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Nurse Care Coordination and Technology Effects on Health Status of Frail Elderly via Enhanced Self-management of Medication: Randomized Clinical Trial to Test Efficacy

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Abstract

Background—Self-management of complex medication regimens for chronic illness is challenging for many older adults.

Objectives—The purpose of this study was to evaluate health status outcomes of frail older adults receiving a home-based support program that emphasized self-management of medications using both care coordination and technology.

Design—Randomized controlled trial with three arms and longitudinal outcome measurement.

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Setting—Older adults having difficulty self-managing medications ($N = 414$) were recruited at discharge from three Medicare-certified home health care agencies in a Midwestern urban area.

Methods—All participants received baseline pharmacy screens. The control group received no further intervention. A team of advanced practice nurses and registered nurses coordinated care for 12 months to two intervention groups who also received either an MD.2 medication-dispensing machine or a medplanner. Health status outcomes (Geriatric Depression Scale, Mini-Mental Status Examination, Physical Performance Test, and the SF-36 Physical Component Summary and Mental Component Summary) were measured at baseline, 3, 6, 9, and 12 months.

Results—After covariate and baseline health status adjustment, time by group interactions for the MD.2 and medplanner groups on health status outcomes were not significant; time by group interactions were significant for medplanner and control group comparisons.

Discussion—Participants with care coordination had significantly better health status outcomes over time than those in the control group, but addition of the MD.2 machine to nurse care coordination did not result in better health status outcomes.

Keywords

health services for the aged; care coordination; medication therapy management; quality of life; randomized controlled trial

For many older adults, the day-to-day realities of managing a chronic illness can be overwhelming. Even mild cognitive impairment can result in care missteps and errors that can cause serious harm. Health care is often delivered in a complicated maze that provides minimal support and creates multiple barriers to persons vulnerable to expensive, preventable health events. Care coordination programs and use of technology are two mechanisms to support those older adults.

Medications are keys to the treatment of many chronic illness but taking medications as prescribed is a complex task. Dosage schedules may be complex, with multiple prescriptions taken at different frequencies using a variety of actions needed to enact a regimen (Maddigan, Farris, Keating, Wiens, & Johnson, 2003). There may be frequent changes in medication dosage, frequency, or both. As the number of prescribed doses of medication increases, the extent to which medications are taken as prescribed decreases (Claxton, Cramer, & Pierce, 2001).

In this study, we targeted older adults with problems self-managing medication regimens for chronic disease. Nurse care coordination, with and without medication dispensing technology, was tested for efficacy in helping older adults self-manage chronic illness.

Theory and Review of Literature

Individual and family self-management theory (IFSMT; Ryan & Sawin, 2009) guided this study. In IFSMT, self-management is viewed as a complex and dynamic phenomenon incorporating context, process, and both proximal and distal outcomes.

Context

Context incorporates risk and protective factors that influence self-management processes and outcomes, including condition-specific characteristics such as chronicity and complexity of a medication regimen. Chronic conditions such as depression and dementia that affect cognition are associated with problems in medication self-management, especially among the oldest old (DiMatteo, Lepper, & Croghan, 2000; Maddigan et al., 2003). Forgetting to

take medication is a frequent problem (Nikolaus et al., 1996). Physical and sensory impairments can interfere with opening medication bottles or blister packs, reading labels and educational materials, and swallowing large pills (Mowerson, 2002; Wilson, Kaiser, & Morley, 2001).

Physical and social environmental factors may enhance or diminish self-management (DiMatteo, 2004). Living with family is helpful when family members remind elders to take medicine or assist them with tasks related to medication management (DiMatteo, 2004; Doshi, Zuckerman, Picot, Wright, & Hill-Westmoreland, 2003). Individual characteristics such as age and race also influence self-management. Polypharmacy increases with age (Veehof, Stewart, Haaijer-Ruskamp, & Jong, 2000). Among elders, African Americans have more problems in medication self-management (Gerber, Cho, Arozullah, & Lee, 2010; Krantz et al., 2011) associated with mistrust of health care providers and the pharmaceutical industry, experiences with racism, and poor communication may affect medication management (Lewis, Askie, Randleman, & Shelton-Dunston, 2010).

Process

Self-management is a dynamic process with interactions among condition-specific knowledge and beliefs, self-regulation skills and abilities, and social facilitation. Variation in perception of seriousness of illness and vulnerability to complications is related to medication management (Ogedegbe, Harrison, Robbins, Mancuso, & Allegrante, 2004). Effectiveness of patient education on medication self-management may be a function of emphasis, such as self-efficacy, commitment (Putnam, Finney, Barkley, & Bonner, 1994) and use of self-regulation tools such as calendars or schedules (Robbins, Rausch, Garcia, & Prestwood, 2004).

Cognitive prostheses that minimize the importance of comprehension, working memory, prospective memory (remembering to take the medication) are available and useful (Cramer, 1998). These include medplanners, reminder devices, and machines that dispense medication. The medplanner is a plastic holder with compartments to hold medications and is one of the most commonly used devices. Other devices provide prompts to take medication such as voice-mail reminders, video-telephone reminders, automated telephone calls, medication caps equipped with digital alarm clocks, and totally automated computer-controlled telecommunications systems (Buckwalter, Wakefield, Hanna, & Lehmann, 2004; Naditz, 2008; Sherrard et al., 2009). However, device usability factors such as display screen size or reliance on prospective memory functions may impede effectiveness for tasks such as medication ordering, organizing, monitoring, and making medication changes in older adults (Insel, Morrow, Brewer, & Figueredo, 2006).

Social Facilitation

Social influence, support, and negotiated collaboration (Ryan & Sawin, 2009), including care coordination use social facilitation to support older adults as they navigate complex self-management regimens. A wide variety of nurse care coordination models (Brown, Peikes, Chen, & Schore, 2008; E. A. Coleman, Parry, Chalmers, & Min, 2006; K. Coleman, Austin, Brach, & Wagner, 2009; Naylor et al., 2004) have common elements including creating an initial comprehensive assessment, developing a plan of care, monitoring, and revising the plan as required (Chen, Brown, Archibald, Aliotta, & Fox, 2000). Medication management and arranging support services are common intervention targets. Care coordination programs have been more effective when care coordinators have more face-to-face time with their patients, serve as a communication hub for care providers, contact patients while in the hospital, and support patient medication management working with prescribers and pharmacists (Brown, Peikes, Peterson, Schore, & Razafindrakoto, 2012).

Outcomes

The proximal outcome of self-management and distal outcomes like health status, quality of life, and cost of care are of interest. Programs designed to enhance self-management, such as medication management in older adults, are effective in improving medication adherence (Conn et al., 2009), but studies of care coordination programs in particular have yielded mixed results related to their effect on distal clinical outcomes (Conn et al., 2009; de Bruin et al., 2012; Peikes, Chen, Schore, & Brown, 2009; You, Dunt, Doyle, & Hsueh, 2012). There is especially limited evidence on the effect of care coordination cognitive functioning, depressive symptoms, functional status, and quality of life (de Bruin et al., 2012). We therefore undertook this study with the purpose of testing both technology and nurse coordination to assist frail older adults self-managing their health care. Clinical outcomes of interest were depression, cognition, quality of life, and functional status.

Methods

Design

This three-arm randomized controlled trial with outcomes measured longitudinally was conducted over a one-year period in persons discharged from home health care from three Medicare-certified home health care agencies in Milwaukee County. The study consisted of a control group and two intervention groups that received nurse care coordination and either the MD.2 medication-dispensing machine or a simple box with separate compartments for individual medication times (medplanner; planner group).

Sample

Inclusion criteria for the study were (a) age 60 or older, (b) Medicare primary payer, (c) impaired ability to manage medications as indicated by a score of 1 or higher on Outcome and Assessment Information Set (OASIS; Shaunnessy, Crisler, Hittle, & Schlenker, 2002) item M0780 (indicates inability to independently take correct oral medications at the proper dose at the proper time), and/or impaired cognitive functioning but able to follow directions with prompting as indicated by a score of 1 or 2 on OASIS item M0560, and (d) working telephone line and electricity. Exclusion criteria were (a) terminal diagnosis or hospice care that would make attrition likely and (b) use of other device for medications (such as pager as a prompt).

Over a three-year period, 456 patients provided verbal permission to a home care nurse for the research staff to contact them. Participants were randomly assigned to one of the three study arms, using a computer program developed by the study statistician, before research staff contacted potential participants. Those who declined to participate in the assigned group were no longer eligible for the study. A total of 414 older adults signed a written informed consent and were admitted to the study. Mid-study the randomization program was weighted to account for the higher attrition rate in the two intervention groups at randomization. Logistic regression analysis revealed assignment to the MD.2 group a significant predictor of higher first-quarter attrition while accounting for other baseline covariates, but there was no difference in attrition among study groups after the first quarter.

Due to the nature of the intervention and because data were collected in the participant's home, it was not possible to blind providers and data collectors (the MD.2 was usually visible in the participant's home). Research data collectors, however, did not deliver the intervention, and interrater reliability among data collectors was monitored closely. The University of Wisconsin-Milwaukee Institutional Review Board approved the protocol.

Pharmacy Screen

Each participant received a pharmacy screen on admission because older adults are vulnerable to adverse drug reactions. After obtaining written consent, a pharmacist and an advanced practice nurse (APN) reviewed all medications identified by the participant with corresponding medical diagnoses (when available from the home care record). In the review they used both the program FirstDataBank® to identify drug interactions and Beers criteria for inappropriate medication use in the elderly (Fick et al., 2003). All participants received the pharmacy screen to remove the influence of the review on participant outcomes. Each participant's prescribing provider(s) received the results of the pharmacy screens. APNs did not prescribe medications and although the pharmacy screen offered suggestions to prescribing providers, the main purpose of the pharmacy screen was to ensure that the medications loaded into the MD.2 machine or medplanner were not harmful to the study participant.

Intervention

Control group—The control group received no intervention beyond the pharmacy screen. We notified all prescribing providers that their patient was a participant in the study, was in the control group, and would not receive any additional intervention from the research project.

Nurse care coordination—A team of nurse providers delivered nurse care coordination to both intervention groups: one that received the MD.2 and nurse care coordination (MD.2 group) and one that received a medplanner and nurse care coordination (planner group). The intervention team consisted of APNs and RNs. Nurse care coordinators worked closely with participants to identify their goals in care and provided education and tools for the participants to manage their chronic conditions. Self-regulation was enhanced through use of the MD.2 machine or medplanner that provided prompts for medication administration as well as feedback on missed doses. Nurse care coordination enhanced participant ability to communicate with multiple physicians, pharmacies, social service agencies, and other individuals or organizations involved in their health care.

An APN coordinated the clinical portion of the research study, assigned the intervention nurses to participants, and assisted the nurses in creating plans of care specific to the clinical conditions of each participant. The care plans included monitoring of specific signs and symptoms related to medical diagnoses, medications, and other individualized problem areas. The nurse care coordinator communicated with the participant ordering physician(s), pharmacist(s) and visited the participants at least every 2 weeks to fill their MD.2 or medplanner and perform the activities identified in their care plans. Nurse care coordinators made additional visits if a participant had a change in medication type, dose, or frequency before the biweekly scheduled visit or when clinical condition required additional visits. If a participant was hospitalized, the nurse care coordinator visited during, and after hospitalization and participated in discharge planning.

MD.2—The MD.2 is a medication-dispensing system (Reminders, 2011) that stores up to 60 plastic reusable cups, preloaded in a locked compartment. At preprogrammed intervals, the user presses a large red exterior button, and a plastic cup containing the medications appears in a chute. Reminders are both audible (spoken words and tones) and visual (a flashing red strobe light). If a user does not push the dispensing button after the first prompt, the machine continues prompting every three minutes for 45 minutes. If after 45 minutes the user does not push the dispensing button, the machine notifies an identified responder (in this study, either a family member or the on-call research nurse). Also, online compliance reports are provided to monitor missed doses (Reminders, 2011).

Medplanner—The medplanner is a simple box with separate compartments for individual medication times over the course of a week. Medplanners are commonly used by older adults to organize and remember to take their medications and are a standard nursing intervention for older adults with problems managing medications (Feldman et al., 2009). Intervention nurses filled two medplanners to cover a 2-week period. Also, nurses recorded the number of medications remaining in the medplanners before refilling.

Training

Nurse care coordinators received a comprehensive training program related to self-management, nurse coordination, drug use in the elderly, appropriate medication use, physiology of aging, and issues in medication management. Intervention protocols were developed to guide care provision (Marek & Antle, 2008). The CareFacts™ (2012) computer system, designed for documentation against participant-specific intervention protocols, was used for clinical documentation. The APN reviewed initial care plans and documentation for each visit and made monthly or as-needed supervisory visits to observe implementation of the research intervention and educate research staff.

Measures

Data collection in the study began in May 2006 and ended in June 2010. At baseline we collected data related to age, race/ethnicity, living arrangement, medical diagnoses, and payment source. Sources of information were the participant, participant family or significant other(s), and the prescribing provider(s). The Medication Complexity Index (MCI; Conn, Taylor, & Kelley, 1991) was used to measure complexity of the medication regimen, including (a) the number of medications in the regimen, (b) number of doses per day, (c) additional directions that must be followed, and (d) mechanical actions necessary to administer the medications.

The proximal outcome of medication self-management was measured in the two intervention groups. In the MD2 group, the machine recorded missed medication doses. In the planner group, the nurse counted medications left in the medplanner during the visit to refill the medplanner. The number of correct doses per month was divided by the total number of medication doses in that month to determine the rate of correct medication self-management. No measure of missed doses was conducted on the control group.

The following clinical health status outcomes were measured at baseline, 3, 6, 9, and 12 months: (a) quality of life based on scores from the SF-36 Physical Component Scale [PCS] and Mental Component Scale [MCS] (Ware & Sherbourne, 1992); (b) depression based on scores from the Geriatric Depression Scale (GDS; de Craen, Heeren & Gussekloo, 2003); (c) cognition based on the Mini-Mental Status Examination [MMSE] (Folstein, Folstein, & McHugh, 1975); and (d) functional status based on the Physical Performance Test [PPT] (Reuben & Siu, 1990).

Analysis

To give the study an 85% probability of detecting a 2-point difference in SF-36 PCS and MCS among groups, with a 5% Type I error rate, a sample of 100 per group was required. Based on experience in a previous study of chronically ill older adults, we expected an attrition rate of 25% over a one-year period (Marek et al., 2005; Marek, Popejoy, Petroski, & Rantz, 2006). Thus, an additional 100 participants were enrolled to account for the expected participant attrition.

Summary statistics were calculated by group. Covariates included IFSMT contextual variables of living arrangements, chronic medical conditions, MCI, race/ethnicity, and age. The following hypotheses were tested:

H1: Controlling for the IFSMT contextual variables, the MD.2 group will exhibit more positive PCS, MCS, GDS, MMSE, and PPT trajectories than the planner group.

H2: Controlling for the IFSMT contextual variables, the planner group will exhibit a more positive PCS, MCS, GDS, MMSE, and PPT trajectories than the control group.

An intention-to-treat analysis was conducted. Participants who withdrew from the study after baseline but before the full 12 months were included; the last value carried forward method was used to complete the data series (Fitzmaurice, Laird, & Ware, 2004). At baseline, four participants were physically unable to complete the PPT; one participant was aphasic and could not complete the MMSE; and seven participants did not complete the SF-36 PCS and MCS, most often due to fatigue after completing the other measures. Missing data after baseline arose when hospitalization occurred at the time data collection was scheduled. Multiple imputation was used for missing values in the longitudinal models. Parameters for PCS, MCS, GDS, MMSE, and PPT trajectory models with linear time effects, random intercepts, fixed slopes within groups, and an AR(1) error covariance structure were estimated using SAS Proc MIXED, Version 9.12.

Results

Of the 456 participants who provided verbal permission to be contacted by research staff, 42 did not enroll into the study (Figure 1). The major reasons for not enrolling were MD.2 related, such as the machine was too big or not wanting someone to assist with medication set up. Of the 414 who enrolled, 30 decided at baseline not to continue in the study because of the machine, not wanting assistance with medications, or both. The third most common reason for leaving the study was hospitalization greater than 2 months. If participants were hospitalized for less than 2 months, they continued in the study. A total of 301 participants completed the 12-month study period.

Characteristics of participants in each group are shown in Table 1. Average age in the three groups ranged from 78.2-79.6. The majority of participants in each group were female. The control group was less diverse (90% White) compared to the MD.2 and planner groups (82% and 83% White, respectively). Diabetes was the most frequently occurring chronic condition in all three groups. Groups differed in occurrences of depression and dementia at baseline, with the control group reporting fewer of both conditions. The control group had significantly higher baseline MMSE, PPT, and MCS scores and lower MCI scores.

In both the MD2 and the planner groups, the average percent of correct doses per month was very high, at 98.8% ($SD = .32$) and 97.4% ($SD = 5.19$), respectively. No measure of correct doses per month was available for the control group.

After we adjusted for age, living arrangements, race/ethnicity, top ten CMS clinical conditions, MCI, and baseline clinical outcome measures (GDS, MMSE, PPT, MCS, PCS), the time by group interaction for the MD.2 vs. planner groups was nonsignificant for all five clinical outcome measures (Hypothesis 1). The time by group interactions were significant for the planner and control groups for all outcome variables (Hypothesis 2). Model estimates are shown in Table 2. Table 3 shows quarterly change between treatment groups and annualized effect size. Participants who received nurse care coordination and the medplanner had significantly better clinical outcomes than the control group, but the addition of the MD.2 to nurse care coordination did not result in better clinical outcomes;

modeled trajectories for each group for each clinical health status outcome are shown in Figure 2.

Some covariate effects were notable (Table 2). The chronic condition of osteoporosis was a significant negative predictor of physical functioning measured by the PPT ($b = -0.78$, $p = .05$). Dementia was a positive predictor of the SF-36 PCS ($b = 3.74$, $p = .002$). Heart failure was negatively associated with SF-36 PCS ($b = -2.939$, $p = .04$), as was MCI ($b = -0.098$, $p < .0001$). In this multivariate context, none of the ten chronic conditions were significant predictors for the GDS, MMSE, or MCS. Living arrangements (living alone) and age were not significantly associated with any outcome measures. Black race was associated with MMSE scores ($b = -0.552$, $p = .005$).

Discussion

The results of this study provide evidence that nurse care coordination has a beneficial effect on cognitive functioning, depressive symptoms, functional status, and quality of life in both mental and physical functioning. No other studies of care coordination programs of chronically ill older adults when compared to control groups have produced favorable results in all five of these clinical health status outcomes (de Bruin et al., 2012).

This study was designed to identify the impact of both nurse care coordination and technology. Technology is often designed to replace activities of care providers such as nurses. Given the frailty of the participants in this study, we believed that it was important to separate the contribution of technology from the contribution of the activities in the nurse care coordination. In comparison with the MD.2, the medplanner appeared to be sufficient for medication administration when filled by a professional nurse in conjunction with other activities of nurse care coordination. Nurses not only filled the medplanner or MD.2 but provided continuity of care by following participants when hospitalized, providing components of transitional care at hospital discharge, and maintaining frequent contact with primary care providers by sending updates or accompanying participants on clinic visits.

Medications touch almost every aspect of care for a chronically ill older adult. Nurse care coordinators were current on all medications, medical diagnoses, and prescribing providers and clearly understood the self-management ability of each participant. The focus on medication management connected nurse coordinators with participants via planned weekly phone calls and every other week visits to the home.

Programs that target chronically ill older adults are not new, but findings about effects on clinical health status outcomes are mixed. In this study, nurse care coordination included elements of several successful programs. First, we targeted frail older adults with an identified problem (medication management) in the self-management of their chronic condition. Second, chronic illness is not a time-limited occurrence. Weekly monitoring of participants provided care beyond care transitions, at varying intensity depending on current condition. This allowed quick intervention when there was an exacerbation of a chronic illness.

Accessing the population for this study was difficult. We were dependent on home care organizations to recruit participants, with home care nurses obtaining verbal permission for the research staff to contact the participants. Due to their busy schedules, home care agency nurses were not consistently able to obtain verbal permissions for research staff to contact their home care clients. Because of this, only about 10% of the older adults who met the screening criteria were asked if they were interested in participating in the study. The second issue we encountered was the disappointment of several pilot participants when they were not assigned to an intervention group. Admission to the study took several hours and often

two visits to obtain written consent and collect all admission information. The participants targeted for this study were recently discharged from home care due to the stability of their chronic condition, making them no longer eligible for the Medicare home health benefit. Yet most were very vulnerable, struggling to manage their chronic conditions and hopeful to receive the additional help of the study intervention. In pilot testing we found that potential participants were often confused by the possibility of membership in one of three groups, and several participants became visibly upset when they were allocated to the control group. To avoid confusing or upsetting potential participants, we decided to conduct random assignment to group following verbal consent and before the research staff contacted the potential participants. Potential participants were told what group they would be assigned to if they participated in the study; participants who refused due to group assignment were not eligible for participation in a different study group.

The control group appeared to be healthier at baseline and may have been less likely to want assistance with their medications, especially with a machine that would require them to be present for medication administration. As the study progressed, we learned better ways to introduce the MD.2 machine. For example, the machine came in a very large box. Participants who saw the nurse wheeling up the large box often refused to be in the study. Refusals decreased significantly after the MD.2 was removed from the large box before carrying it into the home. Participants who accepted the machine were overwhelmingly positive about using it when questioned after 9 months of use (Reeder, Demiris, & Marek, 2013). In our intent-to-treat analysis, those who refused due to the machine or not wanting help were included in the analysis if we had collected baseline data.

Due to the nature of the intervention and since data were collected in the participant homes, it was not possible to blind providers and data collectors (the MD.2 was usually visible in the home). To control for possible contamination, providers of the nurse care coordination were not exposed to the control group. The data collectors were students who were mostly in schools other than nursing. Interrater reliability of data collected was checked routinely to ensure accurate data collection.

Investing in methods to assist older adults with medication and chronic disease management has potential to improve the quality of life of older adults. In our study, home-based nurse care coordination along with the medplanner device was effective in supporting participants to better clinical health status outcomes.

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Figure 1.
Flow of participants through the study.

Figure 2.
 Covariate adjusted mean outcome scores with 95% CI by group over 12-month period.

Table 1

Baseline Characteristics by Group

Characteristic	MD.2		Planner		Control		<i>p</i>
	<i>(n = 152)</i>		<i>(n = 137)</i>		<i>(n = 125)</i>		
	<i>M</i>	<i>(SD)</i>	<i>M</i>	<i>(SD)</i>	<i>M</i>	<i>(SD)</i>	
Age	79.6	(7.92)	79.6	(7.64)	78.2	(7.25)	.20
MCI	40.8	(24.26)	37.3	(22.21)	32.2	(18.09)	.01
MMSE	25.5	(3.33)	25.0	(3.65)	26.3	(3.17)	.01
GDS	4.4	(3.27)	4.2	(3.16)	3.5	(3.16)	.07
PPT	14.6	(5.06)	14.2	(5.16)	15.8	(6.14)	.05
SF-36 PCS	33.5	(9.48)	34.2	(9.39)	35.7	(10.20)	.15
SF-36 MCS	48.3	(12.10)	49.7	(12.08)	54.12	(11.29)	.01
	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	
Gender (female)	104	(68.4)	93	(67.9)	77	(61.6)	.43
Living alone	81	(53.3)	63	(46.0)	60	(48.0)	.44
Race/ethnicity							
White	124	(81.6)	114	(83.2)	113	(90.4)	.10
Black	28	(18.4)	22	(16.1)	12	(9.6)	.11
Hispanic	2	(1.3)	6	(4.4)	3	(2.4)	.26
Chronic Conditions							
Diabetes	59	(38.8)	50	(36.5)	48	(38.4)	0.91
Depression	31	(20.3)	39	(28.4)	18	(14.4)	0.02
COPD	21	(13.8)	20	(14.6)	17	(13.6)	0.97
Atrial fibrillation	21	(13.8)	18	(13.1)	17	(13.6)	0.99
Ischemic heart disease	20	(13.2)	19	(13.9)	18	(14.4)	0.96
Dementia	24	(15.8)	20	(14.6)	7	(5.6)	0.02
Chronic kidney disease	13	(8.6)	15	(11.0)	10	(8.0)	0.67
Heart failure	10	(6.6)	10	(7.3)	14	(11.2)	0.34
Stroke	13	(8.6)	14	(10.2)	7	(5.6)	0.39
Osteoporosis	7	(4.6)	8	(5.8)	7	(5.6)	0.88

Note. *N* = 414.

Table 2

Mixed Model Parameter Estimates for Each Clinical Health Status Outcome

Variable	Clinical Health Status Outcomes														
	GDS			MMSE			PPT			PCS			MCS		
	<i>b</i>	<i>SE</i>	<i>t</i>	<i>b</i>	<i>SE</i>	<i>t</i>	<i>b</i>	<i>SE</i>	<i>t</i>	<i>b</i>	<i>SE</i>	<i>t</i>	<i>b</i>	<i>SE</i>	<i>t</i>
Intercept	0.71	0.92	0.77	2.91	0.98	2.97**	2.15	1.42	1.51	44.84	6.45	6.95***	43.706	6.57	6.66***
Time	-0.31	0.06	-5.33***	0.24	0.05	5.20***	0.28	0.08	3.30***	0.66	0.17	3.86***	0.94	0.21	4.48***
Control	-0.11	0.15	-0.78	0.02	0.16	0.16	0.38	0.23	1.66	1.12	1.03	1.08	3.02	1.16	2.59**
MD2	0.12	0.14	0.91	-0.12	0.14	-0.82	-0.07	0.21	-0.35	-0.30	0.95	-0.32	-0.98	1.08	-0.91
Time*Control	0.32	0.09	3.78***	-0.31	0.07	-4.67***	-1.01	0.12	-8.21***	-0.99	0.25	-3.97***	-1.63	0.30	-5.35***
Time*MD2	-0.05	0.08	-0.56	-0.12	0.06	-1.88	-0.12	0.12	-1.01	0.15	0.24	0.66	0.44	0.29	1.52
Age	0.00	0.01	-0.32	-0.01	0.01	-1.03	-0.03	0.01	-1.88	-0.06	0.06	-0.99	0.07	0.06	1.20
Black	-0.29	0.18	-1.58	-0.55	0.19	-2.83**	-0.43	0.29	-1.50	-1.08	1.25	-0.86	1.24	1.31	0.94
GDS	0.87	0.02	46.60***	0.02	0.02	0.94	0.01	0.03	0.47	-0.73	0.13	-5.81***	-1.80	0.13	-13.53***
MMSE	-0.01	0.02	-0.34	0.91	0.02	43.93***	0.03	0.03	1.20	-0.31	0.13	-2.35*	0.37	0.14	2.68**
PPT	0.00	0.01	-0.22	0.01	0.01	1.10	0.92	0.02	50.16***	0.53	0.09	5.68***	-0.06	0.07	-0.79
MCI	0.00	0.00	0.27	0.00	0.00	-0.77	0.00	0.00	0.19	-0.10	0.02	-4.91***	-0.02	0.02	-0.86
Dementia	-0.03	0.18	-0.17	-0.14	0.19	-0.74	0.07	0.28	0.25	3.74	1.21	3.10**	0.95	1.26	0.76
Atrial fib	0.12	0.17	0.67	0.14	0.18	0.77	0.11	0.27	0.42	-0.09	1.14	-0.08	-0.14	1.20	-0.11
Kidney	-0.05	0.20	-0.26	0.11	0.22	0.52	-0.52	0.32	-1.64	-1.66	1.36	-1.22	0.04	1.44	0.03
COPD	0.03	0.17	0.17	0.26	0.18	1.43	-0.01	0.27	-0.04	-2.09	1.17	-1.79	0.99	1.23	0.80
Depression	0.27	0.14	1.87	-0.01	0.15	-0.07	-0.03	0.23	-0.15	1.90	0.97	1.95	-1.40	1.03	-1.36
Diabetes	0.08	0.13	0.57	0.20	0.14	1.42	0.04	0.20	0.19	0.68	0.87	0.78	1.25	0.92	1.35
Heart Failure	-0.37	0.21	-1.73	0.02	0.22	0.09	0.15	0.33	0.45	-2.94	1.41	-2.09*	-1.27	1.49	-0.85
Ischemic Heart	-0.07	0.16	-0.44	-0.03	0.17	-0.16	0.04	0.26	0.14	-0.66	1.12	-0.59	-1.18	1.17	-1.01
Osteoporosis	0.22	0.26	0.85	-0.03	0.27	-0.12	-0.78	0.40	-1.97*	0.25	1.71	0.15	-1.34	1.80	-0.74
Stroke	0.05	0.21	0.26	-0.29	0.22	-1.29	-0.09	0.33	-0.26	-0.79	1.41	-0.56	-0.03	1.49	-0.02
$Var(b_{0i})$		0.411			0.469			0.677			36.303			45.926	
$Var(e_{0i})$		1.902			2.158			4.608			21.683			31.900	
$Corr(AR(1))$		0.115			0.125			0.117			0.199			0.057	

Note. GDS = Geriatric Depression Scale. MMSE = Mini-Mental Status Exam. PPT = Physical Performance Test. PCS = SF-36 Physical Component Summary. MCS = SF-36 Mental Component Summary.

* $p < .05$

** $p < .01$

*** $p < .001$.

Table 3

Quarterly Improvements and Annualized Effect Sizes

Health Status Outcome	Quarterly Improvement						Annualized Effect Size (Cohen's <i>d</i>)	
	MD.2 vs. Planner			Planner vs. Control			MD.2 vs. Planner	Planner vs. Control
	<i>M</i>	[95% <i>CI</i>]	<i>p</i>	<i>M</i>	[95% <i>CI</i>]	<i>p</i>		
Depression (GDS)	−0.045	[−0.204, 0.114]	.56	0.322	[0.155, 0.490]	.0002	.06	.41
Physical Performance (PPT)	0.118	[−0.111, 0.347]	.31	1.009	[0.768, 1.250]	< .0001	.08	.66
Cognition (MMSE)	0.119	[0.005, 0.244]	.06	0.311	[0.180, 0.442]	< .0001	.18	.39
Physical Summary (PCS)	0.095	[−0.450, 0.640]	.73	1.390	[0.816, 1.963]	< .0001	.07	.39
Mental Summary (MCS)	0.241	[−0.459, 0.940]	.50	1.686	[0.949, 2.423]	< .0001	.16	.58

Note. Estimates are derived from longitudinal mixed models with covariates and linear time component.