Does Paid Versus Unpaid Supplementary Caregiving Matter in Preventable Readmissions?

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Approximately 3.4 million Medicare home health beneficiaries receive professional home health services that are paid by Medicare.[1] These beneficiaries, on average, received 19 visits from home health professionals during an episode of home healthcare, defined as up to 60 days, in 2014.[1] A study based on a large home health agency in New York found that in addition to receiving services from home health professionals, 83.4% of home health beneficiaries received supplementary care from informal caregivers, of which 7% were paid, in order to meet their needs.[2] These paid informal caregivers (hereafter, called paid supplementary caregivers) are paid through beneficiaries and/or families out of pocket or through other programs (eg, Medicaid).

The interpersonal relationships between home health beneficiaries and unpaid informal caregivers (hereafter, called unpaid supplementary caregivers) and the interpersonal relationships between home health beneficiaries and paid supplementary caregivers are different. Unpaid supplementary caregivers are beneficiaries' family members, relatives, and/or friends. They have solid relationships with their patients and understand what patients need without requiring much communication whereas paid supplementary caregivers are introduced by home health agencies and have no prior relationships with the beneficiaries and/or their families. Therefore, they need to learn how to meet patients' needs through communication that is often difficult, given a high prevalence of limitation in cognitive function among Medicare home health beneficiaries.[3]

Regardless of the differences in the interpersonal relationships, paid and unpaid supplementary caregivers provide emotional and social support and a wide scope of direct care to patients, ranging from necessary medical care (eg, medication dispensing and wound care) to assistance with activities of daily living (ADL) (eg, toileting and eating) and/or instrumental activities of daily living (eg, shopping and laundry).[4,5] Given the scope of care activities, paid and unpaid supplementary caregivers are a vital part of a healthcare team and have a significant impact on home health beneficiaries' health outcomes.

ABSTRACT

OBJECTIVES: To examine the impact of paid and unpaid supplementary caregiving on preventable readmissions among Medicare home health beneficiaries with diabetes.

STUDY DESIGN: A retrospective cohort study with a home health episode as the unit of analysis.

METHODS: We gathered multiple 2009 Medicare data and national datasets (eg, Area Health Resources File). We used propensity score matching based on beneficiaries' predisposing, enabling, and health need factors to create matched cohorts for episodes solely assisted by paid supplementary caregivers versus those solely assisted by unpaid supplementary caregivers. We applied Cox regression on the matched cohorts to estimate the 30-day preventable readmissions, including diabetes-related conditions, heart disease-related conditions, chronic obstructive pulmonary disease, urinary tract infection (UTI), pneumonia, and dehydration.

RESULTS: Among beneficiaries (81,481) who received assistance several times during the day and night or several times during only the day, 7.34% were solely assisted by paid supplementary caregivers and 86.34% were solely assisted by unpaid supplementary caregivers. In the matched cohorts, we found that beneficiaries with paid supplementary caregivers had 68% higher hazards of readmission due to UTI than those with unpaid supplementary caregivers.

CONCLUSIONS: The Medicare program is moving toward value-based purchasing and penalizing home health agencies with poor quality of care. It is critical for home health professionals to invite paid and unpaid supplementary caregivers to initiate care plans and assess their competence. Policies that support unpaid supplementary caregivers can also assist caregivers to care for their loved ones and prevent them from using expensive hospital resources.

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About 1.8 million Medicare home health beneficiaries received postacute care in 2012.[1] In order to reduce readmission under the Affordable Care Act (ACA), the Medicare Payment Advisory Commission endorsed a home health financial incentive program for reducing preventable readmissions for home health agencies.[1] Paid and unpaid supplementary caregivers play a critical role in caring for beneficiaries during the transition from hospitals to homes and postacute care,[6] and can therefore impact the likelihood of preventable readmissions. Under a home health financial penalty program, investigating the potential difference in preventable readmissions of Medicare home health beneficiaries with these 2 types of supplementary caregivers is imperative for the home health industry.

The purpose of this study was to compare the likelihood of 30-day preventable readmissions among Medicare home health beneficiaries with diabetes who received care from unpaid supplementary caregivers with that of those who received care from paid supplementary caregivers. We chose diabetes because it is the most common disease (one-third) among Medicare home health beneficiaries,[7] and diabetes significantly contributes to disabilities, such as blindness and amputation,[8] that are associated with high demands for caregiving.

Conceptual Framework

We used Andersen's Behavior Model of Health Services Use as a guiding framework for our statistical modeling.[9] The Andersen model stated that healthcare utilizations and outcomes are a function of patients' predisposing (eg, gender, race/ethnicity), enabling (eg, living alone), and health need factors (eg, ADL, cognitive disorders), as well as the characteristics of healthcare organizations and communities. This model fits our study well because evidence shows that the decision of whether to hire a paid caregiver depends on beneficiaries' predisposing, enabling, and health need factors.[10,11] Additionally, supplementary caregivers—one of the beneficiaries' enabling factors—are part of the healthcare delivery team[12] likely to affect beneficiaries' health outcomes (eg, preventable readmissions).[2,13] Lastly, the characteristics of organizations and communities are associated with beneficiaries' health outcomes.[14-16]

We applied Andersen's framework in 2 stages: 1) we used beneficiaries' predisposing, enabling, and health need factors to estimate the propensity of beneficiaries solely assisted by paid supplementary caregivers and those solely assisted by unpaid supplementary caregivers to construct a matched cohort[10,11]; and

TAKEAWAY POINTS

▸ Among beneficiaries who received assistance several times during the day and night or several times during only the day, 7.34% and 86.34% were assisted solely by paid and unpaid supplementary caregivers, respectively.

▸ Beneficiaries with diabetes and paid supplementary caregivers had a 68% higher hazard of readmission due to urinary tract infections than those with unpaid supplementary caregivers.

▸ The Medicare program is moving toward value-based purchasing. It is critical for home health professionals to invite paid and unpaid supplementary caregivers to initiate care plans and assess their competence. Policies supporting unpaid supplementary caregivers can reduce beneficiaries' use of expensive hospital resources.

2) we applied Cox regression on the matched cohort to estimate the difference in time to first 30-day preventable readmissions between these 2 groups, after controlling for the covariates. The conceptual framework is presented in the **Figure**.

METHODS

Data Sources

Based on the conceptual framework, we utilized several 2009 national datasets in the study. We extracted variables for beneficiary's predisposing, enabling, and health need factors from several Medicare claim and assessment files discussed in our previous studies.[17,18] (Operational definitions are provided in the **eAppendix** for review; eAppendices are available at **ajmc.com**.) The American Hospital Association (AHA) Annual Survey and Provider of Services (POS) file provide the characteristics (eg, ownership) of hospitals and home health agencies, respectively. Finally, the Area Health Resources File (AHRF) and Primary Care Service Area (PCSA) database from HHS provide the characteristics of communities where patients reside.

Study Design and Sample

We conducted a retrospective cohort study with home health episode for postacute care as the unit of analysis. We identified episodes of postacute care—defined as receiving home health services

FIGURE. Conceptual Framework: The Impact of Paid and Unpaid Supplementary Caregiving on Preventable Readmissions
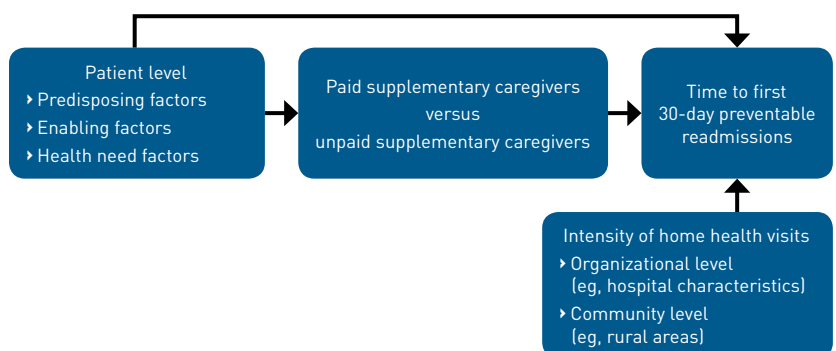
within 14 days of hospital discharge[1,16,19]—by merging the Medicare Provider Analysis and Review (MedPAR) that provides the date of hospital discharge and the Outcome Assessment Information Set (OASIS) that provides the start date of home healthcare, recommended by the literature.[19]

In order to achieve our study aim, we used several criteria to select our study sample. First, beneficiaries must have received assistance several times during the day and night or several times only during the day. The OASIS B1 version provides the frequency of assistance (M0370),[20] which allowed us to exclude beneficiaries who received assistance once daily or less, whose health outcomes are less likely to be significantly affected by supplementary caregivers. Second, beneficiaries could not be dual eligible because their family members could be paid supplementary caregivers under the Medicaid program. As discussed previously about interpersonal relationships, these family members as unpaid supplementary caregivers are quite different from the paid supplementary caregivers who are paid out of pocket by the beneficiaries and/or their families and do not have prior relationships to the beneficiaries and their families. We used the Master Beneficiary Summary File to determine dual eligibility and excluded these individuals from our study sample. Third, beneficiaries must solely rely on paid or unpaid supplementary caregivers (we provided detailed explanation in the subsection of "Paid and Unpaid Supplementary Caregivers"). Finally, beneficiaries must have been 65 years or older and enrolled in the fee-for-service (FFS) program.

Study Variables

Paid and unpaid supplementary caregivers. We used 2 assessment codes from the OASIS B1 version to identify beneficiaries with solely paid or unpaid supplementary caregivers. The assessment code M0360 provides information regarding which primary caregiver is taking the lead responsibility.[21] The categories of primary informal caregivers in code M0360 include a spouse or significant other, daughter or son, other family member, friend, neighbor, member of the community or church members, or paid helper.[21] The assessment code M0350A-M0350E (M0350A indicates that beneficiaries did not have an assisting individual) provides information on whether assisting individuals were paid (M0350B) or unpaid helpers (M0350C-M0350E).[22]

Beneficiaries with solely paid supplementary caregivers were beneficiaries whose code for M0360 was paid helper and M0350B was coded as 1; namely, beneficiaries had paid helpers as primary informal caregivers and received assistance from paid helpers. Beneficiaries with solely unpaid supplementary caregivers were beneficiaries whose code for M0360 was unpaid helper (ie, a spouse or significant other, daughter or son, other family member, friend, neighbor, member of the community, or church members) and the code for M0350C, M0350D, or M0350E was 1; namely, beneficiaries had unpaid helpers as primary informal caregivers and received

assistance from these individuals. Patients who had unpaid supplementary caregivers as primary caregivers and received assistance from paid helpers or vice versa were excluded because we are unable to determine the proportion of care provided by paid and unpaid supplementary caregivers.

Variables for matching. After identifying the qualified study sample, we selected a series of variables from beneficiaries' predisposing, enabling, and health need factors and applied the propensity score matching to match beneficiaries with paid supplementary caregivers and those with unpaid supplementary caregivers.[23,24] The predisposing factors included age, race/ethnicity, and gender. The enabling factors included whether or not beneficiaries lived alone. The heath need factors included ADL limitations, cognitive disorders, a presence of pressure or stasis ulcer, whether or not beneficiaries felt anxious or used a urinary catheter, and a dummy variable for beneficiaries with 3 or more comorbidities defined by Elixhauser and colleagues.[25] The operational definition of the variables for matching was discussed in our previous studies (also presented in the eAppendix).[17,18]

Dependent variables. The dependent variable was 30-day preventable readmissions. We applied the Agency for Health Research and Quality (AHRQ) Prevention Quality Indicator (PQI) software version 4.5 on the MedPAR to identify readmissions due to preventable conditions.[26] These conditions include diabetes with short-term complications (PQI 01), perforated appendix (PQI 02), diabetes with long-term complications (PQI 03), chronic obstructive pulmonary disease (COPD) or asthma in older adults (PQI 05), hypertension (PQI 07), heart failure (PQI 08), dehydration (PQI 10), bacterial pneumonia (PQI 11), urinary tract infection (UTI) (PQI 12), angina without procedure (PQI 13), uncontrolled diabetes (PQI 14), and lower-extremity amputation among patients with diabetes (PQI 16). Hospitalizations due to these conditions are preventable if patients are able to receive proper and timely care in the community.[26-28] Home health beneficiaries receive professional home healthcare at their residences; with proper care and interventions after hospital discharge, readmissions due to preventable conditions identified by AHRQ are avoidable for our study population.

We excluded perforated appendix because none of the matched cohorts had readmission due to this condition. Because the frequency for some preventable conditions was small (eg, hypertension), we regrouped the preventable conditions based on the human organ system. The groups for preventable readmissions are: 1) diabetes-related conditions (PQI 01, PQI 03, PQI 14, and PQI 16), 2) heart disease-related conditions (PQI 07, PQI 08, PQI 13), 3) COPD, 4) UTI, 5) pneumonia, and 6) dehydration. These preventable readmissions were finally defined as a time-to-first event in our analytical model.

Covariates for estimated model. Given the conceptual framework, the covariates in the analytical model are the intensity of home health visits and the characteristics of hospitals, home health agen-

TABLE 1. Tests for Patient Characteristics Before and After Propensity Score Matching

Variables	Before Matching			After Matching		
	Unpaid (%) (n = 70,350)	Paid (%) (n = 5982)	χ² and P	Unpaid (%) (n=5860)	Paid (%) (n = 5860)	χ² and P
Predisposing factors						
Aged 75-84 years	41.58	35.27	90.52***	35.24	35.32	0.01
Aged ≥85 years	18.96	47.54	2696.70***	47.76	47.49	0.09
African American	15.79	8.78	209.62***	8.84	8.74	0.04
Other races	6.10	5.08	10.04**	4.66	5.15	1.54
Female	50.76	65.41	474.33***	65.92	65.48	0.26
Enabling factor						
Living alone	9.89	26.73	1571.12***	26.66	26.55	0.02
Health need factors						
≥3 comorbidities	28.02	32.73	60.28***	32.54	32.66	0.02
Anxiety	41.36	47.94	97.86***	47.82	48.02	0.05
Assistance in 1-3 ADL functions	23.27	20.36	26.27***	19.86	20.17	0.17
Assistance in 4-6 ADL functions	30.44	27.53	22.13***	27.80	27.70	0.02
Assistance in ≥7 ADL functions or complete dependence in ADL function	37.54	44.05	99.19***	44.22	44.01	0.05
Pressure or stasis ulcer	8.35	13.12	157.62***	12.56	12.88	0.28
Mild cognitive disorders	36.54	54.55	759.00***	55.20	54.74	0.25
Severe cognitive disorders	2.58	8.64	684.80***	7.61	8.16	1.20
Use of urinary catheter	45.01	68.14	1171.82***	67.95	67.95	0.00

ADL indicates activity of daily living.
"**" indicates P <.01; "***" indicates P <.001.

cies, and communities. Hospital characteristics—extracted from the AHA Annual Survey—included hospitals' ownership, teaching status, and system affiliation. Ownership of home health agencies was extracted from the POS files. Community characteristics, which were extracted from the AHRF, included a rural/nonrural county characterization and the number of primary care physicians and acute hospital beds per 1000 population at the county level. A log-transformed median household income at the zip code level was extracted from the PCSA. (Information regarding how to merge all datasets is available in the eAppendix.)

Statistical Methods

Matching model to find matched cohorts. Approximately 4% of beneficiaries with diabetes had more than 1 home health episode for post acute care in 2009. To account for the cluster from the same beneficiary using multiple home health episodes, we applied a logistic regression with the Huber Sandwich Estimator on the selected variables from patients' predisposing, enabling, and health need factors to estimate the propensity score. We then applied a caliper without replacement on propensity score to find the matched cohorts.[23,24] We compared the predisposing, enabling, and health need factors of beneficiaries solely assisted by paid supplementary caregivers versus those solely assisted

by unpaid supplementary caregivers, before and after matching, using χ² testing.

Estimated model on matched cohorts. We applied a Cox proportional hazards regression model on the matched cohorts to estimate the adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) for paid supplementary caregivers, after adjusting for the covariates discussed previously. The Cox regression model was applied to 6 preventable conditions individually. Approximately 1% of the matched cohorts were from the same beneficiary; thus, we fit the model with standard errors adjusted for clustering on each individual beneficiary.

RESULTS

We identified 120,208 diabetes-related postacute home health episodes. Among them, 85.79% had primary caregivers (based on code M0360 in the OASIS) and 98% received assistance from paid or unpaid caregivers (based on codes M0350A-M0350E). After excluding unqualified episodes (previously discussed in the study sample), we identified 81,481 episodes in the unmatched study sample, with 70,350 (86.34%) and 5982 (7.34%) observations having solely unpaid and solely paid supplementary caregivers, respectively (5149 observations had both paid and unpaid supplementary caregivers). Before

TABLE 2. Descriptive Analysis for the Matched Cohorts

	Unpaid Supplementary Caregivers (n = 5860)	Paid Supplementary Caregivers (n = 5860)	χ^2 or t Test and P Value
Dependent variables			
Diabetes-related conditions	1.23 (11.02%)	1.16 (10.71%)	0.12
Heart disease-related conditions	3.23 (17.67%)	2.92 (16.83%)	0.93
COPD	0.53 (7.25%)	0.36 (5.98%)	1.93
UTI	0.68 (8.23%)	1.14 (10.63%)	6.88**
Pneumonia	0.58 (7.60%)	0.72 (8.44%)	0.85
Dehydration	0.46 (6.77%)	0.39 (6.25%)	0.32
Covariates			
For-profit hospitals	15.69 (36.37%)	15.45 (36.15%)	0.12
Public hospitals	10.86 (31.12%)	9.16 (28.85%)	9.29**
Teaching hospitals	16.31 (36.94%)	15.33 (36.03%)	2.06
Hospital system affiliation system	66.84 (47.08%)	66.00 (47.38%)	0.96
Public home health agencies	4.78 (21.33%)	3.00 (17.05%)	24.84***
Nonprofit home health agencies	48.94 (50.00%)	41.19 (49.22%)	70.75***
Number of primary care physicians per 1000 population	0.71 (0.30%)	0.77 (0.29%)	−9.93***
Number of acute hospital beds per 1000 population	2.77 (1.86%)	2.69 (1.63%)	2.49*
Rural	22.17 (41.54%)	13.30 (33.96%)	156.49***
Intensity of home health visits	3.63 (2.34%)	3.80 (3.09%)	−3.29***
Median household income ($1000)	53.03 (20.35%)	60.13 (25.09%)	−16.76***

COPD indicates chronic obstructive pulmonary disease; UTI, urinary tract infection.
"*" indicates P <.05; "**" indicates P <.01; "***" indicates P <.001.

matching, patients' predisposing, enabling, and health need factors statistically differed between beneficiaries with paid supplementary caregivers and those with unpaid supplementary caregivers (P <.05). In our matched sample (5860 observations for each group), the difference in predisposing, enabling, and health need factors between these 2 groups became statistically insignificant. **Table 1** presents the descriptive analysis for these matching factors between unpaid and paid supplementary caregivers before and after matching.

Table 2 presents the descriptive analysis for the dependent variables and covariates for the matched cohorts. Among readmission conditions, beneficiaries solely assisted by paid supplementary caregivers had about 0.46% higher readmissions due to UTI than those solely assisted by unpaid supplementary caregivers (P <.01). **Table 3** presents the HR and 95% CI from the Cox regression models for the matched cohorts. For UTI, the HR is 1.68 (95% CI, 1.13-2.50); namely, beneficiaries with solely paid supplementary caregivers had 68% higher hazards of readmission due to UTI than whose with solely unpaid supplementary caregivers. We did not find statistical differences for COPD, heart-related diseases, dehydration, diabetes-related conditions, and pneumonia.

DISCUSSION

Although existing literature primarily focuses on volunteer family caregivers, there is a growing interest in studying paid informal caregivers due to the reduction in family size and rising number of women in the workforce. Lindquist et al (2011, 2012) found that paid informal caregivers had a good heart to help elderly patients, but were likely to have low health literacy and receive little training before they were assigned to patients' homes.[29,30] Among previous studies, one focused on Medicare home health beneficiaries found that beneficiaries with paid informal caregivers had poorer functional improvement than those with unpaid informal caregivers.[2] Another study found that Medicare heart failure beneficiaries with paid informal caregivers had a higher risk of 1-year readmission than those with unpaid informal caregivers.[13]

Among all preventable readmissions, we found that beneficiaries solely assisted by paid supplementary caregivers had a significantly higher hazard of readmissions due to UTI than those solely assisted by unpaid supplementary caregivers. Given that prevention of a UTI requires good genital care and regular bladder emptying, this type of personal care necessitates a good relationship between patients and supplementary caregivers. Paid supplementary caregivers in our study were not beneficiaries' family members; one study showed that patients with family caregivers felt safer and had higher satisfaction in their interpersonal relationship than those with paid nonfamily caregivers,[31] which may explain our significant findings for readmissions due to UTI.

A previous study based on the information from code M0360 in the OASIS found that 83.4% of Medicare home health beneficiaries had primary informal caregivers.[2] Based on code M0360, our study found that 85.79% of Medicare home health beneficiaries with diabetes had primary informal caregivers. Our study moved further and found that for the beneficiaries who received assistance several times during the day and night or several times during only the day, 7.34% were solely assisted by paid supplementary caregivers, 86.34% were solely assisted by unpaid supplementary caregivers, and 6.32% received assistance from both paid and unpaid supplementary caregivers. Our findings also showed that paid and unpaid supplementary caregivers heavily involved in caregiving had a significant impact on health outcomes for these frail, community-dwelling homebound beneficiaries. In order to obtain the full picture for the difference in quality of care pro-

TABLE 3. Results of Multivariable Cox Regression Models After Matching

Variables	Diabetes-Related Conditions (n = 10,306)[a] HR (95% CI)	Heart Disease-Related Conditions (n = 10,519)[a] HR (95% CI)	COPD (n = 10,229)[a] HR (95% CI)	UTI (n = 10,243)[a] HR (95% CI)	Pneumonia (n = 10,248)[a] HR (95% CI)	Dehydration (n = 10,227)[a] HR (95% CI)
Paid caregiver	1.04 (0.71-1.50)	0.93 (0.74-1.15)	0.78 (0.41-1.44)	1.68* (1.13-2.50)	1.35 (0.80-2.28)	0.76 (0.42-1.37)
For-profit hospitals	1.12 (0.66-1.89)	0.84 (0.59-1.18)	0.35 (1.00-1.24)	1.30 (0.74-2.28)	1.22 (0.59-2.50)	1.38 (0.58-3.28)
Public hospitals	1.09 (0.60-1.98)	1.51** (1.11-2.07)	1.00 (0.41-2.49)	1.79* (1.05-3.06)	1.20 (0.52-2.76)	0.92 (0.29-2.90)
Teaching hospitals	1.42 (0.90-2.25)	0.94 (0.69-1.27)	0.64 (0.26-1.59)	1.82* (1.14-2.91)	1.16 (0.59-2.31)	0.31 (0.07-1.31)
Hospital system affiliation system	0.85 (0.58-1.24)	0.86 (0.68-1.08)	0.80 (0.45-1.43)	1.33 (0.86-2.06)	0.92 (0.54-1.57)	1.10 (0.54-2.25)
Public home health agencies	0.88 (0.33-2.40)	0.51 (0.25-1.05)	2.25 (0.71-7.17)	0.87 (0.31-2.41)	1.46 (0.42-5.11)	1.41 (0.24-8.09)
Nonprofit home health agencies	1.15 (0.77-1.73)	1.05 (0.82-1.33)	0.92 (0.49-1.73)	0.84 (0.55-1.28)	1.64 (0.88-3.05)	1.35 (0.64-2.82)
Number of primary care physicians per 1000 population	0.83 (0.40-1.71)	1.30 (0.82-2.04)	1.45 (0.54-3.84)	1.29 (0.48-3.44)	0.23* (0.70-0.72)	0.30 (0.08-1.16)
Number of acute hospital beds per 1000 population	0.96 (0.86-1.07)	1.04 (0.98-1.10)	1.00 (0.87-1.15)	0.90 (0.77-1.05)	1.12 (0.99-1.26)	1.14 (0.97-1.34)
Rural	1.00 (0.60-1.67)	1.19 (0.88-1.61)	1.51 (0.71-3.21)	1.47* (0.83-2.60)	0.98 (0.47-2.04)	0.98 (0.42-2.24)
Intensity of home health visits	2.04*** (1.57-2.64)	1.81*** (1.55-2.11)	1.65* (1.12-2.42)	1.90*** (1.41-2.57)	2.58*** (1.78-3.79)	2.76*** (1.69-4.49)
Median household income	0.64 (0.35-1.18)	0.84 (0.60-1.19)	0.67 (0.29-1.51)	0.51 (0.18-1.43)	1.38 (0.60-3.17)	1.52 (0.58-4.00)

CI indicates confidence interval; COPD, chronic obstructive pulmonary disease; UTI, urinary tract infection.
[a]N is the number of observations left in the regression model.
"*" indicates P <.05; "**" indicates P <.01; "***" indicates P <.001.

vided by paid and unpaid supplementary caregivers, future studies focusing on other quality indicators, such as emergency visits and mortality, are recommended.

Limitations

Our datasets did not provide information on competence, stress, and support systems for paid and unpaid supplementary caregivers, which are likely to affect patients' outcomes.[32] Additionally, we focused on Medicare FFS home health beneficiaries with diabetes without identifying type 1 and 2 diabetes or insulin users. We also excluded beneficiaries with dual eligibility, those receiving assistance once daily or less, and those receiving care from both paid and unpaid supplementary caregivers. Furthermore, we used OASIS, which contains only data in the United States, to provide clinical and functional conditions for Medicare home health beneficiaries and allows researchers to merge with other Medicare claim data, such as MedPAR. Readers must also be aware of the debate concerning the reliability and validity of OASIS.[33,34]

Moreover, we used preventable conditions defined by AHRQ. The conditions for preventable readmissions defined in the 3M Potentially Preventable Readmissions Grouping Software are slightly different from the preventable conditions defined by AHRQ. Future studies based on the 3M Potentially Preventable Readmissions Grouping Software are encouraged. Also, the propensity score matching was based on the variables available in our data. There were missing variables in our study that should be taken into consideration when interpreting our findings. Our datasets do not have beneficiaries' social/contextual factors, such as their education and whether they received social support from other organizations that were associated with the likelihood of hiring a supplementary caregiver and preventable readmissions.

Finally, we used 2009 datasets. Several programs, such as the Hospital Readmissions Reduction Program introduced in 2013 under the ACA,[35] are likely to have a spillover effect on preventable readmissions for Medicare home health beneficiaries. Future studies using recent data are recommended.

CONCLUSIONS

Despite the study limitations, our findings have clinical and policy implications. For clinical implications, paid and unpaid supplementary caregivers are critical partners for home health professionals. Inviting supplementary caregivers to initiate care plans and assuring their competence to meet Medicare home health beneficiaries' health needs becomes critical in the home health industry as the Medicare program is moving toward value-based purchasing and penalizing home health agencies with high preventable readmissions. For policy implications, our findings showed that our society heavily relies on unpaid supplementary caregivers to provide care to meet their loved ones' health needs and that beneficiaries with unpaid supplementary caregivers had lower risks of readmission due to UTI than those with paid supplementary caregivers. Policies that support unpaid supplementary caregivers are critical to help caregivers assist their loved ones and prevent them from using expensive hospital resources.[36,37] ∎

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eAppendix. Operational Definition for Variables Used in the Propensity Score Matching and Multivariate Regression

Variable	Operational Definition	Data Source(s)
Variables for Propensity Score Matching		
Predisposing factors		
Age	Two indicator variables identifying patients 75-84 years and 85[+] years, with patients 65-74 years as the reference group	MBSF[a]
Race	Two indicator variables identifying patients as African American, Hispanic and other races, with White as the reference group	
Female	1 if gender is female, with male in the reference group.	
Enabling factors		
Living alone	1 if patients live alone; 0 otherwise.	OASIS[b]
Health need factors		
Comorbidities[c]	1 if patients 3 or more comorbidities defined by Exhalisuer; 0 otherwise.	MedPAR[c]
Anxiety	1 if patients felt anxious; 0 otherwise	MedPAR and OASIS
Activities of Daily Living	Three dummy variables represent patients with different levels of ADL functions: Patients required assistance in 1 to 3 ADL functions; patients required assistance in 4 to 6 ADL functions; and patients required assistance in at least 7 ADL functions or were completely dependent on someone to perform ADL functions. The reference group is the patients who could independently perform all ADL functions.	OASIS
Pressure or stasis ulcer	1 if patients have pressure or stasis ulcer; 0 otherwise	
Cognitive disorders	Three indicator variables: 1) completely cognitive disorders if patients were totally dependent due to disturbance such as coma, or delirium; 2) severe cognitive disorders if patients require considerable assistance in routine situation; 3) mild cognitive disorders if patients require assistance only under stressful, unfamiliar conditions or in specific situations. Patients who were alert/ oriented and are able to comprehend tasks independently are in the reference group.	

Urinary catheter	1 if patients had urinary catheter; 0 otherwise	
Covariates in the Cox Regression		
Intensity of home health visits	(Number of visits divided by the length of home healthcare) multiplied by 7. Number of visits include the visits from 6 home healthcare professionals: nurses, physical therapists, occupational therapists, speech therapists, home health aides, and medical social workers.	HHA RIF[d]
Hospital factors		
For-profit hospital	1 if hospitals are for-profit hospital; 0 otherwise	AHA Annual Survey[e]
Public hospital	1 if hospitals are public hospital; 0 otherwise	
Teaching hospital	1 if hospital was the member of Council of Teaching Hospital of the Association of American Medical Colleges	
System affiliation	1 if hospitals are affiliated with system; 0 otherwise	
Home health agency factors		
Public home health agency	1 if home health agencies are public; 0 otherwise	POS[f]
Not-for-profit home health agencies	1 if home health agencies are not-for-profit; 0 otherwise	
Community factors		
Primary care resources	Number of primary care physicians/ 1,000 population	AHRF[g]
Acute care hospital bed	Number hospital beds/1,000 population	
Rural	1 if rural/urban continuum code for the counties is from 4 to 9. The rural/urban continuum code for the counties from 1 to 3 is in the reference group.	
Median household income	Median household income at the zip code level	PCSA[h]

[a]MBSF: Master Beneficiary Summary File

[b]OASIS: Outcome Assessment Information Set

[c]MedPAR: Medicare Provider Analysis and Review

[d]HHA RIF: Home Health Agency Research Identifiable File

[e]American Hospital Association (AHA) annual survey

[f]POS: Provider of Services File

[g]AHRF: Area Health Resources File

[h]PCSA: Primary Care Service Area database

We stated how we merged data in our previous studies but also provided the information for merging all data sources below for your review.

The MBSF, MedPAR, OASIS, and HHA RIF have a mocked beneficial ID (called bene_id). We used bene_id to merge these data sources to identify qualified study sample.

The MBSF file has SSA state/county code and zip code for each beneficiary. We used the MBSF file, OASIS, and SSA and FIPS Crosswalk to identify beneficiaries' FIPS state/county code, and then merged with AHRF by FIPS state/county code.

The MBSF has a mocked beneficial ID (called bene_id), beneficiaries' SSA state/county code. The OASIS has a mocked beneficial ID for all Medicare home health beneficiaries. The SSA and FIPS Crosswalk File has SSA state/county code and FIPS state/county code for each county in the US. We used mocked bene_id to merge MBSF and OASIS in order to find beneficiaries' SSA state/county code. We then used SSA state/county code to merge with the SSA and FIPS crosswalk File in order to find FIPS state/county code for each county. Finally, we used FIPS state/county code to merge with AHRF.

For merging with PCSA file, we used the ZTCA and ZIP Crosswalk File that has ZTCA code and ZIP code, which allowed us to merge MBSF by using zip code.

The MedPAR has Medicare provider ID number for the hospitals where beneficiaries receive inpatient care. The American Hospital Association annual survey also has Medicare provider ID number of each hospital and the characteristics of hospitals. We used Medicare provider ID number to merge these 2 datasets to find the characteristics of hospitals that provided inpatient care for beneficiaries. The OASIS has Medicare provider ID number for the home health agencies that provided home health services to beneficiaries. The POS file has Medicare provider ID number for the home health agencies and the characteristic of home health agencies. We used Medicare provider ID number to merge these 2 datasets to find the characteristic of home health agencies that provided home healthcare to beneficiaries.