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Meal Delivery Programs Reduce The Use Of Costly Health Care In Dually Eligible Medicare And Medicaid Beneficiaries

Seth A. Berkowitz, MD, MPH[1,2,3], **Jean Terranova, JD**[4], **Caterina Hill, MSc**[5], **Toyin Ajayi, MD, MPhil**[5,6], **Todd Linksy, BA**[5], **Lori Wiviott Tishler, MD, MPH**[3,5,7], and **Darren A. DeWalt, MD, MPH**[8]

[1]Division of General Internal Medicine, Massachusetts General Hospital, Boston, MA

[2]Diabetes Population Health Research Center, Massachusetts General Hospital, Boston, MA

[3]Harvard Medical School, Boston, MA

[4]Community Servings, Inc, Jamaica Plain, MA

[5]Commonwealth Care Alliance, Boston, MA

[6]Sidewalk Labs Care Lab, New York, NY

[7]Department of Medicine, Brigham and Women's Hospital, Boston, MA

[8]Division of General Medicine and Clinical Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, NC

Abstract

It is unclear whether delivering food to nutritionally vulnerable patients can improve healthcare utilization and costs. We sought to determine whether home delivery of either medically-tailored meals (MTM) or non-tailored food (NTF) reduces healthcare utilization and expenditure in a sample of dually Medicare and Medicaid eligible adults. MTM program participants had fewer emergency department visits (Incidence Rate Ratio [IRR] 0.30; 95%CI 0.20 to 0.45) than matched non-participants, as did NTF program participants (IRR 0.56; 95%CI 0.47 to 0.68). MTM program participants also had fewer inpatient admissions (IRR 0.48; 95%CI 0.26 to 0.90), and lower medical expenditure (difference -$572, 95% CI -$933 to -$210). NTF program participation was not associated with fewer inpatient admissions (IRR 0.88; 95%CI 0.69 to 1.11), but was associated with lower medical expenditure (difference -$159, 95%CI -$310 to -$8). Meal delivery programs may be an important way to improve healthcare utilization and costs for vulnerable patients.

Introduction

Social determinants of health, such as lack of access to nutritious food, are recognized as factors associated with high costs of healthcare.(1–3) Approximately 13% of American households report food insecurity, meaning they lack "consistent, dependable access to enough food for active, healthy living".(4) Food insecurity is associated with poor health and increased use of 'big ticket' health services, such as emergency department visits and inpatient admissions.(5–12) Proposed mechanisms of this association include poor dietary quality leading to increased disease complications, food and medication 'trade-offs' that impair chronic disease management, and increased stress that worsens mental health.(13) Perhaps for these reasons, food insecurity is associated with $77 billion in excess annual healthcare expenditure.(14)

Lack of access to nutritious food may be a particular problem for those who are dually Medicare-Medicaid eligible.(15) These individuals qualify for Medicaid on the basis of low income, and qualify for Medicare either through adjudicated disability or age. The combination of vulnerability from both medical issues and poverty that dually eligible patients face has led to support for services, such as meal programs, that were uncommon in fee-for-service systems.(3, 16) However, we do not yet know whether meal programs improve healthcare utilization.

In this study, we sought to determine the impact of two types of home delivered meal interventions, which have different program costs and target populations, on healthcare utilization and expenditures. One program provided home delivered meals tailored to the participants' specific medical needs, and the other provided nutritious home delivered meals that were not tailored to specific medical conditions. Because there is an association between food insecurity and greater emergency department use, we hypothesized that the meal program interventions would reduce emergency department visits.(5–8) Secondarily, we hypothesized that meal program participation would reduce use of other 'big-ticket' services (inpatient admissions and emergency transportation), along with associated medical expenditure.

Study Data and Methods

Study Population and Sample Selection

The study sample was drawn from members of Commonwealth Care Alliance (CCA), and the primary data source for this study was CCA healthcare claims. CCA is a not-for-profit community-based health plan that manages and administers care for adults (age > 21 years) who are dually eligible for Medicaid and Medicare.(17) CCA uses capitated payments to provide enhanced primary care and care coordination programs. All CCA members with at least 6 months of continuous meal program enrollment between Jan 1, 2014 and Jan 1, 2016, were eligible for this study. The comparison group was comprised of randomly selected CCA members, during the same time period, who did not receive either meal program. The participants' 'index date' was the date they began receiving the meals, or a randomly selected date for the comparison group. In order to have sufficient data for matching, we required 12 months of pre-index enrollment in CCA (Appendix Exhibit A1).(18) Participants were followed until either the end of their membership in CCA, or the end of the study (June 30, 2016). Participants were still analyzed as part of their meal program group if they stopped their meal program.

The Partners Human Research Committee provided human subjects approval for this project.

Meal Delivery Programs

Two meal programs were studied. The first was a medically-tailored meal (MTM) program that provided meals customized to participant's medical needs. The MTM program delivered to the participant's home, weekly, five days of lunches, dinners, and snacks. A registered dietitian tailored the meals to the participant's medical needs across 17 dietary 'tracks' (e.g., diabetes, renal, soft, etc.), with combinations of up to 3 'tracks' permitted (e.g., diabetes, renal, and soft). The second program was a 'Meals on Wheels'-type non-tailored food (NTF) program that also delivered nutritious meals, but without tailoring to medical needs. The NTF program provided five days of prepared lunches and dinners each week, usually delivered daily.

Enrollment into either program was determined by an authorizing clinician. Program authorization required a determination that the member was at nutritional risk (for example, significant weight change, food scarcity, or medical issues that require a specific diet). There was no specific guidance for clinicians as to whether the individual should receive MTM or NTF. It is likely that many CCA members who might have participated in a meal program did not, owing to little 'advertising' of the programs.

Outcomes

The primary outcome was emergency department visits (regardless of ultimate disposition to inpatient admission or home), obtained through healthcare claims. Secondary outcomes included inpatient admissions and use of emergency transportation (e.g., transportation by ambulance)—a high cost component of care in this population. In addition, we examined medical expenditures (expressed as inflation adjusted 2016 dollars) using claims for five service categories where nutrition programs might plausibly affect expenditure(13): inpatient, outpatient, emergency department, pharmacy, and emergency transportation.

Data extraction

From CCA data, we extracted information on age, race/ethnicity, gender, primary language (English or non-English), insurance product (type of CCA plan), and start and end (if any) of CCA enrollment. We examined a risk score (from the CMS-HCC risk adjustment model(19)), and classes of medications filled in the prior year. Claim ICD-9/ICD-10 diagnosis codes were used to create a comorbidity index (range: −2 to 26) following the method of Gagne et al.(20, 21) In addition, we used information about the participant's area of residence, as indicated by their ZIP code, using data from the American Community Survey(22) and from the Dartmouth Atlas(23) (Technical Appendix). (18)

Statistical Analysis

Participation in MTM or NTF programs did not occur at random, which is a major source of confounding in this study. To account for this, we used a nonparametric approach called coarsened exact matching (CEM) (Technical Appendix (18)).(24–27) CEM seeks to balance relevant sociodemographic, clinical, and pre-intervention healthcare characteristics that would lead to treatment between the treated and untreated groups, using only pre-intervention data. CEM leads to matched groups that are not only similar in their mean values of covariates, but also across the entire distribution of values (important for analyzing healthcare use as a small number of cases can contribute a large portion of the total outcome). We created two cohorts using CEM--one comprising those who received MTM and similar participants who received no meal intervention, and one comprising those who received NTF and similar participants who received no meal intervention. Owing to the relatively small sample size and substantial differences between those who received MTM and those who received NTF, we were unable to compare the two interventions with each other.

After creating the matched cohorts, to account for any remaining imbalance between the groups still present after matching, we conducted regression adjusted analyses using generalized linear models. For 'count' outcomes, we used a generalized linear model with a negative binomial distribution and log link. The models included demographic and clinical variables along with medical expenditures in the 12 months prior to the index date (to account for regression to the mean--an 'Analysis of Covariance' [ANCOVA] approach)(28), and the index date to account for 'secular' trends. To analyze monthly post-intervention medical expenditure, we used a generalized linear model with a gamma distribution and a log link(29). We express differences in post-intervention medical expenditure between the groups both in terms of the medical expenditure itself ('gross' difference), and medical expenditure net of intervention costs ('net' difference). Intervention costs were calculated by summing the paid claims for the services and dividing by the participant's follow-up time to calculate an average per-person monthly cost.

We conducted several sensitivity analyses to check the robustness of the results. First, we sought to determine whether differences may be due to a 'triggering' event, such as an inpatient admission, and conducted analyses in a sample that matched based on these events (Technical Appendix (18)). Next, we ran the same models on the entire (unmatched) sample. After that, we forced a very close match on baseline costs, with less emphasis on other factors, and then conducted gamma regression analyses as above. Finally, to check whether changes may have been related to other social support services (e.g., personal care assistants or home health aides), we examined use of these services in the peri-index period (60 days before and after the index date), and during the entire post-index period.

All models used robust confidence intervals for inference. All analyses were conducted in SAS version 9.4, and Stata/SE 14.2.

Limitations

The findings of this study should be interpreted considering several limitations. Entry into the meal delivery programs was not randomized. Though we accounted for measured factors that could influence program entry, we cannot exclude unmeasured confounding, for example, by stigma associated with program participation. The study sample was drawn from a population of Medicare-Medicaid 'dual eligibles' participating in a health insurance program specifically designed for those with high levels of medical and social complexity. These participants were more diverse than state averages, and highly concentrated in urban areas. How these results might generalize to different populations is unclear. We did not have data on who was offered, but declined, participation in either program. We present our results using an 'intention-to-treat' analysis strategy. However, this may bias results to the null as those who discontinue the intervention could dilute the association between the intervention and changes in utilization. Finally, we are unable to assess how concurrent interventions that did not result in healthcare claims might have affected results.

Study Results

For the MTM analyses, we included 133 participants who received the meals and 1002 matched controls. For the NTF analyses, we included 624 participants who received the NTF intervention and 1318 matched controls. In these cohorts, demographics were generally similar between the intervention and control group, both for mean values and across the distribution of covariates (Exhibit 1 and Appendix Exhibits A2a-b).(18)

Very few patients were lost to follow-up: in the MTM cohort 99.5% (1129/1135) of participants were enrolled in CCA through the end of the study; and in the NTF cohort 96.6% (1875/1942) were enrolled in CCA through the end of the study (details of meal program participation are given in Appendix Exhibit A3).(18) Owing to a later intervention start within the study period, average post-index follow-up time in the MTM cohort was 19.1 (SD: 5.8) months for those who received meals and 23.0 (SD: 2.0) months for their controls. Average post-index follow-up time in the NTF cohort was 23.6 (SD: 5.1) months for those who received meals and 24.3 (SD: 2.6) months for their controls. In the MTM analyses, mean per person counts of emergency department, inpatient, and emergency transportation use were: 1.8, 0.3, and 1.2, respectively. In NTF analyses, mean per person counts of emergency department, inpatient, and emergency transportation use were: 1.3, 0.4, and 1.0, respectively.

In negative binomial regression analyses, participation in an MTM program was associated with fewer emergency department visits (adjusted Incidence Rate Ratio [aIRR] 0.30; 95%CI 0.20 to 0.45), inpatient admissions (aIRR 0.48; 95%CI 0.26 to 0.90), and uses of emergency transportation (aIRR 0.28; 95%CI 0.16 to 0.51) (Exhibit 2, Appendix Exhibits A4–7).(18) Participation in an NTF program was associated with fewer emergency department visits (aIRR 0.56; 95%CI 0.47 to 0.68) and uses of emergency transportation (aIRR 0.62; 95%CI 0.49 to 0.78). However, participation in an NTF program was not associated with fewer inpatient admissions (aIRR 0.88; 95%CI 0.69 to 1.11) (full models in Appendix Exhibit A8–10)(18).

In gamma regression models examining average monthly medical expenditure after the index date, participation in an MTM program was associated with lower medical expenditure than not participating (difference -$570, 95% CI -$931 to -$208) (Exhibit 3, Appendix Exhibit A11).(18) Participation in an NTF program was also associated with lower medical expenditure (difference -$156, 95%CI -$308 to -$5) (Appendix Exhibit A12).(18) The average monthly cost of the MTM program was $350 and the average monthly cost of the NTF program was $146. Subtracting the costs of the programs from the estimated savings yields a net savings of $220 for the MTM program and $10 for the NTF program.

We found that the results of our main analyses were robust across a number of sensitivity analyses. As an illustration, matching based on a ‘triggering event’, rather than pre-intervention costs did not substantially alter the results (Exhibit 4). Other sensitivity analyses included using the entire (unmatched) cohort, in which results for the MTM program were qualitatively unchanged, and results for the NTF program results were also similar, except that the reduction in medical expenditure was no longer statistically significant (p=.05), and reductions in inpatient admissions were significant (p=.001). Sensitivity analyses that forced a very close match on costs again favored receipt of medically-tailored meals (difference in cost -$706, p < .0001)(Appendix Exhibit A13–14)(18). We did not find significant differences in use of, or costs associated with, other supportive programs such as home health or personal care assistant services, between either intervention group and their matched controls (Appendix Exhibit A15)(18). Adjusting for supportive services use and cost did not substantially alter the estimates of cost savings, which remained in favor of the intervention programs (Appendix Exhibit A16)(18).

Discussion

We found that participating in an MTM intervention for at least 6 months was associated with significant reductions in emergency department visits, compared with similar participants who did not receive an MTM intervention. Similarly, we found that participating in an NTF intervention for at least 6 months was associated with reduced emergency department use. These programs were also associated with lower use of other ‘big ticket’ health services. Sensitivity analyses conducted on the entire unmatched cohort were generally similar to the matched analyses, and we did not see evidence that regression to the mean, use of other social supports, or a ‘triggering event’ explained these findings.

The MTM and NTF interventions, were used in different populations. In general, the NTF intervention was used in an older and less likely to be English speaking group, and the MTM program was used in a younger group with higher rates of disability. Information regarding these programs may be useful to policy makers and payers, particularly to the extent that the groups they are providing care for reflect these groups. The NTF program may be a useful, and less expensive, option to improve healthcare utilization for those who are older but otherwise relatively healthy. The MTM program may be particularly useful for those who are sicker and disabled. For both programs, the overall reductions in emergency department visits are large enough to be meaningful clinically. Though we did not conduct a formal cost-effectiveness analysis in this study, the lower expenditures estimated suggest that these programs may offer savings to payers, or at least be cost-neutral while reducing unplanned and disruptive events such as emergency department visits and ambulance rides. Thus, the programs are likely to be beneficial for both patients and healthcare systems.

This study extends our knowledge regarding home delivered meals and health outcomes. Few prior studies have examined the impact of medically-tailored meals, but one that did, in a different patient population, found cost savings associated with MTM.(30) With regard to non-medically tailored food delivery, prior studies have suggested that home delivered meals decrease nursing home admissions, but these studies were limited by their ecological design.(31, 32) Further, a recent systematic review of home delivered meal interventions found that most studies were cross-sectional, and did not examine healthcare expenditures or utilization as this study did.(33)

This study suggests several directions for future work. Randomized evaluation for this type of intervention is feasible, and, given the promise shown here, would be an important next step. It will also be important to confirm these findings in larger samples, and in different settings to evaluate generalizability. This work also supports the overall approach of increasing the integration between the healthcare and social services sectors.(16, 34, 35)

This study had several key strengths. We used detailed assessment of pre-intervention data across several domains: clinical and claims based, demographic, social, and geographical, which helped minimize confounding related to intervention assignment. Our data were also longitudinal, and the participants were racially and ethnically diverse. Finally, the results were robust to several sensitivity analyses.

Conclusion

Home delivered meals, and particularly medically-tailored meals, show promise for helping to improve the use of health services in Medicare-Medicaid dually eligible adults, a medically and socially complex population where effective interventions can be hard to come by. While further, preferably randomized, evaluations are needed, this study suggests that meal delivery may be an important way to improve health for vulnerable patients.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1:

Sociodemographic and clinical characteristics of matched cohorts

	Medically Tailored Meals		Non-tailored Food	
	Control	**Intervention**	**Control**	**Intervention**
	N=1002	**N=133**	**N=1318**	**N=624**
	% or mean	**% or mean**	**% or mean**	**% or mean**
Age, years (mean)	57.9	57.4	73.1	73.5
Age, years (standard deviation)	5.4	8.4	5.9	7.5
Female	53.49	55.64	63.78	60.74
Race/Ethnicity				
Non-Hispanic White	35.22	37.59	12.50	12.50
Non-Hispanic Black	13.78	20.30	0.80	0.80
Hispanic	8.27	8.27	28.53	28.53
Asian/Other/Multi/Declined	42.73	33.84	58.17	58.17
Non-English Primary Language	34.98	27.07	46.86	52.88
Insurance Product				
One Care	78.04	81.95	22.55	20.03
Senior Care Options	21.96	18.05	77.45	79.97
Total costs in 12 months prior to intervention, $ (mean)	5,475	11,251	5,095	5,446
Total costs in 12 months prior to intervention, $ (standard deviation)	3849	8553	3887	5619
Risk Score (mean)	1.42	1.40	1.54	1.53
Risk Score (standard deviation)	0.44	0.69	0.43	0.54
Comorbidity Index (mean)	0.26	0.26	0.17	0.17
Comorbidity Index (standard deviation)	0.25	0.39	0.26	0.32
Percent of ZCTA that is rural (mean)	0.24	0	0.38	0.48
Percent of ZCTA that is rural (standard deviation)	0.45	0	0.98	1.32
Percent households in ZCTA living in poverty (mean)	16.06	16.26	17.96	17.86
Percent households in ZCTA living in poverty (standard deviation)	3.24	5.14	5.38	6.66
Percent of Medicare beneficiaries in ZIP code that had PCP visit in last 12 months (mean)	80.50	79.48	80.97	80.97
Percent of Medicare beneficiaries in ZIP code that had PCP visit in last 12 months (standard deviation)	1.00	1.06	1.22	1.52
Prescribed Medications				
Insulin	10.24	18.80	13.71	15.71
Anti - hypertensive	52.62	59.40	68.11	70.35
Other CVD medication	26.14	29.32	40.22	40.22
Anticoagulant	4.42	4.51	6.65	7.05
Proton pump Inhibitor	30.39	48.12	40.01	43.27
Anti-retroviral	0.75	0.75	0.89	1.12
Phosphate binder	0.11	0.00	0.75	0.32
Inhaler	15.18	30.08	17.69	19.55

	Medically Tailored Meals		**Non-tailored Food**	
	Control	**Intervention**	**Control**	**Intervention**
	N=1002	**N=133**	**N=1318**	**N=624**
	% or mean	**% or mean**	**% or mean**	**% or mean**
Oral steroids	15.09	25.56	16.37	14.90
Antibiotics	33.22	45.11	36.75	30.61

Abbreviations: CCA—Commonwealth Care Alliance; ZCTA—ZIP Code Tabulation Area; CVD—Cardiovascular Disease; PCP—Primary Care Provider

Source: Authors' analysis of CCA data

Multivariate imbalance was assessed using the L1 statistic (0.97 in the MTM group and 0.96 in the NTF group after matching). Detailed information on balance can be found in appendix exhibit A2a and A2b

Table 2:

Estimated Absolute and Relative Changes in Utilization by Intervention

	Emergency Department Visits				
	Mean Event Count				
	Intervention	**Matched Comparison**	**P**	**Incidence rate ratio**	**P**
Medically Tailored Meals	0.63	2.10	****	0.30	****
Non-Tailored Food	0.90	1.59	****	0.56	****
	Inpatient Admissions				
	Event Count				
	Intervention	Matched Comparison	P	Incidence rate ratio	P
Medically Tailored Meals	0.27	0.56	**	0.48	**
Non-Tailored Food	0.43	0.49		0.88	
	Emergency Transportation Events				
	Event Count				
	Intervention	Matched Comparison	P	Incidence rate ratio	P
Medically Tailored Meals	0.46	1.60	****	0.28	****
Non-Tailored Food	1.06	1.70	****	0.62	****

Table presents estimated absolute number of events (‘count’) and relative differences [incidence rate ratio], with associated p-value. Estimates from negative binomial models adjusted for: Received Medically Tailored Meal, Index Year, Total costs in 12 months prior to intervention, Risk Score, Comorbidity Index, CCA Enrollment Year, Insurance Product, Age, Age squared. Percent of ZCTA that is rural, Percent households in ZCTA living in poverty, Non-Hispanic White, Non-Hispanic Black, Hispanic, Female, prescription of medication classes prior to intervention (Insulin, Anti – hypertensive, Other CVD medication, Anticoagulant, Proton Pump Inhibitor, Anti-retroviral, Percent of Medicare beneficiaries in ZIP code that had PCP visit in last 12 months, English primary language, Phosphate binder, Inhaler, Oral steroids, and Antibiotics), and follow-up time

Abbreviations: CCA—Commonwealth Care Alliance; ZCTA—ZIP Code Tabulation Area; CVD—Cardiovascular Disease; PCP—Primary Care Provider

* p<.1

** p < .05

*** p<.01

**** p<.001

Source: Authors’ analysis of CCA data

Table 3:

Estimated Medical Expenditure by Intervention

	Average Monthly Costs				
	Intervention	**Matched Comparison**	**Gross Difference**	**P**	**Net Difference**
Medically Tailored Meals	$843	$1413	−$570	***	−$220
Non-Tailored Food	$1007	$1163	−$156	**	−$10

Estimates from gamma regression models adjusted for: Received Medically Tailored Meal, Index Year, Total costs in 12 months prior to intervention, Risk Score, Comorbidity Index, CCA Enrollment Year, Insurance Product, Age, Age squared. Percent of ZCTA that is rural, Percent households in ZCTA living in poverty, Non-Hispanic White, Non-Hispanic Black, Hispanic, Female, prescription of medication classes prior to intervention (Insulin, Anti – hypertensive, Other CVD medication, Anticoagulant, Proton Pump Inhibitor, Anti-retroviral, Percent of Medicare beneficiaries in ZIP code that had PCP visit in last 12 months, English primary language, Phosphate binder, Inhaler, Oral steroids, and Antibiotics), and follow-up time

Abbreviations: CCA—Commonwealth Care Alliance; ZCTA—ZIP Code Tabulation Area; CVD—Cardiovascular Disease; PCP—Primary Care Provider

Gross Difference represents estimated difference in healthcare claims by intervention status. Net difference represents estimated difference in healthcare expenditures, accounting for the cost of the intervention

P value tests the null hypothesis that the difference in gross costs between intervention and matched controls is equal to zero

[*] $p<.1$

[**] $p < .05$

[***] $p<.01$

[****] $p<.001$

Source: Authors' analysis of CCA data

Table 4:

Sensitivity analysis showing estimated changes in utilization and cost based on matching using pre-intervention services ('triggering events')

	Emergency Department Visits	
	Incidence rate ratio	**P**
Medically Tailored Meals	0.36	***
Non-Tailored Food	0.54	***
	Inpatient Admissions	
	Incidence rate ratio	P
Medically Tailored Meals	0.41	**
Non-Tailored Food	0.81	
	Emergency Transportation Events	
	Incidence rate ratio	P
Medically Tailored Meals	0.18	***
Non-Tailored Food	0.52	***
	Average Monthly Costs	
	Difference in gross costs	P
Medically Tailored Meals	−$802	***
Non-Tailored Food	−$228	**

Estimates from negative binomial (incidence rate ratio) and gamma (cost difference) regression models adjusted for: Received Medically Tailored Meal, Index Year, Total costs in 12 months prior to intervention, Risk Score, Comorbidity Index, CCA Enrollment Year, Insurance Product, Age, Age squared. Percent of ZCTA that is rural, Percent households in ZCTA living in poverty, Non-Hispanic White, Non-Hispanic Black, Hispanic, Female, prescription of medication classes prior to intervention (Insulin, Anti – hypertensive, Other CVD medication, Anticoagulant, Proton Pump Inhibitor, Anti-retroviral, Percent of Medicare beneficiaries in ZIP code that had PCP visit in last 12 months, English primary language, Phosphate binder, Inhaler, Oral steroids, and Antibiotics), and follow-up time

Abbreviations: CCA—Commonwealth Care Alliance; ZCTA—ZIP Code Tabulation Area; CVD—Cardiovascular Disease; PCP—Primary Care Provider

* p<.1

** p < .05

*** p<.01

Source: Authors' analysis of CCA data