Delivery (Accuracy of ADS Plus presentation)	Manualization; Experiential and didactic training; Checklists; Guiding scripts	Delivery Assessment form measuring dose, intensity, assessment scores completed by interventionists following completion of each session	PIs will conduct ongoing coaching calls in which cases are presented. PIs will monitor delivery assessment forms to assure they completion.
Receipt (How ADS Plus is utilized)	Modeling skills; Caregiver-centric- approach; Practice opportunities; Written materials and ADS Plus Prescriptions tailored to caregiver identified concerns	Interventionist ratings of caregiver understanding, level of engagement, therapeutic relationship; Caregiver rating of relationship to interventionist	PIs review delivery assessment forms, number of prescriptions
Enactment (Caregiver use of Prescriptions)	Practice opportunities; Problem solving; Action Plans to reinforce strategy use	Interventionist rating of caregiver strategy use, perceived benefits, reduction of unmet needs	PIs review on-going assessments of needs and whether they have been met on the Caregiver Assessment of Management Protocol – Revised (CAMP-R)

and independent sample *t*-tests will be employed on categorical and continuous variables, respectively, to identify differences between the two groups at baseline. In addition to serving as a final data quality check, these analyses will characterize the study sample, assess the effect of randomization in balancing the two groups and determine whether there is a differential dropout rate with respect to potentially important prognostic factors (e.g., age, caregiver education level). Covariates such as comorbidities, gender of caregiver and person with dementia will also be considered. All analyses will use current versions of SAS or Mplus.

Our sample size projections were made with the assumption that typical, parametric, multilevel models would be used to examine intervention effectiveness. Those analytic approaches are described below. However, additional power will likely be made available due to the smaller standard errors that typically result from the optimal balance achieved between intervention and control sites through the re-randomization procedures [33]. Permutation analyses will be conducted as sensitivity analyses to the parametric models described below in order to compare significance levels (*p*-values) and examine empirically the increased power achieved by the re-randomization procedures.

Aim 1 (ADS Plus effects on caregiver wellbeing and depressive symptoms at 6 months). We will use a multilevel analysis approach to examine changes in caregiver outcomes at 6 months consisting of two levels: 1) a participant-level model within each ADS that includes the outcome variable and person-level covariates, and 2) an ADS site-level model that includes an indicator for the randomized intervention (ADS Plus vs. control) and additional program-level covariates. Since ADS Plus versus control randomization will occur at the site-level, the primary independent variable in the proposed investigation consists of an indicator variable for assignment at this level. The baseline value of the outcome will be included as a covariate such that the intervention effect and other predictors of the 6-months post-baseline assessment value will represent effects on change from baseline. Additional analyses will determine if participant-level covariates (socio-demographic characteristics, client cognitive impairment, client health conditions, resources, program characteristics, duration and frequency of ADS use) significantly vary across ADS Plus and control groups at baseline. If statistically significant variations between ADS Plus and control groups are found, these covariates may be included in analytic models to provide additional statistical control. For participants with missing 6-month outcome data, we will use interim 3-month outcome data and baseline covariate information to impute missing data and compare these models with complete case only models in sensitivity analyses to further confirm the robustness of any findings. As mentioned previously, ADS plus utilization data will be examined, and if non-trivial variability in utilization is observed, we will use site- and individual-level predictors of compliance in CACE (Complier Average Causal Effects) models that will test the intervention effect among the subclass of participants who were most likely to use the ADS Plus program. We will conduct similar sets of analyses as the above for our secondary caregiver outcomes (NPI-Q upset with behaviors, burden, and self-efficacy).

Aim 2 (Long-term maintenance effects of ADS Plus at 12 months on caregiver well-being and depressive symptoms). The multilevel analysis strategy described for Aim 1 will be extended to examine long-term maintenance effects at 12 months. In this context, a 3-level design will be adopted with: 1) a within-person time level (6-month, 12-month) nested within 2) the individual participant-level, which remains nested within 3) the ADS site level. A measure of time (e.g., months after participant enrollment in the trial) will be included in the within-person level, and a cross-level intervention*time interaction effect will examine whether, on average, ADS Plus and control caregivers have different trajectories of wellbeing and depressive symptoms over time (Hypothesis #2). Complementary models will "center" the time variable at 6- and 12-months post-baseline to provide specific contrasts of ADS Plus and control conditions at those time points. Statistically significant contrasts at both 6- and 12-months would support an interpretation that the effects of the ADS Plus are maintained over time, whereas a statistically significant intervention*time interaction effect would indicate a different pattern and would be interpreted after careful examination of the condition-specific trajectories.

Aim 3 (Days using ADS and residential placement over 12-months). A Cox proportional hazard survival analysis will determine whether participation in the ADS Plus group results in more days in ADS and less risk for residential care placement over a 12-month period (e.g., admission into a 24-h residential care setting for health care needs, including assisted living, a family care home, or a nursing home) when compared to participants in the control group (Hypothesis #3). The Cox proportional hazard survival model examines whether a particular event occurs (e.g., residential care placement), and if so, when. As above, ADS Plus vs. control membership will be the independent variable of interest in the test of Hypothesis #3; days in ADS and time to residential care placement from date of randomization will serve as the dependent variables in separate analyses. Additional variables will serve as covariates, including time-invariant and time-varying measurements of sociodemographic background, cognitive impairment, resources, ADS program characteristics, frequency and duration of ADS use, caregiver stressors and depressive symptoms, client physical health/function. Likelihood ratio tests and covariate-adjusted odds ratios will be examined to determine the degree to which these variables explain time to residential care placement. It is hypothesized that caregiver participation in ADS Plus will lead to increased days using ADS for their relatives and their delayed residential care placement.

Aim 4 (Assess net financial benefits at 6- and 12-months; Hypothesis #4). The economic analysis will consist of measuring whether ADS Plus (costs of ADS Plus = ADS plus program delivery costs + person with dementia's direct costs + primary caregivers direct costs + primary caregivers lost productivity + primary caregivers time spent providing informal care) results in a cost offset, defined as the net financial benefit

or savings in dollars, versus standard care controls (standard care costs = standard ADS program delivery costs + person with dementia's direct costs + primary caregivers direct costs + primary caregivers lost productivity + primary caregivers time spent providing informal care) controls. Costs captured will include direct (intervention and healthcare service) and indirect (productivity) costs and the analysis will be taken from a societal perspective then repeated from a government payer perspective (combined Medicare and Medicaid). For both groups, days attending ADS will be monetized utilizing service rates per day of participating ADS. Direct costs encompass healthcare service use (inpatient, outpatient, emergency visits, medications), community service use (e.g., meals on wheels, social worker visits, adult day services, formal homemaker/housecleaning services, formal caregiver/home aides), and long-term care use (e.g. admission or respite stays in nursing home, rehabilitation, assisted living, group homes). We will also measure caregiver healthcare service and indirect costs in the form of caregiver productivity losses.

Standard ADS Costs: Days For both groups, days attending ADS will be monetized utilizing service rates per day of participating ADS.

Intervention Costs: Days attending ADS will be monetized utilizing service rates per day of participating ADS. The "Plus" component of the intervention will be added to the standard ADS service rates and ADS Plus intervention costs will be captured using a template outlining cost categories used previously by the investigators [27]. Total intervention costs of delivering the ADS Plus component will be the sum of five direct cost categories: interventionist time for face-to-face, telephone sessions and preparation for mailings, training, intervention materials, and supervision/adherence. Interventionist time will be calculated as the present value of earnings: (number of hours spent delivering ADS Plus) x (interventionist reported wage rates + fringe benefits). Interventionists will log time spent in preparation, documentation and implementation of ADS Plus for each session. Intervention materials will also be logged (e.g., educational materials provided to caregiver). Total intervention costs of ADS Plus will be the sum of five direct cost categories: interventionist time for face-to-face, telephone sessions and preparation for mailings, training, intervention materials, and supervision/adherence. Interventionist time will be calculated as the present value of earnings: (number of hours spent delivering ADS Plus) x (interventionist reported wage rates + fringe benefits). All direct medical costs will be estimated using published sources of Medicare reimbursement rates for inpatient and outpatient medical services (obtained from the U.S. Agency for Healthcare Resource and Quality Health Care Utilization Project National Inpatient Sample; Ingenix National Fee Analyzer). Community-based services and long-term care costs (nursing home, assisted living, hospice facility) will be based on caregiver report as in previous trials.

Person with dementia and primary caregiver's direct costs: Direct costs encompass the person with dementia's and primary caregiver's healthcare service use (inpatient, outpatient, emergency visits, medications), community service use (e.g., meals on wheels, social worker visits, adult day services, formal homemaker/housecleaning services, formal caregiver/home aides), and long-term care use (e.g. admission or respite stays in nursing home, rehabilitation, assisted living, group homes). Direct service encounters will be converted to costs by multiplying number of events by all direct medical costs will be estimated using published sources of Medicare reimbursement rates for inpatient and outpatient medical services (obtained from the U.S. Agency for Healthcare Resource and Quality Health Care Utilization Project National Inpatient Sample; Ingenix National Fee Analyzer). Community-based services and long-term care costs (nursing home, assisted living, hospice facility) will be based on caregiver report as in previous trials.

Caregiver lost productivity and time spent caregiving: Time spent caring for the person with dementia will be captured using the Resource Utilization in Dementia (RUD) instrument [36,43–45]) Cost will be calculated as: (number of hours spent caregiving) x (published hourly wage for a home health aide).

Aim 5 (Effects on client behaviors, caregiver efficacy and upset managing symptoms). We will follow an identical analytic strategy as for Aims 1 and 2.

Aim 6 (Mediational pathways of treatment change). For the quantitative approach, we will use longitudinal mediation models to evaluate the indirect or mediated effects of several potential mediators (change in unmet needs, social support, and stress/upset) on the primary outcomes. An "a" path represents the effect of the intervention condition on the mediator, and the "b" path is the effect of the mediator on the outcome. The "a*b" mediated effect is tested for significance using a standard error that can be calculated using the Sobel method. The unmediated or direct effect, c', represents the intervention effect not explained by the mediation pathway, and the sum of a*b and c' comprises the total (baseline-adjusted) effect of intervention on a primary outcome variable. In addition to testing these estimates for statistical significance, the proportion of the total intervention effect that could be attributed to each mediator will be calculated with ((a*b)/((a*b) + c')).

For the qualitative approach, analyses of the secondary aim's semi-structured interviews will primarily focus on thematic content analysis of open-ended data to examine ADS Plus utility and mechanisms of benefit. Systematic reading and rereading of qualitative content and hand coding of a significant proportion of this content will yield understandings of meanings in their conversational or observational contexts. Dr. Gaugler and his team will independently develop coding categories with descriptors (via hand-coding and NVivo) and generate a shared coding scheme reflecting the primary categories of transcriptions. Through repetition of this procedure, a consensus perspective on appropriate coding categories and themes concerning mechanisms of benefit will be developed. Grounded theory techniques will guide analyses. All open-ended data collected will be first read by Dr. Gaugler, Co-I's Dr. Garcia and Dr. Peden-McAllpine (qualitative research experts), and a research assistant to identify textual elements that emerge repeatedly (i.e., codes). Codes will be clustered into larger categories that are later used to construct major thematic elements from the text (using nVivo 10 analytic software). During weekly analytic meetings, the PI, Drs. Garcia and Peden-McAlpine, and a research assistant will discuss their own independently identified codes to reach a consensus about specific codes, categories, and themes that emerge from the qualitative data (decisions will be noted in an audit trail). In addition, patterns linking particular themes will be identified and discussed in successive meetings to identify ADS Plus' pathways to benefit for caregivers. UMN (University of Minnesota) team meetings will facilitate exploration of alternative interpretations of the qualitative data and provide a check as to data quality and richness. Additional mixed methods analyses will also take place. Thematic codes and categories of implementation and mechanisms of benefit will be cross-tabulated with empirical data from the RCT to evaluate if findings diverge, converge, or highlight path-ways toward additional questions and analysis. Findings that diverge will be treated as "interpretive opportunities" to either demonstrate that no true discrepancy in efficacy exists or to propose the phenomenon that explains the apparent discrepancy. Specifically, empirical outcome data of the randomized controlled component will be sorted according to the qualitative themes that emerge in the post-RCT semi-structured interview component with purposively selected caregivers and staff from ADS programs. This integration will provide an empirical context for caregivers' and ADS staff members' statements as to why ADS Plus was perceived to work or not. The comparative, mixed method analysis approach may also suggest that those clients or caregivers who demonstrate the most improvement during ADS Plus implementation indicate certain themes more often than caregivers indicating the least improvement; variations in themes across sites may also suggest those programmatic-level variables that are essential for implementing ADS Plus. Treatment fidelity analysis. Similar to above, descriptive and univariate analyses of quantitative

data collected from close-ended, post-session delivery assessment forms and checklists will be utilized; also, open-ended data collected during treatment fidelity procedures will be analyzed using thematic content analysis (detailed above). Analysis of descriptive quantitative data and qualitative themes will inform whether ADS Plus implementation occurred as intended; if not, the PIs (Drs. Gitlin/Gaugler) will address in monthly calls with ADS Plus interventionists to recalibrate intervention delivery.

5. Discussion

Over 16 million family caregivers in the United States provide ongoing support to individuals living with dementia over the long trajectory of the disease and this number will escalate with the aging of our society. Most caregivers assume responsibilities without access to disease education and skills to manage the vicissitudes of care challenges. Caring for an individual living with dementia can place caregivers at risk for depression, burden, poor health and financial burdens. Augmenting existing community-based resources, such as adult day services, with evidence-based programs designed to support family members in their caregiving efforts is a promising approach that can expand reach and implementation potential of previously scientifically-tested interventions.

This clinical trial is the first large-scale study with an adequate comparison group to evaluate an augmentation to adult day services. The few previous translational and implementation studies of evidence-based caregiver programs have used a pre-post study design and have lacked one or more comparison groups [4,48]. The focus on enrolling caregivers from a range of race, ethnic, socioeconomic backgrounds, and geographic locations will enable an examination of effectiveness under different contexts, adult day service organizational conditions and characteristics of clients. Also, we will examine whether spouses versus non-spouses or men versus women benefit more from the ADS Plus program to determine applicability of the approach and if adaptations are necessary for certain groups. Additionally, the randomization and re-randomization techniques used address imbalances that might have occurred with a single randomization process and ensures that a balance was achieved across the multiple site-level characteristics (ADS size, geographic location, staff-client ratio, etc.).

An innovative feature of this study is that it allows for an investigation of the implementation process and the facilitators and challenges. Lewin's force field provides a framework from which to identify and understand both positive and negative valences and the relative strength by which each impinges on implementation behavior and program adoption by caregivers and ADS sites. Lastly, the study values the economic benefits of the intervention; that is, we seek to determine if ADS Plus costs will be offset by savings in direct and indirect costs.

The ADS Plus program is tailored to the needs of the caregiver. In the program, the caregiver initially identifies three to five problems areas they wish to address. Over the course of 12 months, caregivers learn a particular approach to manage challenges; this includes, clear identification of the problem, problem solving about the characteristics of the problem, brainstorming possible solutions, trying solutions and then evaluating what works and what does not, and repeating the process as necessary. The ADS Plus interventionist also provides ongoing dementia education, referral and linkage (if needed) to address unmet needs and a prescription for each problem area. “Prescriptions” that provide specific strategies to address a caregiver-identified challenge are provided. Strategies provided include for communication, simplifying tasks, simplifying the environment, taking care of self). Caregivers receive the Gitlin and Piersol Caregiver Guide (2014) that provides checklists of strategies to deploy to address common behavioral and psychological symptoms. Training in the ADS Plus program is necessary and involves how to assess the caregiver's readiness as well as the person with dementia's cognitive and physical functioning and daily routines. Training also incorporates how to best elicit caregivers' participation and identification of care challenges.

A few possible limitations of the proposed protocol should be noted. First, the cognitive functioning of the person living with dementia is not directly assessed, although caregivers report cognitive status using the IQCode. Another possible limitation is reliance on family caregivers to self-report their well-being and depressive symptoms and the frequency and severity of behavioral and psychological symptoms of persons with dementia. Nevertheless, our approach reflects the state-of-the science in measurement widely used in drug and non-drug trials. Another design challenge is ensuring standard delivery across sites with diverse resources, staff turnover and changes in mission. These limitations must be weighed against the benefits afforded by the pragmatic orientation of this trial.

Our findings will have broad clinical significance. If ADS Plus is found to be effective, it would suggest that augmenting services for older adults may be a potential model for scaling up evidence-based caregiver support programs. Furthermore, our design will elucidate the model's financial value and afford an understanding of ways to maximize caregiver- and site-receptivity to aid in its subsequent widespread dissemination and implementation. The importance of this trial is underscored by the high rates of depression among caregivers of people with dementia, the projected growth in the number of new cases of dementia in the coming decades and the critical role that community-based programs, such as adult day services, have in supporting families living with dementia.

Funding source

Funded by the National Institute on Aging (Grant # R01 AG049692).

Financial disclosure

The authors have no financial relationships relevant to this article to disclose.

Acknowledgements

The study protocol reported in this article is supported in part by a grant from the National Institute on Aging (R01 AG049692).

References

[1] Alzheimer's Association, 2018 Alzheimer's disease facts & figures, (2018) Retrieved from https://www.alz.org/media/HomeOffice/Facts%20and%20Figures/facts-and-figures.pdf.
[2] C.S. Aneshensel, L.I. Pearlin, J.T. Mullan, S.H. Zarit, C.J. Whitlatch, G.M. Williamson, Profiles in Caregiving: The Unexpected Career, Academic Press, San Diego, 1995.
[3] S.H. Belle, L. Burgio, R. Burns, D. Coon, S.J. Czaja, D. Gallagher-Thompson, L.N. Gitlin, J. Klinger, K.M. Koepke, C.C. Lee, J. Martindale-Adams, L. Nichols, R. Schulz, S. Stahl, A. Stevens, L. Winter, S. Zhang, Enhancing the quality of life of dementia caregivers from different ethnic or racial groups: a randomized, controlled trial, Ann. Intern. Med. 145 (10) (2006) 727–738, https://doi.org/10.7326/0003-4819-145-10-200611210-00005.
[4] L.D. Burgio, I.B. Collins, B. Schmid, T. Wharton, D. McCallum, J. DeCoster, Translating the REACH caregiver intervention for use by area agency on aging personnel: the REACH OUT program, The Gerontologist 49 (1) (2009) 103–116, https://doi.org/10.1093/geront/gnp012.
[5] L.D. Burgio, R. Allen-Burge, D.L. Roth, M.S. Bourgeois, K. Dijkstra, J. Gerstle, ... L. Bankester, Come talk with me, The Gerontologist 41 (4) (2001) 449–460, https://doi.org/10.1093/geront/41.4.449.
[7] L.D. Burgio, A. Stevens, K.L. Burgio, D.L. Roth, P. Paul, J. Gerstle, Teaching and maintaining behavior management skills in the nursing home, The Gerontologist 42 (4) (2002) 487–496, https://doi.org/10.1093/geront/42.4.487.
[8] P. Campbell, J. Wright, J. Oyebode, D. Job, P. Crome, P. Bentham, ... C. Lendon, Determinants of burden in those who care for someone with dementia, Int. J. Geriat. Psychiatry 23 (10) (2008) 1078–1085, https://doi.org/10.1002/gps.2071.
[9] J. Cohen, Statistical Power Analysis for the Behavioral Sciences, L. Erlbaum Associates, Hillsdale, NJ, 1988.
[10] K.M.T. Collins, A.J. Onwuegbuzie, Q.G. Jiao, A mixed methods investigation of

mixed methods sampling designs in social and health science research, J. Mixed Methods Res. 1 (3) (2007) 267–294, https://doi.org/10.1177/1558689807299526.
[11] C. Cooper, C. Katona, M. Orrell, G. Livingston, Coping strategies, anxiety and depression in caregivers of people with Alzheimer's disease, Int. J. Geriat. Psychiatry 23 (9) (2008) 929–936, https://doi.org/10.1002/gps.2007.
[12] K.E. Covinsky, R. Newcomer, P. Fox, J. Wood, L. Sands, K. Dane, K. Yaffe, Patient and caregiver characteristics associated with depression in caregivers of patients with dementia, J. Gen. Intern. Med. 18 (12) (2003) 1006–1014, https://doi.org/10.1111/j.1525-1497.2003.30103.x.
[13] G.M. Curran, M. Bauer, B. Mittman, J.M. Pyne, C. Stetler, Effectiveness-implementation hybrid designs, Med. Care 50 (3) (2012) 217–226, https://doi.org/10.1097/mlr.0b013e3182408812.
[14] H. Dabelko-Schoeny, S. King, In their own words: participants' perceptions of the impact of adult day services, J. Gerontol. Soc. Work. 53 (2) (2010) 176–192, https://doi.org/10.1080/01634370903475936.
[15] N.L. Fields, K.A. Anderson, H. Dabelko-Schoeny, The effectiveness of adult day services for older adults, J. Appl. Gerontol. 33 (2) (2014) 130–163, https://doi.org/10.1177/0733464812443308.
[16] J.E. Gaugler, M. Reese, M.S. Mittelman, Effects of the NYU caregiver intervention-adult child on residential care placement, The Gerontologist 53 (6) (2013) 985–997, https://doi.org/10.1093/geront/gns193.
[17] J.E. Gaugler, D.L. Roth, W.E. Haley, M.S. Mittelman, Can counseling and support reduce burden and depressive symptoms in caregivers of people with alzheimer's disease during the transition to institutionalization? Results from the New York University Caregiver Intervention Study, J. Am. Geriatr. Soc. 56 (3) (2008) 421–428, https://doi.org/10.1111/j.1532-5415.2007.01593.x.
[18] J.E. Gaugler, D.L. Roth, W.E. Haley, M.S. Mittelman, Modeling trajectories and transitions, Nurs. Res. *60* (Supplement) (2011) S28–S37, https://doi.org/10.1097/NNR.0b013e318216007d.
[19] L.N. Gitlin, M. Corcoran, Occupational Therapy and Dementia Care: The Home Environment Skill-Building Program for Individuals and Families, American Occupational Therapy Association, 2005.
[20] L.N. Gitlin, K. Reever, M.P. Dennis, E. Mathieu, W.W. Hauck, Enhancing quality of life of families who use adult day services: short- and long-term effects of the Adult Day Services Plus Program, The Gerontologist 46 (5) (2006) 630–639, https://doi.org/10.1093/geront/46.5.630.
[21] L.N. Gitlin, N.A. Hodgson, S.S.W. Choi, Home-Based Interventions Targeting Persons with Dementia: What Is the Evidence and where Do we Go from Here? An Evidence-Based Approach, Dementia Care, 2016, pp. 215–230, https://doi.org/10.1007/978-3-319-18377-0.
[22] L.N. Gitlin, K. Marx, I.H. Stanley, N. Hodgson, Translating evidence-based dementia caregiving interventions into practice: state-of-the-science and next steps, Gerontologist 55 (2) (2015) 210–226, https://doi.org/10.1093/geront/gnu123.
[24] L.N. Gitlin, C.V. Piersol, A clinician's Guide to Supporting People Living with Dementia and their Care Partners, Camino Books, Inc., 2014.
[25] L.N. Gitlin, L. Winter, M.P. Dennis, N. Hodgson, W.W. Hauck, A biobehavioral home-based intervention and the well-being of patients with dementia and their caregivers, JAMA 304 (9) (2010) 983, https://doi.org/10.1001/jama.2010.1253.
[26] L.N. Gitlin, L. Winter, M.P. Dennis, N. Hodgson, W.W. Hauck, Targeting and managing behavioral symptoms in individuals with dementia: a randomized trial of a nonpharmacological intervention, J. Am. Geriatr. Soc. 58 (8) (2010) 1465–1474, https://doi.org/10.1111/j.1532-5415.2010.02971.x.
[27] L.N. Gitlin, L.F. Harris, M. McCoy, N.L. Chernett, E. Jutkowitz, L.T. Pizzi, A community-integrated home based depression intervention for older African Americans: descripton of the Beat the Blues randomized trial and intervention costs, BMC Geriatr. 12 (1) (2012) 4.
[28] P.A. Harris, R. Taylor, R. Thielke, J. Payne, N. Gonzalez, J.G. Conde, Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support, J. Biomed. Inform. 42 (2) (2009) 377–381, https://doi.org/10.1016/j.jbi.2008.08.010.
[29] D.G. Harwood, W.W. Barker, M. Cantillon, D.A. Loewenstein, R. Ownby, R. Duara, Depressive symptomatology in first-degree family caregivers of alzheimer disease patients: a cross-ethnic comparison, Alzheimer Dis. Assoc. Disord. 12 (4) (1998) 340–346, https://doi.org/10.1097/00002093-199812000-00015.
[30] J.P. Lendon, V. Rome, Variation in adult day services center participant characteristics, by center ownership: United States, NCHS Data Brief, no 296, National Center for Health Statistics, Hyattsville, MD, 2016, p. 2018.
[31] K. Lewin, Field Theory in Social Science, 1st ed., Harper & Row, 1964.
[32] K.L. Lichstein, B.W. Riedel, R. Grieve, Fair tests of clinical trials: a treatment implementation model, Adv. Behav. Res. Ther. 16 (1) (1994) 1–29, https://doi.org/10.1016/0146-6402(94)90001-9.
[33] A. Mason, H. Weatherly, K. Spilsbury, H. Arksey, S. Golder, J. Adamson, ... C. Glendinning, A systematic review of the effectiveness and cost-effectiveness of different models of community-based respite care for frail older people and their carers, Health Technol. Assess. 11 (15) (2007), https://doi.org/10.3310/hta11150.
[34] K.L. Morgan, D.B. Rubin, Rerandomization to improve covariate balance in experiments, Ann. Stat. 40 (2) (2012) 1263–1282, https://doi.org/10.1214/12-AOS1008.
[35] J.M. Morse, B. Doberneck, Delineating the concept of hope, Image 27 (4) (1995) 277–285, https://doi.org/10.1111/j.1547-5069.1995.tb00888.x.
[36] S. Neubauer, R. Holle, P. Menn, E. Grässel, A valid instrument for measuring informal care time for people with dementia, Int. J. Geriat. Psychiatry 24 (2009) 275–282.
[38] L.I. Pearlin, J.T. Mullan, S.J. Semple, M.M. Skaff, Caregiving and the stress process: an overview of concepts and their measures, The Gerontologist 30 (5) (1990) 583–594, https://doi.org/10.1093/geront/30.5.583.
[39] K.E. Reever, E. Mathieu, M.P. Dennis, L.N. Gitlin, Adult day services plus: augmenting adult day centers with systematic care management for family caregivers, Alzheimer's Care Today 4 (4) (2004) 332–339 Retrieved from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Augmenting+Adult+Day+Centers+With+Systematic+Care+Management+for+Family+Caregivers#3.
[40] R. Schulz, L. Burgio, R. Burns, C. Eisdorfer, D. Gallagher-Thompson, L.N. Gitlin, D.F. Mahoney, Resources for Enhancing Alzheimer's Caregiver Health (REACH): overview, site-specific outcomes, and future directions, The Gerontologist *43* (4) (2003) 514–520 Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12937330.
[41] R. Schulz, J. Eden (Eds.), Families Caring for an Aging America, National Academies Press, Washington, D.C., 2016, , https://doi.org/10.17226/23606.
[42] A.L. Strauss, J.M. Corbin, Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory, Sage Publications, Thousand Oaks, 1998.
[43] A. Wimo, A.L. Wetterholm, V. Mastey, B. Winblad, Evaluation of the resource utilization and caregiver time in anti-dementia drug trials- a qualitative battery, in: A. Wimo, A. Wimo, B. Jönsson, G. Karlsson, B. Winblad (Eds.), The Health Economics of Dementia, John Wiley & Sons, London, England, 1998, pp. 465–499.
[44] A. Wimo, N. Gunilla, Validity and reliability of assessments of time: comparisons of direct observations and estimates of time by the use of the resource utilization in dementia (RUD)-instrument, Arch. Gerontol. Geriatr. 44 (2007) 71–81.
[45] A. Wimo, L. Jonsson, A. Zbrozek, The Resource Utilization in Dementia (RUD) instrument is valid for assessing informal care time in community-living patients with dementia, J. Nutr. Health Aging 14 (2010) 685–690.
[46] Z. Xu, J.D. Kalbfleisch, Repeated randomization and matching in multi-arm trials, Biometrics 69 (4) (2013) 949–959, https://doi.org/10.1111/biom.12077.
[47] Gitlin, L. N. & Parisi, J, M. (2016) in Gitlin, L. N. and Czaja, S. J, Behavioral Intervention Research: Designing, Evaluating and Implementing. Springer Book Publ. pp. 215-243
[48] L.O. Nichols, J. Martindale-Adams, R. Burns, M.J. Graney, J. Zuber, Translation of a Dementia Caregiver Support Program in a Health Care System—REACH VA, Arch. Intern. Med. 171 (4) (2011) 353–359.