Effects of Care Management and Telehealth: A Longitudinal Analysis Using Medicare Data

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OBJECTIVES: To evaluate mortality and healthcare utilization effects of an intervention that combined care management and telehealth, targeting individuals with congestive heart failure, chronic obstructive pulmonary disease, or diabetes mellitus.

DESIGN: Retrospective matched cohort study.

SETTING: Northwest United States.

PARTICIPANTS: High-cost Medicare fee-for-service beneficiaries (N = 1,767) enrolled in two Centers for Medicare and Medicaid Services demonstration participating clinics and a propensity-score matched control group.

INTERVENTION: The Health Buddy Program, which integrates a content-driven telehealth system with care management.

MEASUREMENTS: Mortality, inpatient admissions, hospital days, and emergency department (ED) visits during the 2-year study period were measured. Cox-proportional hazard models and negative binomial regression models were used to assess the relationship between the intervention and survival and utilization, controlling for demographic and health characteristics that were statistically different between groups after matching.

RESULTS: At 2 years, participants offered the Health Buddy Program had 15% lower risk-adjusted all-cause mortality (hazard ratio (HR) = 0.85, 95% confidence interval (CI) = 0.74–0.98; $P = .03$) and had reductions in the number of quarterly inpatient admissions from baseline to the study period that were 18% greater than those of matched controls during this same time period (−0.035 vs −0.003; difference-in-differences = −0.032, 95% CI = −0.054 to −0.010, $P = .005$). No relationship was found between the Health Buddy Program and ED use or number of hospital days for participants who were hospitalized. The Health Buddy Program was most strongly associated with fewer admissions for individuals with chronic obstructive pulmonary disease and mortality for those with congestive heart failure.

CONCLUSION: Care management coupled with content-driven telehealth technology has potential to improve health outcomes in high-cost Medicare beneficiaries. **J Am Geriatr Soc 61:1560–1567, 2013.**

Key words: telehealth; electronic communication; care management

Chronic diseases are associated with considerable morbidity, mortality, and costs, and managing them well is of considerable interest.[1] Barriers to effective management can arise because of coordination and communication gaps when individuals have multiple providers of care.[2] Better disease management may be a way to address this challenge. The Centers for Medicare and Medicaid Services (CMS) has sponsored several demonstration projects emphasizing disease management for chronically ill Medicare recipients,[3,4] that provide important opportunities to investigate the effect of better disease management on health outcomes. One demonstration project examined the Health Buddy Program (HBP), which integrates care management with the Health Buddy device, a telehealth device located in an individual's home and linked over the telephone, to care managers to facilitate information exchange. The current study analyzed the effect of the HBP on healthcare utilization and mortality.

Previous evaluations have considered care management and telehealth programs separately and reported mixed results.[5–10] Approaches integrating information technology tools with care management appear promising but are less well studied. Previous analyses have found an association between the HBP, lower costs, and longer survival in Medicare beneficiaries,[11,12] and benefits of HBP in a Veterans Affairs setting.[13,14]

In contrast to prior publications, this article focuses on mortality and healthcare utilization effects, particularly

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DOI: 10.1111/jgs.12407

0002-8614/13/$15.00

hospitalizations and emergency department (ED) visits. Hospitalizations are of interest because they can amplify morbidity and age-related physiological changes. Hospitalization itself poses risks to elderly adults because of lack of mobility, lower activity levels, and iatrogenic risks.[15]

METHODS

The Intervention

The Health Buddy device is a small electronic device with a high-resolution screen and four large buttons designed to easily collect information from individuals regarding their symptoms, vital signs, mental health, knowledge, and health behaviors. Participants received daily questions related to their diagnoses (e.g., "Do you have more shortness of breath than usual today?") and responded using the buttons. Responses were uploaded to a software system accessible over a secure Web portal that risk-stratified responses to support daily care manager review. The system identified the need for intervention based on signals such as deteriorating clinical signs (e.g., shortness of breath at all times vs with activity), lack of response, or gaps in individuals' knowledge and behaviors, potentially improving coordination of appropriate services and contact with providers.[12] It also provided appropriate feedback and educational information to individuals about their condition that may have improved self-care (e.g., "Call your doctor today to report your increased shortness of breath" or "Be sure to take rest breaks in between your routine activities. This is called activity pacing. If this increased shortness of breath continues, call your doctor to report it").

The HBP demonstration project was implemented at two multispecialty clinics located in Bend, Oregon, and Wenatchee, Washington. The demonstration targeted individuals with congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), or diabetes mellitus (DM).[12] To select intervention participants, beneficiaries residing in a county that the two clinics primarily served were identified from Medicare records. A selection algorithm then identified participants with the targeted conditions who were loyal to a study clinic (had ≥2 visits at the clinic or received more care from the clinic than any other). The algorithm selected only those who were not in hospice, did not have conditions that would limit interaction with HBP or its effectiveness (e.g., dementia, blindness), or had high-cost conditions unlikely to be affected by HBP, such as end-stage renal disease. A full list of target exclusionary comorbidities is available upon request.

Demonstration participants were selected at two time points. The first cohort comprised 763 beneficiaries identified in early 2006. The second cohort consisted of 1,056 beneficiaries identified in early 2007 to expand the study and account for attrition. Care managers from each clinic contacted and invited selected participants over a period of several months beginning in February 2006 and 2007 for the first and second cohorts, respectively.

Analytical Overview

This project examined the relationship between the HBP and mortality and healthcare utilization, including inpatient admissions, hospital days for those admitted, and ED visits, by comparing the intervention group with a propensity-matched control group. An intention-to-treat approach was used, considering all participants offered HBP as the intervention group, regardless of whether they used it. Approximately 37% of the intervention population inputted information into the system at least once ("engaged" the system). Engaged participants used Health Buddy for 300 days during the demonstration, on average.

Changes in utilization measures for the intervention and control participants from a 1-year period before the intervention was offered (baseline) were compared with a 2-year period afterward (study period). Hazard models were used to study differences in survival for the intervention and control groups during the study period.

Data Sources and Matching Controls

Data for intervention participants came from finalized Medicare claims that CMS provided from the demonstration project. Control data came from Medicare claims from a 5% random sample of all beneficiaries (CMS 5% sample).[16] Mortality (date of death) was observable from enrollment files linked to Social Security Administration death records.

To construct the propensity-matched control group, Pacific Northwest counties similar to Bend and Wenatchee in terms of demographic characteristics and hospital markets (control county selection criteria available upon request) [17] were identified, and Medicare beneficiaries in the CMS 5% sample residing in those areas were selected. Propensity-score matching was then used to select beneficiaries who most resembled intervention participants[18] using probit regression models for each cohort. Being offered HBP was the dependent variable, and demographic characteristics, diagnoses, Medicare Hierarchical Condition Category (HCC) risk scores,[19] and baseline utilization were independent variables. Control and intervention participants were matched 1:1 with replacement based on closest propensity scores, requiring scores within 0.01. A sufficiently close match could not be found for 52 intervention participants, and they were excluded (propensity score distribution available upon request).

Measurements

Mortality was based on validated date of death. Quarterly measures of the number of inpatient admissions, hospital days for those admitted, and ED visits were constructed for each beneficiary. Quarters (3-month intervals) for intervention participants were aligned to match the February 1 start date of the intervention. Participant age and sex and presence of CHF, COPD, or DM were coded based on information available in claims data. Other comorbidities were used to construct the Elixhauser index,[20] excluding CHF, COPD, and DM because they were included in the matching model. Disease conditions were identified based on diagnosis codes using Medicare claims (codes available upon request).

Statistical Analysis

SAS 9.2 (SAS Institute, Inc,. Cary, NC) and Stata 10.1 (StataCorp, College Station, TX) were used for analyses.

Unadjusted survival rates in the study period were evaluated using Kaplan-Meier curves and log-rank tests. To adjust for potential differences in participant characteristics, Cox proportional hazard models were used, in which the dependent variable was time from the first day of HBP availability until death or the end of the study period, controlling for demographic and health characteristics from the propensity-score matching algorithm that were statistically different between the groups after matching ($P < .10$) (full regression results available upon request).

Utilization was studied using the year before HBP began as a baseline and comparing changes in utilization over the study period.[13] Utilization analyses presented here include only quarters in which the participant was alive and enrolled in Medicare Part A and B for the whole quarter and exclude quarters immediately before and after HBP became available to account for uncertainty in the effective intervention start time.[12] For participants who died, the utilization analyses also excluded data from the quarter of death. In multivariate analyses, panel negative binomial models in which the dependent variable was quarterly utilization were used. Important explanatory variables were intervention status, a study period indicator, and the interaction of these two indicators. The models also controlled for relevant demographic and health characteristics. Results from the model were used to compute predicted quarterly utilization estimates, holding control characteristics fixed at their sample means. Statistical significance was determined using t-tests for continuous variables, chi-square tests for categorical variables in univariate analysis, and bootstrapped confidence intervals (CIs) for the multivariate predictions.[21]

Subgroup Analyses

All members of the intervention group were initially analyzed regardless of their active participation in the program. Results for participants who ever used the system (engaged) and those who never did (non-engaged) were compared separately with those of controls with closest propensity-score matches. Separate models were used to explore the intervention and control group members with each targeted health condition because these conditions are diverse, and the system may have influenced disease groups differently.

Sensitivity Analyses

Sensitivity analyses were performed including quarters surrounding program implementation and including the quarter of death for participants who died. Whether the use of propensity-score matching with replacement biased findings was also investigated by creating another control group using matching without replacement.

RESULTS

Participant demographics and clinical characteristics were similar between intervention (n = 1,767) and matched control (n = 1,767) participants (Table 1).

Mortality

Health Buddy Program was associated with lower risk of mortality in unadjusted survival analysis ($P = .01$) (Figure 1). In Cox proportional hazard models, HBP was associated with a 15% lower risk-adjusted probability of death (Hazard ratio (HR) = 0.85, 95% CI = 0.74–0.98, $P = .03$). Subgroup analyses found that the lower probability of death was largest in individuals with CHF (HR = 0.70, 95% CI = 0.57–0.85, $P < .001$) and engaged participants (HR = 0.52, 95% CI = 0.39–0.68, $P < .001$).

Healthcare Utilization

In the intervention group, there were an average of 0.179 admissions per quarter during baseline and 0.144 in the study period, a reduction of 0.035 per member per quarter (Table 2). Average quarterly hospitalizations for the control group decreased by 0.002 visits per member per quarter, suggesting a net decline of 0.032 (18%) associated with HBP (95% CI = −0.054 to −0.010, $P = .005$) and a number needed to treat to avoid one hospitalization per quarter of 32 participants. No significant relationship was found for quarterly number of hospital days conditional on hospitalization or for ED visits.

Adjusted results for hospitalizations were consistent with univariate findings, with a decline of 0.034 more in the intervention group than in controls (95% CI = −0.057 to −0.016, $P < .001$) (Table 2). Additionally, the differences in reductions between inpatient admissions of participants with COPD and engaged participants and the reductions of their matched controls (COPD subgroup, $P = .03$; engaged subgroup, $P = .003$) were larger than difference in reductions between the overall intervention group and the reductions of their matched controls.

Sensitivity Analysis

Results were similar when additional quarters were included. Including the two quarters surrounding program implementation resulted in an estimated net reduction of 0.018 (95% CI = −0.037 to 0.001, $P = .06$) in average quarterly admissions. Including the quarter of death for participants who died resulted in an estimated reduction of 0.035 admissions (95% CI = −0.057 to −0.014, $P = .001$).

Utilization and Cox proportional hazard model results using matching without replacement (n = 1,480 HBP and 1,480 control participants) were generally consistent with the main analyses. Although the lower mortality trend was statistically insignificant in the overall sample (HR = 0.88, 95% CI = 0.74–1.03, $P = .11$), the lower mortality associated with HBP in the subgroup with CHF (HR = 0.71, 95% CI = 0.56–0.91, $P = .006$) and the engaged subgroup (HR = 0.47, 95% CI = 0.34–0.65, $P < .001$) was still evident. Matching without replacement was not the preferred approach because it reduced the precision of matches, potentially accounting for the higher *P*-value, although similarity of the estimates confirmed that matching some control observations multiple times did not drive the main result.

Table 1. Baseline Demographic and Clinical Characteristics

Characteristic	Intervention, n = 1,767	Control, n = 1,767	*P*-Value[a]
Demographic			
Age, mean	76.8	76.7	.54
Male, %	53.7	52.5	.50
Aged <65, %	7.4	6.7	.47
Baseline comorbidities, %[b]			
Primary diseases of interest			
CHF	35.8	37.7	.22
DM	50.0	53.0	.07
Chronic obstructive pulmonary disease	35.7	38.2	.13
Sequelae of CHF: Arrhythmia	24.8	23.4	.33
Sequelae of DM			
Neurological symptoms	15.6	16.0	.75
Peripheral vascular disease	21.8	22.8	.49
Cardiovascular disease	80.1	82.5	.08
Ischemic heart diseases	24.9	28.9	.008
Renal complications	22.8	23.8	.47
Endocrine and metabolic complications	27.1	25.1	.17
Ophthalmic complications	29.9	29.9	>.99
Other complications	12.7	12.6	.88
Other comorbidities			
Hypertension	51.4	52.6	.50
Disorders of lipid metabolism	25.5	23.3	.12
Diseases of esophagus, stomach, and duodenum	8.1	8.8	.51
Coronary artery disease	25.1	29.3	.005
Hyperlipidemia	25.5	23.3	.12
Atrial fibrillation	21.2	19.7	.26
Anemia	14.3	14.7	.74
Chronic kidney disease	23.1	24.3	.41
Arthritis	26.4	26.0	.79
Cancer	13.2	14.7	.21
Skeletal muscle dysfunction	10.0	9.1	.33
Respiratory infection	19.5	19.0	.67
Glaucoma	8.8	8.8	.95
Overall health indicators			
Adjusted Elixhauser comorbidity index, mean	1.68	1.71	.84
Hierarchical conditions categories score, mean	2.28	2.38	.16
End-stage renal disease, %	1.3	1.8	.22
Exclusionary comorbidity, %	7.8	7.8	>.99
Baseline cost quintile ($),%			
1 (<3,109)	20.6	18.9	.20
2 (3,109–6,250)	20.4	19.9	.71
3 (6,251–12,293)	19.9	19.4	.70
4 (12,294–25,000)	19.6	20.8	.38
5 (≥25,000)	19.6	21.1	.26
Resource utilization, mean number			
Inpatient hospital visits	0.64	0.71	.19
Skilled nursing facility visits	0.09	0.08	.001
Outpatient visits	12.72	11.83	<.001
Emergency department visits	0.74	0.80	.08
Home health visits	0.20	0.22	.007
Carrier visits	38.57	38.95	.18
Durable medical equipment claims	9.04	9.00	.36
≥1 hospice visits, %	0.6	1.1	.09

CHF = congestive heart failure; DM = diabetes mellitus.

[a]Univariate comparisons of central tendencies used Wilcoxon tests for continuous variables and chi-square tests for categorical variables.

[b]Baseline comorbidities were diagnosed based upon at least two claims with the related *International Classification of Diseases, Ninth Revision*, codes, excluding laboratory or radiology claims.

DISCUSSION

The growing prevalence of chronic conditions poses challenges to the healthcare system. This study evaluated an intervention integrating telehealth with care management in participants with chronic disease. Two-year mortality for HBP was 15% lower than propensity score–matched controls, and admissions were 18% lower, but an effect on ED visits and hospital days was not found.

This study was designed to investigate overall relationships between HBP, utilization, and mortality. It did not provide sufficient data to identify underlying mechanisms for the observed effect, but several possibilities warrant further research. HBP includes components that could facilitate improvements in self-management in areas including exercise, diet, medication adherence, and communication with providers.[22] Use of HBP may lead participants to better understand their health conditions, improving self-care and reducing hospitalizations.[23]

Health Buddy Program may also improve the ability of care managers to respond quickly to changes in patient conditions, which may be associated with better outcomes.[24] Some literature also links hospitalization itself with new and worsening geriatric health conditions [25] in addition to a subsequent greater mortality risk.[26,27] An intervention that reduces hospitalizations, as this intervention appears to do, may be able to reduce mortality through this mechanism.

These findings suggest that effects of HBP vary according to disease subgroup. Individuals with CHF experienced the strongest survival effect, consistent with previous work showing an effect of remote telemonitoring on mortality for individuals with CHF.[28] The largest reduction in hospitalizations was found for the COPD subgroup. COPD is progressive; lung function typically worsens over time even with the best available care.[29] Pharmacotherapy is typically used to control symptoms and reduce severity and frequency of exacerbations.[29] Because exacerbations are the main cause of healthcare utilization,[30] it seems plausible that a care management program aimed at improving medication adherence and timely access to care could reduce exacerbation-related healthcare utilization. In a subgroup analysis, participants in the HBP group who engaged with the system at least one time had lower mortality and fewer hospital admissions than the subset of the intervention group who never

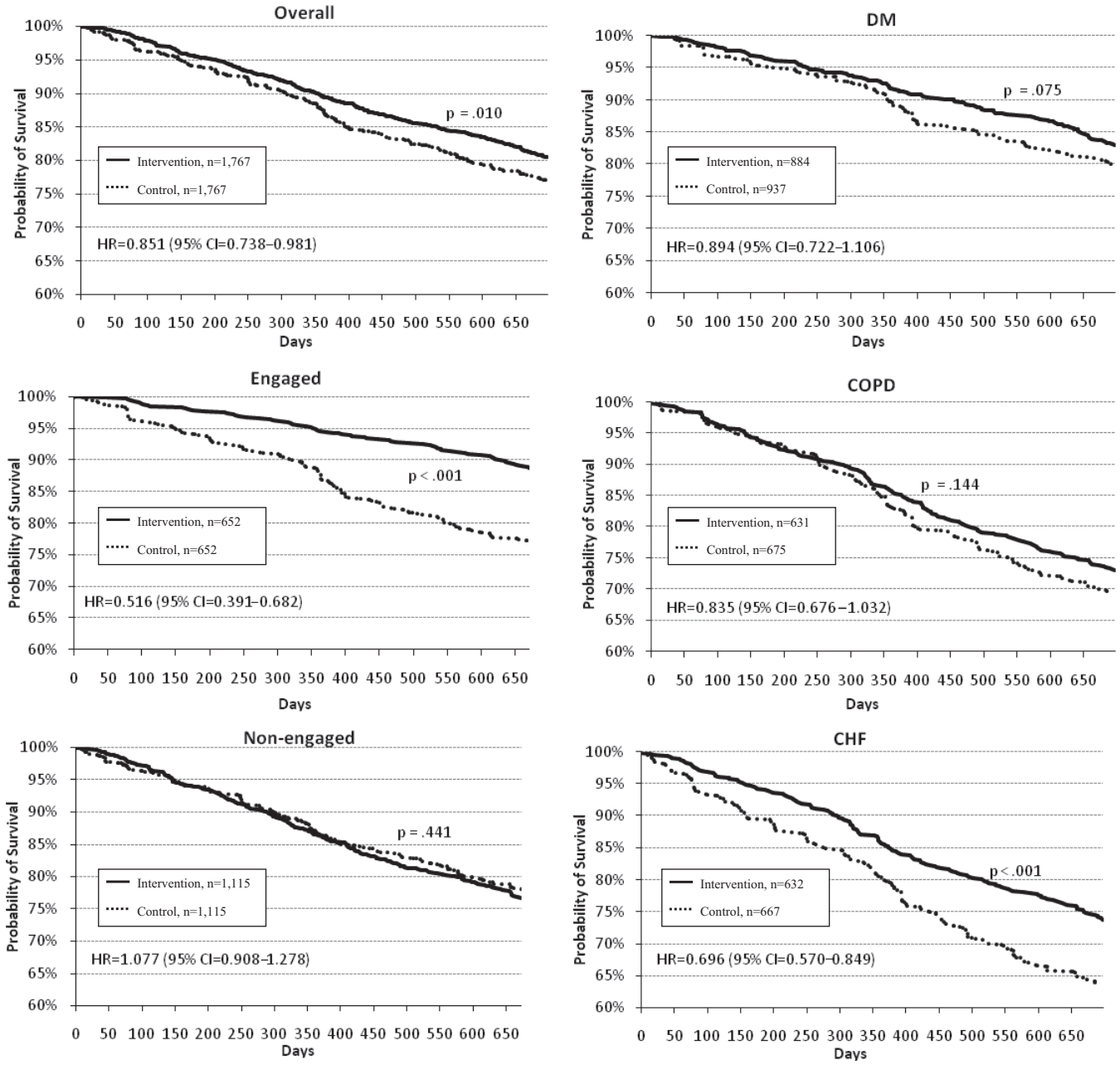

Figure 1. Kaplan-Meier and Cox proportional hazard estimates for survival after baseline period. Kaplan Meier curves represent unadjusted difference in survival between intervention and control participants, with *P*-values based on the test. Cox proportional hazard ratios (HRs) and 95% confidence intervals (CIs) curves represent adjusted difference in survival between Intervention and Control participants. Ties in event occurrence are treated using the exact method; a true, but unknown, ordering is assumed to exist for tied event times (time is continuous).

used the system. Although there may be selection effects in this subgroup, these findings suggest an opportunity to increase participation and better target the HBP selection toward particular groups of individuals who are most likely to use the program and benefit from it. Future analyses could investigate this possibility.

This study was conducted independently of a CMS-sponsored evaluation of the demonstration program.[11] Although the approaches shared certain features, the current study used a different approach to select a control group with the CMS 5% sample. Specifically, the control group was based on the selection algorithm used to identify the intervention group and matched using propensity score methods. Disease subgroups were also evaluated, and different analytical methods were employed in an attempt to account explicitly for time trends in utilization. The conclusions also shared some similarities, notably the findings toward reductions in utilization and mortality for the HBP group.

Previous evaluations of the effectiveness of telehealth technologies have found mixed results. For example, a randomized controlled trial comparing telemonitoring with usual care at the Mayo Clinic in older adults with multiple health conditions found that telemonitoring was associated

Table 2. Average Resource Use Comparison of Intervention and Control Participants

	Intervention		Control		Relative Change (95% Confidence Interval)			
Resource	Baseline	Study	Baseline	Study	Unadjusted[b]	*P*-Value[a]	Adjusted[c]	*P*-Value[a]
Quarterly number of inpatient admissions[d]								
Overall	0.179	0.144	0.171	0.169	−0.032 (−0.05 to −0.01)	.005	−0.034 (−0.06 to −0.02)	<.001
DM	0.191	0.151	0.206	0.175	−0.010 (−0.04 to 0.02)	.56	−0.024 (−0.05 to 0.01)	.12
COPD	0.216	0.178	0.220	0.225	−0.042 (−0.08 to −0.001)	.045	−0.044 (−0.08 to −0.003)	.03
CHF	0.218	0.165	0.277	0.239	−0.016 (−0.06 to 0.03)	.45	−0.028 (−0.07 to 0.01)	.21
Engaged Health Buddy	0.177	0.131	0.187	0.182	−0.041 (−0.08 to −0.004)	.03	−0.048 (−0.09 to −0.02)	.003
Non-engaged	0.180	0.152	0.162	0.161	−0.026 (−0.05 to 0.002)	.07	−0.027 (−0.06 to 0.002)	.07
Hospital days per quarter, conditional on hospitalization[e]								
Overall	4.765	5.829	5.402	6.845	−0.378 (−1.29 to 0.53)	.42	−0.244 (−0.92 to 0.28)	.29
DM	4.530	5.968	5.442	7.442	−0.563 (−1.81 to 0.68)	.38	−0.018 (−0.93 to 0.60)	.66
COPD	5.067	5.735	5.488	7.370	−1.214 (−2.63 to 0.20)	.09	−0.742 (−1.66 to 0.06)	.07
CHF	5.073	6.039	5.870	7.490	−0.654 (−2.17 to 0.86)	.40	−0.192 (−1.16 to 0.82)	.73
Engaged Health Buddy	5.010	5.839	5.900	7.555	−0.826 (−2.44 to 0.79)	.32	−0.868 (−2.08 to 0.01)	.05
Non-engaged	4.623	5.824	5.082	6.400	−0.118 (−1.21 to 0.97)	.83	0.084 (−0.66 to 0.78)	.88
Quarterly number of emergency department visits[d]								
Overall	0.190	0.185	0.192	0.175	0.011 (−0.02 to 0.04)	.41	0.007 (−0.02 to 0.03)	.53
DM	0.209	0.194	0.230	0.185	0.031 (−0.01 to 0.07)	.12	0.022 (−0.02 to 0.06)	.27
COPD	0.230	0.230	0.257	0.217	0.041 (−0.01 to 0.09)	.12	0.021 (−0.03 to 0.08)	.32
CHF	0.211	0.187	0.266	0.222	0.020 (−0.03 to 0.07)	.43	0.017 (−0.03 to 0.07)	.38
Engaged Health Buddy	0.158	0.162	0.204	0.186	0.021 (−0.02 to 0.06)	.30	0.011 (−0.03 to 0.05)	.54
Non-engaged	0.209	0.199	0.185	0.169	0.006 (−0.03 to 0.04)	.72	0.006 (−0.03 to 0.04)	.67

DM = diabetes mellitus; COPD = chronic obstructive pulmonary disease; CHF = congestive heart failure.

[a]Univariate comparisons of central tendencies used t-tests for continuous variables.

[b]Calculated as (intervention sample study period outcome–intervention sample baseline period outcome)–(control sample study period outcome–control sample baseline period outcome).

[c]Predictions were estimated using panel negative binomial models. Control variables were those criteria with $P < .10$ after matching.

[d]Quarterly number of inpatient admissions and emergency department visits were calculated based on the average total number of claims for that category in each quarter.

[e]Hospital days per quarter was calculated based on the claim utilization day count variable and was measured conditional on being hospitalized.

with significantly higher risk of mortality and nonsignificantly higher rates of hospitalizations, ED visits, and total hospital days.[31] This study differed from the current one, which found that HBP was associated with significantly lower all-cause mortality for individuals with CHF and DM and nonsignificantly lower all-cause mortality for those with COPD. It also found significantly fewer hospitalizations for individuals with COPD but nonsignificantly fewer for those with CHF and DM. There are two important differences between these studies that may have affected the outcomes. First, the Health Buddy is a different telehealth system, which may lead to different associations with the individual and outcomes. Second, participants were similar at baseline in terms of demographics, comorbidities, and important resource utilization categories. Although participants randomized to telemonitoring or usual care at the Mayo Clinic had similar baseline characteristics, there were substantially higher baseline rates of ED visits in the telemonitoring group (73%) than with usual care (40%), suggesting that, despite randomization, there may be some underlying difference between the groups.[31]

By combining telehealth with care management, the HBP is interactive for individuals and care managers. This integrated approach may teach individuals to understand their medical conditions and improve health behaviors. Similarly, care managers with better information may be able to reinforce positive behavior by helping beneficiaries manage their conditions. Care managers may also be able to identify beneficiaries requiring attention and can intervene before the condition worsens.

The main strength of this study was the use of statistical methods to compensate for the lack of a randomized control trial design. Propensity score–matching methods improved the balance in covariates between the two groups, and the difference-in-differences approach allowed for the evaluation of an intervention effect while controlling for time-invariant unobservable factors.

The study had some limitations. First, the data did not contain clinical or sociodemographic information (e.g., income or educational attainment) because claims collected for administrative purposes were used. Any underlying differences in these characteristics could not be controlled for and may have affected results. Additionally, 5% Medicare data identify dates of services at the quarter level, making analysis of readmissions impossible. Second, the demonstration project was based on sole community providers in the Pacific Northwest, potentially limiting generalizability of these findings. In addition, this study was designed to compare usual care with an intervention that combined telehealth and care management. It did not attempt to demonstrate the added value of telehealth over care management without telehealth. It also did not investigate different patterns of HBP use (e.g., length and frequency of engagement) and the ways in which these patterns affected outcomes. Further research into these areas is warranted. Like all studies based on

retrospective analysis of nonrandomized settings, this analysis could not prove causality with certainty. Additional prospective studies would be valuable to further verify the findings.

These findings show that the availability of HBP was associated with fewer hospitalizations and longer survival in a group of Medicare beneficiaries with chronic disease and suggest that integrated telehealth and disease management could offer a valuable approach to improving care for high-cost Medicare beneficiaries with complex chronic conditions.

ACKNOWLEDGMENTS

The authors thank Kevin Brennan for database development support.

Conflict of Interest: Dendy S. Macaulay, Rachael A. Sorg, Melissa D. Diener, and Howard G. Birnbaum are employees of Analysis Group, Inc., which received an unrestricted grant from Robert Bosch Healthcare for this research. Scott J. Johnson was an employee of Analysis Group, Inc. at the time of this research. Laurence C. Baker acted as a consultant to Analysis Group under the unrestricted grant.

Author Contributions: All authors contributed to study design; collection, management, analysis, and interpretation of data; and preparation, review, and approval of the manuscript. All authors had full access to the data in the study. Laurence C. Baker and Dendy S. Macaulay take responsibility for the integrity of the data and the accuracy of the data analysis.

Sponsor's Role: This project was supported by Robert Bosch Healthcare under a contract that provided for independent analysis by the authors. The role of the sponsor in each phase of the research was as follows. Design and Conduct of the Study: The sponsor requested a proposal for analysis from the authors. The authors designed and proposed the study, which the sponsor accepted. The authors conducted the study. Collection, management, analysis, and interpretation of the data: Some of the data used in the study were collected as part of a CMS demonstration project. The sponsor assisted in having these data made available to the authors. The authors collected these and other data used in the study and managed, analyzed, and interpreted the data. Preparation, review, or approval of the manuscript: The authors prepared the manuscript. The manuscript was made available to the sponsor for comment, and the sponsor provided comments, which the authors considered in further revisions. By contract, the authors had the authority to independently revise and submit the manuscript.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Figure S1. Distribution of propensity score for Intervention and Control participants.

Table S1. List of Exclusionary Comorbidities, ICD-9 Codes, and CPT Codes.

Table S2. Control county selection criteria.

Table S3. ICD-9-CM diagnosis codes for disease classification of participants.

Table S4. Regression specifications.

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