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Profiling Patient Characteristics Associated with the Intensity of Nurse Care Coordination

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Abstract

The purpose of this study was to identify characteristics of chronically ill community-dwelling older adults that differentiate the intensity of care provided by nurse care coordinators. We performed data mining on electronic health records, nurses' activity logs, and health status measures from 784 care episodes provided to 196 older adults. An inductively created decision tree identified nine groups from a combination of the six participant characteristics including medication regimen complexity, cognition, physical and mental health, hospital admission, and physical functioning. Overall there was a 5-hour difference in the intensity (or contact hours) per quarter of nurse care coordinators between individuals in the highest versus lowest intensity groups. The highest intensity group presented higher medication complexity and lower mental/physical health status. With caseloads of 30–35 participants, nurse care coordinators were able to provide care based on participant needs that were not influenced by regulatory payment requirements.

Keywords

older adults; care coordination; nursing care; decision tree

Health care in the United States is changing rapidly, moving to population-based care with a shift from transaction-based to outcomes-based payment for health care. Individuals with chronic disease, particularly older adults with multiple comorbidities are the highest users of health care service (Centers for Medicare & Medicaid Services [CMS], 2012). For this population care is inefficient and fragmented, resulting in poor quality of life and ever increasing healthcare costs. Implementation of care coordination programs is one of the key strategies identified by the Institute of Medicine (IOM, 2010) to decrease inefficiencies in the health care system and improve the quality of health care delivered (Bodenheimer, 2008; McDonald et al., 2011; Osborn, Moulds, Squires, Doty, & Anderson, 2014; Wolff, Starfield, & Anderson, 2002). A 2014 survey of older adults in 11 countries (including the U.S) found that "no health system consistently offers older adults accessible, coordinated, and patient

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Conflict of Interest

The authors declare that they have no conflicts of interest associated with the work presented in this manuscript.

centered care." This type of care requires continuous care coordination and coaching in self-management of chronic illness (Osborn et al., 2014).

The Agency for Healthcare Research and Quality defines care coordination as "the deliberate organization of patient care activities between two or more participants (including the patient) involved in a patient's care to facilitate the appropriate delivery of health care services (p. 5)" (McDonald et al, 2007). This broad definition reflects the fact that care coordination is delivered in a wide variety of approaches with different populations, making it difficult to determine which approach is best for each population, especially community-dwelling older adults. Programs also vary in setting and configuration such as primary care, vendor support, integrated multispecialty groups, hospital-to-home, and home-based (Bodenheimer & Berry-Millett, 2009).

Transitional care and comprehensive care coordination models are considered effective interventions in managing chronic conditions for older adults who reside in the community (Lamb, 2014). In the transitional care models, patients are first engaged in the hospital and followed for 1–12 weeks post hospitalization, usually by advance practice nurses (APNs) (Baldwin, Black, & Hammond, 2014; Englander, Michaels, Chan, & Kansagara, 2014; Naylor et al., 2004) or Registered Nurses (RNs) directed by APNs (Coleman, Parry, Chalmers, & Min, 2006). In comprehensive care coordination models, common elements include self- management education via the Chronic Care Model (Coleman, Austin, Brach, & Wagner, 2009; Wagner et al., 2001), and interventions provided by nurses (mostly via telephone) to monitor patients with chronic conditions at high risk for hospitalization and facilitate communication among health care providers, family, and patient (Brown, 2009; Brown, Peikes, Chen, & Schore, 2008; Marek et al., 2013; Rantz et al., 2014). Types of nursing interventions include medication coordination, medical/dental care coordination including hospital admission and discharge, physical signs and symptoms monitoring, durable medical equipment management, monitoring of laboratory findings, and teaching coping skills (Kim, Marek, & Coenen, 2016).

While components of transitional care interventions and care coordination programs are overlapping, high intensity care involving home visits and multidisciplinary team efforts is more likely to improve patient outcomes (Feltner et al, 2014). Success of care coordination interventions depends on the identification of individuals who might best benefit from such interventions and provision of long-term care by a care team with designated RN care managers who collaborate with primary care providers (Lamb, 2014). Still little is known about who benefits most from intensive care coordination and how much is needed to be effective in reducing costs while improving health outcomes (McDonald et al., 2007; Marek, Stetzer, Adams, Bub, Schlidt, & Colorafi, 2014). Many programs are too costly due to the mismatch of the amount of care coordination provided and the patient needs. Examination of programs with successful outcomes can provide clues to the type of patient that requires more intensive care coordination.

Home Care Medication Management (HCMM) Program

The HCMM program was a randomized controlled trial designed to examine whether a medication management program that included nurse care coordination would affect older adults' health outcomes, satisfaction, and health care costs over a one-year period (Marek et al., 2013, 2014). Participants were adults age 60 or older who were discharged from home health care with problems in medication management (Marek et al., 2013). Each participant was randomly assigned to one of three groups - (a) home medication dispensing machine plus nurse care coordination, (b) a simple pillbox plus nurse care coordination, and (c) usual care. Care coordination interventions followed participants across multiple settings with emphasis on medication self-management using an evidence-based protocol (Marek et al., 2014). The intervention period for the primary study was one year, with rolling admissions from 2006 to 2010 in the Midwest. Participants received a nurse care coordinator home visit at least every two weeks. The nurse care coordinator customized patient care in accordance with health care needs of the chronically ill older adults, providing additional home visits or phone calls to participants as necessary. Details on the study design and results are reported elsewhere (Marek et al., 2013). Overall community-dwelling older adults who received nurse care coordination showed statistically significant improvement over time in clinical outcomes (including depression, cognition, physical performance, and quality of life) when compared to the usual care group. The HCMM program suggested that the type of medication management system was not the major mediator to improved clinical outcomes; instead it was nurse care coordination that contributed to positive clinical outcomes over time.

Purpose

The findings of the HCMM study motivated us to further examine the variation in the intensity of nurse care coordination participants received over the one-year intervention period. To be specific, the objectives of this secondary analysis were to (a) describe the intensity of nurse care coordination by quarter; (b) examine participant factors associated with intensity of care; (c) identify subgroups that required different levels of intensity in nursing care; and (d) profile participant characteristics.

Methods

This study applied a data mining technique to a dataset created from 196 participants who completed 12 months in the HCMM study. For the evaluation we examined each three month (quarter) period as an individual episode of care, resulting in a total of 784 health care episodes. The following summarizes four steps involved in this data mining process: (a) data acquisition, (b) data preparation, (c) variable selection, and (d) decision tree induction using a classification and regression tree (CRT) method. Additional statistical analysis was then completed to summarize participants' characteristics by subgroup. All the analysis was conducted using the IBM SPSS Statistics for Windows (Version 22). Approval of this study was obtained from Institutional Review Boards of Arizona State University and University of California Davis.

Data acquisition

A relational research database using MySQL (version 5.5) was created to consolidate various records collected from all intervention participants of the HCMM study. Tables residing in this research database were then created through data extraction, transformation, and loading (ETL) processes (Han & Kamber, 2006). First, all visit notes and communication logs were extracted through an EHR system (CareFacts® Version 5, 2012) where the nurse care coordinator documented all nursing activities over the one-year study period. Each Visit Note included individual nursing interventions coded using the Omaha System (Martin & Scheet, 1992; Martin, 2005) consisting of 42 client problems and 76 interventions. The Omaha System is a standardized nursing terminology recognized by American Nurses Association and is used for data collection in nursing education, practice and research (Martin, Monsen, & Bowles, 2011; Monsen et al., 2010; Westra, Solomon, & Ashley, 2006). A Nurse Care Coordinator Communication Log recorded indirect patient care interventions such as phone calls and care conferences. Each Visit Note and Communication Log also included encounter dates and system-recorded time data which were abstracted from the EHR server and integrated into the research database for analysis.

Second, study variables selected from the HCMM study were extracted from the HCMM Microsoft Access database and then transferred/loaded into the research database, including participant–related characteristics, health status measures, and nurse-recorded time data. In addition to clinical care, nurse care coordinators recorded data related to time spent in travel, direct care, indirect care such as phone calls, and activities specific to the research evaluation.

Data preparation

Once the ETL process was completed, a data file was created for data mining. All study measures examined in this study were recoded and extracted from the relational research database by study participant using the procedural language/structural query language (PL/SQL). All study variables included in data mining are summarized below with a permissible value set.

Study variables—The research database included the participant-related characteristics of age (years), gender (male/female), race (white/black/other), living arrangement (living alone/living with someone), occurrence of hospitalization over a quarter (yes/no), complexity of medication regimen, chronic conditions, and quarterly health status measures. The complexity of the participant's medication regimen was scored with the Medication Complexity Index (MCI) by calculating the number of medications in the regimen, number of doses per day, additional directions required, and mechanical actions required for medication administration (Conn, Taylor, & Kelley, 1991). A higher MCI score indicates a more complex medication regimen.

The ten most frequently occurring Centers for Medicare & Medicaid Services Chronic Conditions (CMS, 2010) were coded as present or absent, including chronic kidney disease (CKD), chronic obstructive pulmonary disease (COPD), dementia, diabetes, depression, atrial fibrillation, ischemic heart disease, heart failure (HF), stroke, and osteoporosis.

Measures of cognition, functional status, and quality of life assessed at the time of enrollment and at the end of each quarter over the 12-month study period were used to represent health status. The cognitive abilities of individuals were assessed using the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975). The MMSE score of less than 26 indicates that an individual had cognitive impairment in this study (Kukull et al., 1994). Functional status was examined using the Physical Performance Test (PPT) that measured the level of difficulty in performing seven specified tasks, such as picking up a penny from floor and 50-foot walk test (Reuben & Siu, 1990). Each task is scored using a 5-point Likert scale (0–4), suggesting a total score of 0 to 28. A decreasing score is associated with increasing disability and loss of independence. The quality of life was measured using the SF-36 Physical Component Scale (PCS) and Mental Component Scale (MCS; Ware & Scherbourne, 1992). The higher the PCS and MCS scores are, the better the quality of life is.

The intensity of nursing care is defined as the "frequency of patient contact (Feltner et al., 2014)" over the 12-month intervention period by the nurse care coordinators via in-person home visits and telephone communications outside the home visit. As each contact required different types and amount of nursing care, the *total intensity of nursing care* was further operationalized in this study as 'total contact hours or nursing time' spent in both home visits and phone communications for each individual per quarter, yielding four measures of intensity of nursing care for each participant. It is noted that nurse time spent in research activities was not included in the nursing time required to provide person-centered nursing interventions (Kim et al., 2016).

Variable selection

Correlation analysis between study variables and the quarterly intensity of nurse care coordination were performed using Pearson's r statistic by quarter. Factors with a statistically significant association with quarterly intensity of nursing care ($p \leq .10$) were selected for use in decision tree induction. It is noted that the less-restrictive alpha level was chosen in this univariate analysis to include a broad range of participant factors in decision tree analysis (Lang & Secic, 2006).

Decision tree induction

To identify meaningful subgroups, decision tree analysis via a classification and regression tree (CRT) method was applied to the dataset. This non-parametric data mining technique identifies reciprocally distinct subgroups (or terminal nodes) by examining the various interactions of study variables and the best combination of categories and/or cut-off points of independent variables in explaining the variation of the dependent variable (Breiman, Friedman, Olshen, & Stone, 1984; Han & Kamber, 2006). Each subgroup of a decision tree shares characteristics that significantly influence the split of the intensity of nurse care coordination (i.e., total nursing care time). The least-squared deviation (LSD) measure of impurity was used to determine the best split of a parent node into two child nodes. In other words, a parent node is divided into two child nodes when the level of homogeneity in the child nodes is maximal and the heterogeneity of member characteristics in the child nodes is minimal, meaning group members in terminal nodes present the same characteristics. As the unit of analysis was the quarterly episode of nursing care, the minimum number of

observations in each final node was set at 39 corresponding to approximately 5% of the total episodes (n=784). To prevent over-fitting of a classification rule produced by CRT, this analysis employed a 10-fold cross validation approach through which the dataset with the 784 care episodes were divided into10 subsets. This approach then repeated the cross-validation process 10 times with training data (9 subsets) and testing data (1 subset) selected randomly each time from the dataset (Han & Kamber, 2006).

Statistical analysis

Descriptive statistics were used to summarize participants' characteristics and the quarterly intensity of nursing care. Comparisons of the quarterly intensity of nursing care within the sample were completed using repeated samples Friedman's two-way analysis of variance (ANOVA) by ranks.

Results

Participants' characteristics

The dataset included 196 study participants who received the nurse care coordination over the 12-month period. As shown in Table 1, the majority of the participants were age 75 or older, female and white. The mean number of medications taken by the participants was 11.5 and mean medication complexity score was 39.4, ranging from 7 to 141. Of the top 10 CMS chronic conditions, diabetes (41.3%) was most prevalent followed by cardiovascular disease (34.2%) including atrial fibrillation, heart failure, ischemic heart disease, and stroke. Approximately 44% presented more than one CMS chronic disease. Half of the study participants scored for mild to moderate cognitive impairment (51%), and low functional status (47%) at baseline using the cutoff points of MMSE score 26 and PPT score 15 respectively. A mean score of the SF-36 PCS was 34.3 while a mean score of SF-36 MCS was 49.5 at baseline. Forty-three percent (n = 84) of the participants were hospitalized at least once over the one-year study period.

Intensity of nursing care

A total of 6,446 home visits and 4,834 communications were identified for the 196 participants over the one-year period. On average, 33 home visits and 25 phone communications occurred per participant over the year. The nurse care coordinator spent approximately 141 minutes/month per person, in addition to 38 minutes/month of travel time per person. On average, three face-to-face home visits and two phone communications occurred per person in each month. In each home visit, nurse care coordinators provided approximately nine nursing interventions (e.g., medication set-up and coordination, physiological and psychological signs/symptoms monitoring, management of medical durable equipment, laboratory findings monitoring) and required 51 minutes.

There was a wide variation in the number of home visits and communications conducted by the nurse care coordinators, resulting in large variations in time spent per participant over the one year period (range: 11.5–74.2 hours/year). Table 2 summarizes quarterly changes in the intensity of nursing care broken down by home visit and phone communication. There was a significant difference across the four quarters when running repeated samples Friedman's

two-way ANOVA by ranks. Overall the nurse care coordinators spent more time in the first quarter, which was then dropped subsequently in the second and third quarters ($p < .001$).

Factors associated with the intensity of nursing care

When performing correlation analysis, different factors were correlated with the increased intensity of nursing care in each quarter. The MCI score, quality of life, and occurrence of hospitalization were significantly correlated with the intensity of nursing care in each quarter ($p < .10$). Of the top 10 CMS chronic conditions, only CKD and diabetes were correlated with the increased intensity ($p < .10$). However, sex, living status, age, and other CMS conditions (atrial fibrillation, COPD, dementia, depression, HF, ischemic heart disease, osteoporosis) were not significantly associated with the intensity of care as shown in Table 3.

Decision tree induction

The CRT analysis produced nine subgroups (or terminal nodes) using the 784 care episodes. Each group shared a combination of six characteristics including complexity in medication regimen, mental health status (SF-36 MCS cut-off point of 49.2), cognition level (MMSE cut-off point of 28.5), occurrence of hospital admission, level of physical functioning (PPT cut-off point of 18.5), and physical health (SF-36 PCS cut-off point of 24.1). Two subgroups (17.1%) presented in Figure 1 required the most nurse time (> 9 hours) over the quarter while three other groups (35.3%) needed the least amount of nurse time (< 6 hours/quarter).

Participant profiles discriminating the intensity of nursing care

As shown in the top two levels of Figure 1, when the level of complexity in medication regimen was lower than the MCI score of 29.5, the nurse care coordinators needed less time per person (i.e., approximately 2 hours/month). Of individuals with low medication complexity, lower cognition levels as measured by the MMSE (≤28.5) led to higher nurse intensity (7.0 ± 3.3 hours/quarter) as compared to those with higher cognition levels (4.9 ± 1.6 hours/quarter). While participants who were hospitalized required more nurse time (9.4 ± 3.8 hours/quarter), lower mental and physical health status determined by the SF-36 MCS and PCS scores contributed to the highest intensity of nursing care (9.9 ± 3.3 hours/quarter) for those with higher MCI scores. Individuals with better physical functioning (PPT score > 18.5) and mental status (SF-36 MCS > 49.2) needed less nurse time (5.8 ± 2.2 hours/quarter), demonstrating that nurse care coordinators tailored the amount of care provided based on participant needs.

Table 4 summarizes characteristics of each subgroup using the medication complexity, quarterly health status, and intensity of nursing care. Along with variations in the level of medication regimen complexity, differences in physical and mental health status were observed across subgroups. Collectively, Group 1 included only 5.9% of the 784 care episodes but needed approximately two times more of home visit hours and three times more of communication time as compared to those hours identified in group 9 involving 9.7% of the care episodes. Overall both physical performance and mental health status of groups 7, 8 and 9 were best, which accounted, in part, for less intensity of nursing care by quarter.

Notably, when individuals needed more home visits, nurse time spent for communications outside the home visits also increased.

Discussion

As programs are developed to deliver care coordination it is evident that there is not ‘one size fits all.’ Unlike other programs that focus on a specific chronic illness, the dataset used for this study was obtained from a nurse care coordination program for chronically ill older adults in their homes, with an emphasis on medication self-management. We identified nine subgroups characterized by different profiles determined by the factors of cognition, hospital admission, medication regimen complexity, mental health, physical health, and physical performance. Our findings reaffirm that chronically ill older adults vary in the amount of nurse care coordination time needed based on factors beyond their chronic disease and that nurse care coordinators can tailor care to meet the individual needs of the older adult.

When the medication regimen was less complex and the quality of life score higher, less nursing time was needed as shown in groups 8 and 9 in Table 4. On the other hand, individuals with more complex medication regimens and hospital admissions were likely to demand a higher intensity of nursing care. Clearly, the occurrence of hospital admission was another major factor, requiring more nurse time via both home visits and telephone communications. Nurse care coordinators followed participants while hospitalized and were active in their discharge planning. These findings are consistent with previous research demonstrating that targeting patients at substantial risk for hospitalization were associated with positive outcomes in care coordination programs (McDonald et al., 2007).

Overall baseline quality of life, measured with both SF-36 PCS and MCS baseline scores, was below the national average for the same age group of the U.S. population (Maglinte, Hays, & Kaplan, 2012). Group 1, the highest intensity group, showed poor physical and mental health status (i.e., lowest SF-36 PCS and MCS scores). In contrast, individuals in the lowest intensity group were healthier, especially in both physical functioning and mental functioning. The results of this study support the importance of attending to mental health symptoms in older adults and the need to allocate nurse time to provide the care needed to help older adults who exhibit such symptoms.

Finally, as demonstrated in this analysis, tailored contact of targeted individuals is a key factor to the success of a community-based care coordination program. While each subgroup presented a different profile of participants’ characteristics, it is apparent that tailored intensity of nursing care played a critical role in improving clinical outcomes. On average, 1–2 hours of nurse time per month helped chronically ill older adults with problems in self-management maintain their health in the community. Profiles of each subgroup presented in Table 4 clearly indicate a different case-mix in each group, supporting the need to adjust nurse care coordinator caseloads depending on the medication complexity, cognitive abilities, physical and mental health status, and hospitalization. Nurse care coordinators in this study had caseloads of 30–35 participants and provided care based on participants’ needs that were not influenced by payment regulatory requirements, resulting in improvement in all patient outcomes over the one year study period (Marek et al., 2013). In

contrast, lack of significant cost savings or clinical improvement in many care coordination programs may be due to the large caseloads of 300 or more individuals per nurse coordinator (Burwell, 2014).

With the rapid adoption of electronic health records in health care, massive amounts of electronic data are accumulated across settings, requiring an advanced approach to translate these data into practice-based evidence. Knowledge discovery in databases using data mining technique is promising as previously unknown relationships could be identified (Han & Kamber, 2006). Among various data mining algorithms, decision tree analysis is a simple but powerful approach to identify subgroups sharing risk factors for adverse events, poor health outcomes, or care needs as terminal nodes of a decision tree can be easily interpreted by practitioners (Fenton et al., 2016, Lei, Nollen, Ahluwahlia, Yu, & Mayo, 2015; Handley et al., 2014).

This study has limitations in that it employs a secondary data analysis using electronic health records created through the HCMM study. A major limitation of using electronic health records is that the quality of data may not be a true reflection of nurse care coordinators' practice. Although there might be missing documentation, especially in the area of time spent in short communication activities, the quality of data was well controlled as research nurses continuously monitored the documentation and gave feedback to the nurse care coordinators. Also the dataset used in this study did not include other types of participant's characteristics (e.g., health literacy) that might have influenced the intensity of nursing care. Further geographical location of the study subjects and nurses who provided care coordination interventions may hinder the generalization of research findings.

In conclusion, this study identified participant factors associated with increased intensity of nursing care, demonstrating needs for tailored intensity of nursing care to improve clinical outcomes in the community-dwelling older adults with chronic illness. Our findings reaffirm that older adults who needed more nursing time exhibited complex needs associated with medication regimens, hospital admission, as well as lower physical and mental functioning. Nurse time in indirect care such as phone communications outside the home visits increases at a greater rate for older adults who require complex care coordination. Care coordination is an effective intervention to improve older adults' clinical and cost outcomes, especially when implemented with care coordinator caseloads that allow adequate time to meet both mental and physical needs of the older adult. It is recommended that assessments to determine need for care coordination include comprehensive examinations of mental and physical health in order to better match resources to older adults care needs. Research related to matching nurse care coordinator caseload to participant needs is also recommended.

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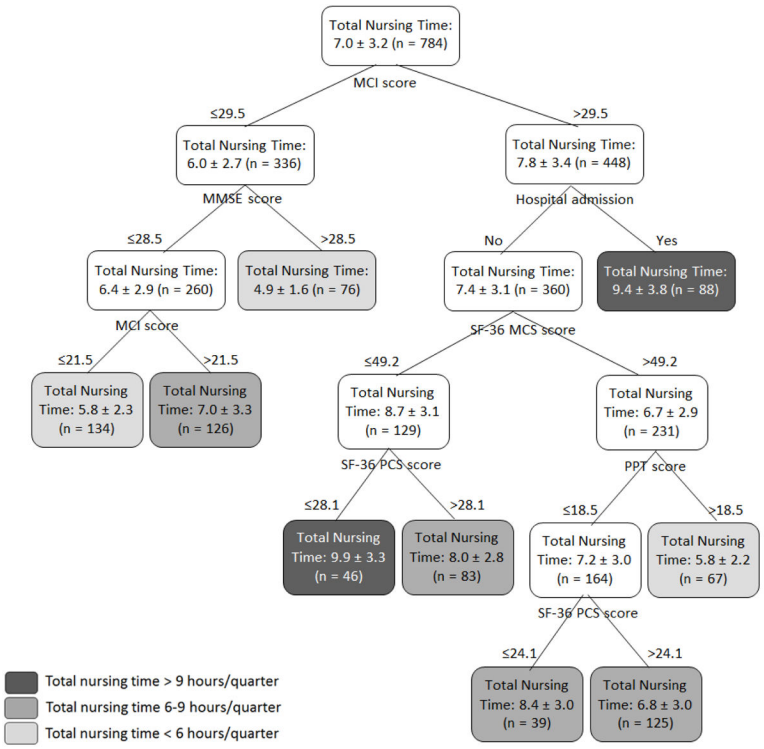

Figure 1.

Identification of Subgroups Using Classification and Regression Tree Analysis

Note. The total nursing time (hour) is the mean nurse time spent for in-person home visits and phone communications in each quarter. The unit of analysis was a quarterly care episode involving 784 observations. MCI = medication complex index, MMSE = mini-mental state exam, PCS = physical component scale, MCS = mental component scale, PPT = physical performance test.

Table 1

Characteristics of the Study Participants (n = 196)

Characteristics: Categorical Variables		***n***	***%***
Sex	Female	136	69.4
	White	159	81.1
Race/Ethnicity			
	Black	37	18.9
Living Status	Living alone	111	48.1
	Diabetes	81	41.3
	Depression	46	23.5
	Chronic obstructive pulmonary disease (COPD)	26	13.3
	Dementia	28	14.3
Comorbidities: CMS	Ischemic heart disease	30	13.0
Chronic conditions	Atrial fibrillation	25	12.8
	Chronic kidney disease (CKD)	20	10.2
	Stroke	14	7.1
	Heart Failure (HF)	10	5.1
	Osteoporosis	11	5.6
Characteristics: Continuous Variables		*M*	*SD*
Age	Years	80.1	7.5
MCI	Medication complexity index (MCI) score	39.4	23.3
	Mini-mental state exam (MMSE) score	25.5	3.5
	Physical performance test (PPT) score	14.9	4.8
Baseline health status			
	SF-36 physical component scale (PCS) score	34.3	9.8
	SF-36 mental component scale (MCS) score	49.5	11.9

Note. CMS = Centers for Medicare & Medicaid Services.

Table 2

A Summary of the Intensity of Nursing Care by Quarter (n = 196)

Intensity of Nursing Care	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
	M ± *SD*	*M* ± *SD*	*M* ± *SD*	*M* ± *SD*
Total nursing time (hour) ***	8.5±3.3	6.5±3.1	6.1±2.8	7.1±3.0
Number of home visits ***	9.2±2.7	7.7±2.8	7.4±2.6	8.6±2.9
Nurse time spent for home visits (hour) ***	7.5±2.7	5.7±2.4	5.4±2.2	6.2±2.5
Travel time (hour) ***	2.3±1.3	1.7±0.9	1.7±1.0	2.0±1.3
Number of communications **	7.0±7.4	5.8±6.8	5.6±6.9	6.3±7.8
Nursing time spent for communications (hour) ***	1.0±1.0	0.8±1.1	0.7±1.0	0.9±1.3

** $p < .01$.

*** $p < .001$.

Table 3

Pearson's Correlation Coefficients Measuring Association between Study Variables and Quarterly Intensity of Nursing Care (n = 196)

Variables	Intensity of Nursing Care (Nurse Time)			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Medication complexity index	.238***	.173*	.184**	.239***
Chronic Kidney disease	.153*	.132†	*ns*	*ns*
Diabetes	.220**	.138†	*ns*	.121†
PPT score[a]	*ns*	*ns*	−.163*	*ns*
MMSE[a]	*ns*	*ns*	*ns*	−.126†
SF-36 PCS score[a]	−.174*	−.224**	−.251***	−.233***
SF-36 MCS score[a]	−.156*	−.175*	−.190**	−.136†
Hospitalization[b]	.207**	.174*	.284***	.158*

Note. *ns* = no significance ($p > .10$).

[a]. Since mini-mental state examination (MMSE), physical performance test (PPT), and SF-36 physical component scale (PCS) and mental component scale (MCS) were measured at the beginning of each quarter, quarterly baseline scores were used in this analysis.

[b]. The presence and absence of hospitalization was counted in each quarter.

† $p \leq .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 4

A Summary of Participant Characteristics and Intensity of Nursing Care by Group

Subgroup (n=784)	MCI Score	CMS[a] Condition ≥ 2	MMSE Score ≤ 26	PPT Score ≤ 18.5	SF-36 PCS Score	SF-36 MCS Score	Home Visit Hours/Quarter	Communication Hours/Quarter	Total Nurse Time per Quarter (Hour)
	M ± *SD*	*N (%)*	*N (%)*	*N (%)*	*M* ± *SD*	*M* ± *SD*	*M* ± *SD*	*M* ± *SD*	*M* ± *SD*
Group 1 (n=46)	54.7 ± 18.4	27 (58.7)	22 (48.9)	38 (92.7)	23.7 ± 2.8	36.9 ± 8.8	8.4 ± 2.7	1.4 ± 1.2	9.9 ± 3.3
Group 2 (n =88)	53.6 ± 18.1	50 (56.8)	38 (43.2)	71 (81.6)	29.1 ± 8.1	52.0 ± 11.8	7.8 ± 2.8	1.6 ± 1.6	9.4 ± 3.8
Group 3 (n=39)	53.1 ± 20.2	27 (69.2)	13 (33.3)	39 (100)	18.8 ± 3.7	59.8 ± 6.3	7.6 ± 2.5	0.7 ± 0.9	8.4 ± 3.0
Group 4 (n=83)	53.1 ± 20.3	42 (50.6)	36 (43.4)	67 (80.7)	35.8 ± 5.2	39.3 ± 5.7	7.2 ± 2.5	0.8 ± 0.7	8.0 ± 2.8
Group 5 (n=126)	25.6 ± 2.1	49 (38.9)	89 (73.0)	79 (65.3)	41.3 ± 8.9	54.8 ± 9.0	6.1 ± 2.5	0.9 ± 1.2	7.0 ± 3.3
Group 6 (n=125)	54.6 ± 24.6	71 (56.8)	54 (43.2)	124 (100)	35.5 ± 7.5	58.8 ± 5.4	6.0 ± 2.3	0.8 ± 1.2	6.8 ± 3.0
Group 7 (n=67)	51.9 ± 22.4	39 (58.2)	15 (22.4)	0	36.4 ± 10.4	58.8 ± 5.4	5.4 ± 1.9	0.4 ± 0.5	5.8 ± 2.2
Group 8 (n=134)	15.7 ± 4.3	28 (20.9)	96 (71.6)	105 (78.9)	39.7 ± 9.8	51.1 ± 11.0	5.1 ± 1.9	0.6 ± 0.9	5.8 ± 2.3
Group 9 (n=76)	20.5 ± 6.2	15 (19.7)	0	42 (55.3)	38.9 ± 9.6	54.9 ± 8.6	4.6 ± 1.5	0.4 ± 0.4	4.9 ± 1.6

Note. The unit of analysis was a quarterly care episode involving 784 observations. MCI = medication complex index, MMSE = mini-mental state exam, PPT = physical performance test, PCS = physical component scale, MCS = mental component scale.

[a]. CMS comorbidities included atrial fibrillation, chronic kidney disease, chronic obstructive pulmonary disease, dementia, depression, diabetes, heart failure, ischemic heart disease, osteoporosis, and stroke.

Total nursing time > 9 hours/quarter

Total nursing time 6–9 hours/quarter

Total nursing time <6 hours/quarter