



OMG Center for Collaborative Learning

Evaluation, Strategic Research & Planning, Philanthropy & Capacity Building

**Final Report:
An Examination of Health Care Costs and Health Outcomes
among MANNA Clients and a Comparison Group**

Prepared for
MANNA

By OMG Center for Collaborative Learning

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Acknowledgments

This research project was conceived over three years ago by MANNA leadership and has culminated in this final report. Along the way, several entities and individuals made this work possible. OMG Center for Collaborative Learning would like first to thank the First Hospital Foundation, the 1956 Otto Haas Charitable Trust, and the Claneil Foundation for providing grant support, and the CEO of MANNA, Richard Keveany, for trusting us to be the stewards of this pioneering endeavor. In addition, the project directors at MANNA, Sue Daugherty and Cyndi Dinger, whose seemingly unlimited patience and perseverance, encyclopedic knowledge of and deep passion for the MANNA program, as well as their commitment to state- and federal-level policy change were crucial to moving the project ahead even when it seemed at a standstill. We would also like to thank the several volunteers at MANNA, who gave their valuable time and energy to conduct phone screenings and a mail campaign to recruit subjects and gain their informed consent. Etienne Phipps, Roberta Costello, and Shana Stites of Einstein Medical Center provided expeditious IRB support.

Abstract

INTRODUCTION: Chronically ill populations have a strong need for quality public health nutrition services to aid in disease management and improve health outcomes. Evidence suggests that neglecting the importance of proper and adequate nutrition in chronically ill patients has far reaching implications on the health status of the individual as well as the cost of healthcare. Despite extensive evidence around the efficacy of food and meal programs for various populations such as the elderly, there continues to be a need for evaluation of programs and interventions in order to establish best practice guidelines for the chronically ill. MANNA (Metropolitan Area Neighborhood Nutrition Alliance), a non-profit organization serving Southeastern Pennsylvania and Southern New Jersey, provides people who have chronic illnesses three medically appropriate meals a day, seven days a week, to help them maintain optimal health. Additional components of MANNA's services include nutrition education and counseling. This pilot study explores and describes the health care expenditures and health outcomes of a group of MANNA clients over time (before and after entry into the MANNA program), and also compares outcomes among MANNA clients retrospectively to a similar group who did not receive MANNA services.

METHODS: Using over three years of health care claims from a local MCO, we tracked mean monthly health care costs of 65 MANNA clients during the year before they began receiving services, and during the period in which they were receiving services. Other cost variables included those associated with HIV/AIDS, inpatient stays, and emergency room visits. We then compared clients' mean during-service costs, inpatient lengths of stay, and numbers of stays with those of a comparison group (chosen from the same MCO using Propensity Score Matching, weighted N=633) who had health claims during the same period.

RESULTS: Mean monthly health care costs of MANNA clients decreased for 3 consecutive months after beginning MANNA service for a total drop of almost \$30,000. For HIV/AIDS clients, the decrease was \$17,000. Mean monthly health care expenditures of MANNA clients during-service (\$28,268) were significantly lower than those of the comparison group (\$40,960, $t=3.45$, $p<.01$); among those with HIV/AIDS the trend was the same (\$16,765 vs. \$37,287, $t=6.04$, $p<.01$). Inpatient costs, lengths of stay, and numbers of stays trended downward after clients received MANNA services and were significantly lower among the client group.

DISCUSSION: Organizations that provide complete nutrition and counsel may contribute to lower health-care costs and utilization for their clients. The results of this study could have implications for funding for such organizations, as well as physician decision-making and recommendations. This pilot study contributes information to an area of the scientific literature that is currently lacking and generates further questions for scientific inquiry.

1. Introduction

Chronically ill populations have a strong need for quality public health nutrition services to aid in disease management and improve health outcomes. Evidence suggests that neglecting the importance of proper and adequate nutrition in chronically ill patients has far reaching implications on the health status of the individual as well as the cost of healthcare (1, 2). Nutrition is an integral part of disease management, often enabling the chronically ill, such as those living with HIV/AIDS and cancer, to maintain a healthy body weight, withstand side effects of heavy medications, improve the functions of the immune system, and enhance overall quality of life (1, 3). Increased access to care and treatment, the availability of life extending drugs such as antiretroviral therapy, and advances in technology have had a tremendous impact on those living with diseases like HIV/AIDS and cancer, resulting in more individuals living longer while managing and treating their disease. These individuals require the advice and expertise of nutrition professionals in determining their nutritional status and needs.

Chronic illness, coupled with aging, creates a unique nutritional need. As the chronically ill population ages, co-morbidities arise. Patients often deal with primary and secondary diagnoses, making nutrition a critical component of survival. In inpatient as well as outpatient settings, physicians and public health personnel are tasked with developing comprehensive strategies that address nutrition as a part of overall treatment. The American Dietetic Association (ADA)¹ stresses the importance of medical nutrition therapy and other cost-effective forms of preventive care and disease management in improving population health outcomes. Further, the ADA suggests that for patients with diabetes, renal failure, cancer, and HIV/AIDS – illnesses in which a special diet is required – effective home health care upon hospital discharge be provided in an outpatient setting in order to avoid high hospitalization costs (4).

As a result of the recent economic crisis, large numbers of vulnerable populations are currently at increased risk for malnutrition. The population groups most affected are those with the highest nutrition requirements including the chronically ill, particularly those with HIV/AIDS (5). A study on the characteristics of HIV/AIDS meal delivery program participants showed that these programs are catering increasingly to minority populations, women, and children, and that they are having to expand their services in order to meet the growing needs of these client populations (6). Access to food may also influence adherence to therapy. For example, for individuals with limited access to resources, money for transportation to clinic appointments may be redirected to food, thus decreasing need for access to medications and other medical care (7).

1.1 Prior Research

Literature has shown the efficacy of nutrition-related interventions including medical nutrition therapy, meals-on-wheels, and other types of food/meal programs in both clinical and non-clinical settings. Various studies link improved health outcomes and expenditures to nutrition services, with the majority of nutrition intervention studies conducted among the elderly as they are a population often living with one or more chronic illnesses. We could find no studies that examined the relationship between nutrition intervention and health care costs among a distinctly younger population like the one MANNA serves.

¹ In January 2012, the American Dietetic Association changed its name to the Academy of Nutrition and Dietetics.

Several studies examine the efficacy of medical nutrition therapy, a treatment usually provided in a clinical setting by a dietitian and including a formal assessment of nutrition needs and the prescription of the proper nutrition that addresses the underlying chronic illness. These studies link medical nutrition therapy to improved health and cost outcomes; for example, studies have shown that appropriately selected nutrition support can: address the problem of malnutrition, improve clinical outcomes, and result in a net reduction in health services utilization and costs (2, 9, 10). The American Dietetic Association suggests that appropriate medical nutrition therapy leads to improved health outcomes, resulting in improved quality of life and cost savings (4). With the success of medical nutrition therapy on health outcomes, there has been a move to more accurately assess its effect on the cost of care and service utilization. In one study, medical nutrition therapy was associated with a reduction in the utilization of hospital services for patients with diabetes and cardiovascular disease; the net reduction in service utilization for the older population often exceeded the cost of providing medical nutrition therapy (9).

Studies of meal programs including home-delivered nutrition services are also well established. Evidence around meal programs and home-delivered meals suggest it is an effective means of maintaining or improving nutrition in the elderly (11). For example, one study shows that the Elderly Nutrition Program, congregate and home-delivered meals, and other nutrition- and health-related services, leave participants better nourished as compared to non-participants (12). Studies of home-delivered meals also suggest that addressing nutritional need may lead to a decrease in the length of hospital stays and the cost deficit incurred by malnourished patients (13). There is evidence that diabetic meal delivery is as effective as individual counseling for the self-management of diabetes, and that the delivery of meals is suitable for patients who are not able to depend on family participation or support (17).

Despite the extensive evidence around the efficacy of food and meal programs geared towards improving nutritional risk, there is a lack of literature examining the outcomes related to provision of *complete* nutrition, education, and counseling for a chronically ill population, such as that served by MANNA (Metropolitan Area Neighborhood Nutrition Alliance). Additionally, there are no studies that look at the relationship between complete nutrition and health care costs and utilization. The current economic climate in particular brings forth the need to replicate successful program models in other communities and populations.

1.2 MANNA's Model of Nutrition Services

MANNA (Metropolitan Area Neighborhood Nutrition Alliance), a non-profit organization serving Southeastern Pennsylvania and Southern New Jersey, provides nourishing meals and counsel to people with chronic illnesses with the stated intent of “empowering individuals to battle illness and improve their quality of life.” MANNA clients receive three medically appropriate meals a day, seven days a week, to help them maintain optimal health as they undergo treatment for chronic illnesses. The MANNA model integrates components of medical nutrition therapy in the initial assessment and intake process and provides nutritionally appropriate meals catered to the medical needs of a client; this model is similar to home-delivered meals programs that have been shown to be successful, although most other meal programs have no special provisions for individuals with Chronic Kidney Disease and no consistency modifications for those with Dysphagia. In addition, MANNA provides nutrition education and counseling services in which registered dietitians help clients understand the role

of nutrition in disease management. These services provide them with tools to take charge of their nutritional needs. MANNA dieticians may also serve as advocates, communicating with clients' physicians and helping them navigate medical insurance issues.

The MANNA model is based on components that individually have been shown to be effective in improving health status, particularly in the elderly population. However, as noted above, there is a lack of literature examining both the health and cost outcomes related to provision of *complete nutrition, education, and counseling for a chronically ill and younger population*. The inclusion of all three of these services in the model sets MANNA apart. The efficacy of medical nutrition therapy, Meals-On-Wheels, and home-delivered meals programs suggest that the MANNA model may demonstrate those individual successes but that the provision of complete nutrition – meals seven days a week – in addition to nutrition education and counseling, may have an added impact worth paying attention to.

1.3 About this Study

The primary research questions addressed by this study are:

- What are the characteristics, medical expenditures, and health outcomes (ER visits, hospitalizations) of MANNA clients?
- Does provision of MANNA services correlate with reduced expenditures, ER visits, and hospitalizations?
- Do MANNA clients have less costly health care expenditures and/or better health outcomes than patients with similar needs and characteristics who are not receiving MANNA services?
- What are clients' perceptions of how MANNA services affect their health status?

The primary component of this study, which addresses the first three questions above, involved analysis of existing data from MANNA's client database and data from a local health maintenance organization's medical claims database. We explored and described the health care expenditures and health outcomes of a group of MANNA clients over time and compared these outcomes retrospectively to a similar group who did not receive MANNA services.

A supplemental component of the study, which addresses the fourth question above, involved key informant interviews with a subset of MANNA clients. These interviews were conducted in an attempt to better understand the MANNA program as well as the possible relationships between MANNA services and the results found in the primary study component.

2. Methods

2.1 Data Sources Overview

Data for this study were obtained from three sources: MANNA's client database, the medical claims database of a local managed care organization (MCO), and interviews with a subsample of MANNA clients.

MANNA clients' demographic characteristics and start and end dates of MANNA services were obtained from MANNA's client database. Each person in the database had a unique record and was assigned a random ID number. At the time of sample selection, study participants' records

were matched with their corresponding health insurance medical claims from a local MCO; the match was performed by name, date of birth, and when possible, social security number. The merged records were then stripped of these identifiers, save the original random ID assigned before the merge. It was from this final data source that all MANNA client health outcome data and associated costs were obtained. Using an adapted propensity score matching algorithm (14), a group of individuals from the participating MCO who were not MANNA clients but had a similar aggregate demographic and chronic illness profile was identified as a comparison group. Sampling methodology for both the MANNA client group and the comparison group is described in detail in the section below. In addition, for the supplemental portion of the study, we conducted one-hour in-person individual interviews with a subgroup (n=12) of the MANNA client sample.

2.2 Sample Selection: MANNA Clients

MANNA began providing complete nutrition—three meals a day, seven days a week—in August 2008; Institutional Review Board (IRB) approval for this study was received in September 2010. We considered the 629 people who were ever MANNA clients between August 2008 and April 2010 as potential study participants. In order to obtain information about how clients fared prior to MANNA services, we defined the start of the period of study as August 1, 2007, twelve months prior to the earliest possible MANNA start date. Similarly, we wanted to understand as much as we could about clients after they started their MANNA services. With the exception of three clients whose start dates were after December 31, 2009 (February, March, and April 2010 respectively), we were able to have twelve months of post-service data for all the other MANNA clients. In sum, the full range of dates for which we have medical claims is August 1, 2007 to December 31, 2010.

All potential MANNA client study participants were screened for eligibility according to whether they had received MANNA services between August 1, 2008 and April 30, 2010 for at least three months without interruption²; had not died during the client group study period; were presumed members of the local MCO³; and had provided verbal or written consent (using IRB approved scripts) to be a part of this study. This initial screening yielded 130 clients. Of these, 68 were confirmed members of the MCO (by match to the MCO's eligibility database) during the study period; 65 had hospital, clinic, or skilled nursing facility (SNF) service type health care claims. The number of claim lines for the 65 people totaled 12,620; with costs broken out per claim sequence number,⁴ the total number of claim lines was 41,984.

In preparation for choosing a comparison group that was matched in part on the presence of chronic illness, we identified from the client group claims the prevalence of a group of common illnesses using the Charlson Comorbidity Index⁵ (CCI), a well-known index that can be used to

² Because our sample was so small, we decided to include nine people whose MANNA length of service was under three months long. Six had service for more than two months but just shy of three months, and three had service for one month or less.

³ Presumed membership indicates that MANNA staff had some knowledge based on intakes and/or follow up phone calls that a client had health insurance with the selected MCO, but no confirmed knowledge of this. Prior to the beginning of the study, MANNA and the local MCO had a Memorandum of Understanding for data sharing.

⁴ MCO claims data came to us in two ways: one way contained a summary of each claim's costs, the other was broken out by individual parts of the claim, which had separate costs for separate diagnoses and procedures. It was the latter dataset that we analyzed.

⁵ The Charlson Comorbidity Index assesses illness comorbidity by accounting for both the number and severity of 22 pre-defined comorbid conditions (we use the 17 present in our study that are understood to have an impact on health care costs—see Table 2); conditions were identified using up to 18 primary and secondary International Classification of Diseases (ICD-9) codes (<http://www.icd9data.com/2012/Volume1/default.htm>). Each condition is assigned a score, together which can be summed and used to predict

predict patient prognosis. We later utilized this prevalence to determine sample weights of our matching criteria (described in the section below).

We had initially hoped to include in the study only those clients whose MANNA services began on August 1, 2008 as well as those who had had no prior MANNA services. Or, if they had had prior services, they would have had a “clean period” with no services received during the preceding month (July 2008). However, since it was evident that the sample was going to be small, we opted to include nineteen people who had prior service with no clean period. In light of both the groundbreaking and pilot nature of this study, we felt that inclusion of this group was necessary to obtain more robust findings. We did conduct sensitivity analyses with our health care cost outcomes (running the analyses both with and without this group of nineteen), and our findings did not change substantially and were still significant. We deliberate over this and other limitations of the study in the Limitations section.

For the supplemental portion of the study, twelve clients were chosen at random from the MANNA sample to participate in an in-person or telephone interview (their preference). These individuals were contacted by trained volunteers, interns, and/or contract employees of MANNA and provided consent for interview participation prior to the release of their contact information to interviewers.

2.3 Sample Selection: Comparison Group

After determining the MANNA client sample, we obtained the hospital, clinic, and skilled nursing facility (SNF) health claims of all individuals who were members of the MCO between August 1, 2007 and December 31, 2010 and from this population chose a comparison sample of individuals based on the aggregate age range of the MANNA clients (31 to 65); presence of a hospital, clinic, or SNF claim during the study period; and diagnosis with a CCI illness identified in the MANNA client group. We weighted the sample on these measures of sickness and other demographics using propensity score matching (described below) since finding a one-to-one match on all of these characteristics in such a chronically ill population was not possible. The total number of individuals who were members of the MCO during the study period who were between the ages of 31 and 65 was 42,202. Among those, 21,260 individuals had hospital, clinic, or SNF claims; of these, 20,490 individuals (with a total of 1,486,611 claim lines) had a CCI chronic illness according to primary and secondary diagnosis codes, and complete demographic information.

Using a propensity score matching algorithm that contained an iterative series of multiple logistic regressions with the binary outcome as “cases” (MANNA clients) or “comparisons” (non-MANNA clients), we examined age, race, gender, and ethnicity to continue to establish how well the non-MANNA individuals would match the MANNA client group. In addition to demographics and the CCI illnesses, we factored in eight nutrition-related diagnoses: Dysphagia, Anemia, Failure to Thrive, Underweight, Abnormal Loss of Weight, Constipation,

short- and long-term outcomes such as function, hospital length of stay and mortality rates (Charlson, Pompei, Ales, & Mackenzie, 1987; Elixhauser, Steiner, Harris, & Coffey, 1998). The four major chronic diseases afflicting MANNA clients are chronic kidney disease, cancer, HIV/AIDS, and Type II diabetes, all of which are included in the CCI.

Gastroenteritis, and Nutritional Deficiency⁶. Using a regression model where the outcome was case (N=65) or comparison (N=20,490), and the predictors were the demographics outlined above and chronic illnesses from the CCI as well as the eight nutrition-related diagnoses, we calculated the predicted probability that the cases matched the comparisons. Using this probability, we calculated a balancing weight for each non-MANNA client. The final weighted number of MCO members chosen for comparison was 633.

2.4 Analytic Framework

We conducted three sets of analyses, outlined below. We describe the outcomes in detail in Key Outcomes (section 2.5).

- 1. Descriptive Analysis.** In the first analysis, we examined the characteristics of both the MANNA client and comparison group populations, including demographics, CCI diagnoses, nutritional illness diagnoses, and the distribution of these diagnoses across the MANNA client group and the comparison group.
- 2. Within-Group Analysis: Pre- and Post-MANNA Service.** In order to understand whether MANNA services corresponded to reduced health care costs, we studied cost patterns for MANNA clients both prior to service and after service began. To do this, we “looked back” at six months of health claims preceding the start date of MANNA clients’ services, and “looked ahead” at the six months of claims post-start-of-service and calculated all of the cost outcomes⁷. Outcomes were evaluated on a **monthly** basis to allow for MANNA clients’ differing lengths of MANNA services and enrollment patterns of MCO participation. That is, not all MANNA clients were enrolled and/or had health care claims in a given month. The numbers of individuals present in each month of the analyses are indicated directly on the charts in the Results section. Outcomes evaluated were as follows, presented as monthly means: health care costs overall, health care costs overall for individuals with HIV/AIDS, health care costs for emergency room visits, and health care costs for inpatient stays.
- 3. Between-Group Analysis: MANNA Clients vs. Comparison Group.** In order to generate a fuller understanding of the effectiveness of the MANNA program, we examined the outcomes of MANNA clients vis-à-vis a comparison group. We conducted an analysis of all of the cost and stay type outcomes as mean totals over the length of the study periods (twelve months for the MANNA client group, 44 months – i.e., the entire time period for which there were medical claims – for the non-MANNA group), comparing those of MANNA clients to those of the comparison group. In addition to the outcomes listed above for the within-group analysis, the outcomes evaluated for the between-group analysis included: number of emergency room visits, number of inpatient stays, inpatient length of stay, and presence of inpatient discharges to home.

⁶ This list is part of a larger group of nutrition-related illnesses that was provided by MANNA; the eight included in the propensity score matching model were the eight most commonly diagnosed conditions in the MANNA group medical claims. See appendix A for the complete original list.

⁷ Although we had twelve months of “look-back” and “look-ahead” data, we had small samples in the individual months before the six months prior and after the six months post-service. Therefore, since the within-group analyses examined costs in individual months, we opted to display only six months on either side of service for this portion of the analysis.

2.5 Definitions of Key Outcomes

We reported the frequency distributions of demographic indicators and those of the CCI and nutrition-related diagnoses described above. We also examined the following cost outcomes: overall health care costs, health care costs of those with an HIV/AIDS diagnosis, health care costs of emergency room (ER) visits, and health care costs associated with inpatient stays. In addition, we analyzed the frequency of ER visits and inpatient stays, the average length of inpatient stays, and the presence of any home discharges among those with inpatient stays.

Below we describe in detail the key outcomes and how each was computed.

- **Health Care Costs Overall.** The calculation of mean monthly costs included all persons who had any health care costs during a given month. It was calculated by summing, for each month, the total costs incurred and dividing by the number of persons who incurred the costs.
- **Health Care Costs for HIV/AIDS.** The calculation of mean monthly costs for HIV/AIDS was calculated the same as Overall Health Care Costs; however, the calculation includes only those who were diagnosed as having AIDS/HIV.
- **Health Care Costs for Emergency Room (ER) Visits.** Mean monthly ER visit costs was calculated by summing, for each month, the total costs incurred associated with ER visits and dividing by the total number of persons who incurred the costs; the calculation includes only those who had ER visits during a given month.
- **Number of Emergency Room Visits.** Mean monthly number of ER visits was calculated by summing, for each month, the total number of emergency room visits and dividing by the total number of persons with claims; the calculation includes all persons who had health care claims during a given month.
- **Health Care Costs for Inpatient Stays.** Mean monthly inpatient costs was calculated by summing, for each month, the total inpatient costs incurred and dividing by the number of persons who incurred the costs; the calculation includes only those who had inpatient hospital or inpatient skilled nursing facility Medicare Part A claims during a given month.
- **Number of Inpatient Stays.** Mean monthly number of inpatient visits was calculated by summing, for each month, the number of inpatient hospital or inpatient skilled nursing facility Medicare Part A claims and dividing by the number of persons with claims; the calculation includes all persons who had health care claims during a given month.
- **Inpatient Length of Stay.** Mean monthly inpatient length of stay was calculated by summing, for each month, the number of days per stay and dividing by the total number of persons with stays; the calculation includes only those who had inpatient hospital or inpatient skilled nursing facility Medicare Part A claims during a given month.
- **Presence of Inpatient Discharges to Home.** Mean monthly proportion of clients who had inpatient discharges to home (as opposed to an institutional facility) was calculated by flagging whether a person had a home discharge code (as indicated by a disposition code on the medical claims), summing these flags, and dividing by the total number of persons with inpatient stays in a given month.

In addition, in the supplementary component of the study, we utilized open-ended questioning to collect information on topics including: how long the client received MANNA services, why

they were referred to MANNA, their health status and conditions at the time of referral, satisfaction with MANNA services, perceived changes in health status during the time of MANNA meal receipt, and participation in additional components of the MANNA model (nutrition education and/or counseling).

2.6 Data Analysis

Results of several statistical analyses are presented throughout the study. Frequencies and percentages are reported in the descriptive analysis section; monthly means are reported in the within-group analysis section; study period means are reported in the between-group analysis section; sample t-tests are used to compare these means. All analyses were conducted using SAS v. 9.3.

For the supplementary component of the study (interviews with MANNA clients), interviews were cross analyzed for common themes pertaining to clients’ background, how they became connected to MANNA, health status at the time of referral to MANNA, and perceived changes in health status during the time of MANNA meal receipt.

3. Results

3.1 Descriptive Analysis

Table 1 shows the demographic characteristics of the MANNA client group and the comparison group. The two groups were well-matched on gender, age, race (African American and White), and ethnicity. Both groups were predominantly African American and almost entirely non-Hispanic. The average age was around 52 years old.

Table 1: Demographic Characteristics of Study Participants (August 2007 – December 2010)

Characteristic:	MANNA Clients (n=65)	Comparison Group (Weighted n=633)
Gender		
Female	27 (42%)	225 (36%)
Average age (yrs)	52 (sd=6.2, range=31-62)	51 (sd=1.2, range=27-68)
Race		
African American	50 (77%)	500 (79%)
White	13 (20%)	118 (19%)
Other	2 (3%)	15 (2%)
Ethnicity		
Hispanic	1 (2%)	9 (1%)
Non-Hispanic	64 (98%)	624 (99%)

Table 2 shows the prevalence of CCI conditions and nutritional illnesses among the study participants. The two groups were well-matched on almost all illness categories. Over 40% of

both groups were positive for HIV/AIDS. The next most prevalent illnesses were chronic pulmonary disease and cancer. Over one-fifth of the MANNA group and similarly high proportions of the comparison group had diagnoses of diabetes, mild liver disease, renal disease, and congestive heart failure. The most prevalent nutritional illness for both groups was dysphagia, with nearly half of study participants coded positively for this.

Table 2: Number of Study Participants with Charlson Indexed Chronic Illnesses or Nutritional Diseases as Coded in MCO Health Claims (August 2007 – December 2010)

	MANNA Clients (N=65)	Comparison Group (Weighted N=633)
Charlson Indexed Chronic Illness		
AIDS/HIV	28 (43%)	300 (47%)
Chronic Pulmonary Disease	25 (38%)	220 (35%)
Cancer	17 (26%)	199 (31%)
Mild Liver Disease	16 (25%)	148 (23%)
Diabetes without complications	16 (25%)	137 (22%)
Congestive Heart Failure	13 (20%)	122 (19%)
Renal Disease	13 (20%)	111 (17%)
Metastatic Carcinoma	10 (15%)	90 (14%)
Myocardial Infarction	7 (11%)	60 (10%)
Cerebrovascular Disease	6 (9%)	50 (8%)
Diabetes with complications	5 (8%)	43 (7%)
Peripheral Vascular Disease	4 (6%)	40 (6%)
Connective Tissue Disease-Rheumatic Disease	1 (2%)	9 (1%)
Peptic Ulcer Disease	1 (2%)	9 (1%)
Paraplegia and Hemiplegia	1 (2%)	9 (1%)
Moderate or Severe Liver Disease	1 (2%)	8 (1%)
Dementia	1 (2%)	7 (1%)
Nutritional Disease		
Dysphagia	30 (46%)	301 (48%)
Anemia	13 (20%)	110 (17%)
Failure to Thrive	9 (14%)	139 (22%)
Underweight	8 (12%)	77 (12%)
Abnormal Loss of Weight	8 (12%)	77 (12%)
Constipation	7 (11%)	89 (14%)
Gastroenteritis	3 (5%)	34 (5%)
Nutritional Deficiency	1 (2%)	16 (3%)

Tables 3 and 4 illustrate the number per person of CCI conditions and nutritional illnesses among the study participants. Over 40% of the MANNA group had one or two CCI diagnoses, while for the comparison group, this proportion was 35%. The same pattern held true for nutritional

diagnoses. Almost 40% of both groups had *zero* nutritional diagnoses; this may be due largely to a wide variance of coding practices by physicians and the fact that standards for nutritional diagnosis coding are not well documented.

Table 3: Number of Major (Charlson Indexed) Chronic Illness Diagnoses per Person as Coded in MCO Health Claims August 2007 – December 2010

Number and percent of people who had...	MANNA (N=65)	Comparison (Weighted N=633)
0 diagnoses ⁸	8 (12%)	0 (0%)
1 diagnosis	12 (18%)	122 (19%)
2 diagnoses	15 (23%)	99 (16%)
3 diagnoses	14 (22%)	86 (14%)
4 diagnoses	7 (11%)	91 (14%)
5 diagnoses	3 (5%)	108 (17%)
6 or more diagnoses	6 (9%)	127 (20%)

Table 4: Number of Major Nutritional Illness Diagnoses per Person as Coded in MCO Health Claims August 2007-December 2010

Number and percent of people who had...	MANNA (N=65)	Comparison (Weighted N=633)
0 diagnoses ⁹	25 (39%)	239 (38%)
1 diagnosis	19 (29%)	160 (25%)
2 diagnoses	10 (15%)	99 (16%)
3 diagnoses	6 (9%)	86 (14%)
4 diagnoses	3 (5%)	28 (4%)
5 or more diagnoses	2 (3%)	21 (3%)

3.2 Within-Group Analysis: Pre- and Post-MANNA Services

Average Monthly Health Care Costs, Overall and for HIV/AIDS

Figures 1 and 2 examine overall health care costs during the six months before and after clients began receiving MANNA services. Figure 1 shows the average monthly costs among all MANNA study participants, and Figure 2 shows the average monthly costs among those who were positive for HIV/AIDS. In both groups, average costs varied widely from month to month. Over the 13-month period examined, overall costs ranged from about \$20,000 to over \$60,000 for study participants. They ranged even more widely among study participants with HIV/AIDS, from about \$5,000 to over \$90,000.

⁸ Note that this does not indicate lack of chronic illness, only that they did not have a Charlson Indexed diagnosis.

⁹ Note that this does not indicate lack of chronic illness, only that they did not have a Nutritional Disease diagnosis.

For all clients, the average monthly health care costs in the six months following initiation of MANNA services (approximately \$28,000) was considerably lower than the average in the six months prior to receiving services (approximately \$39,000). The decline in costs for those with HIV/AIDS was even more dramatic, going from an average of approximately \$50,000 per month prior to receiving MANNA services, to approximately \$17,000 per month following initiation of services. For both groups, costs declined most markedly during the first three months after clients started receiving MANNA services; among all MANNA study participants, total costs fell 62% in the first three months (from approximately \$46,000 in month zero to about \$17,000 in month three), and for clients with HIV/AIDS, average monthly costs fell by over 80% in the first three months, from approximately \$22,000 to about \$4,000.

Figure 1: Average Monthly Health Care Costs of All MANNA clients six months prior to service and six months after beginning service (August 2007-December 2010)

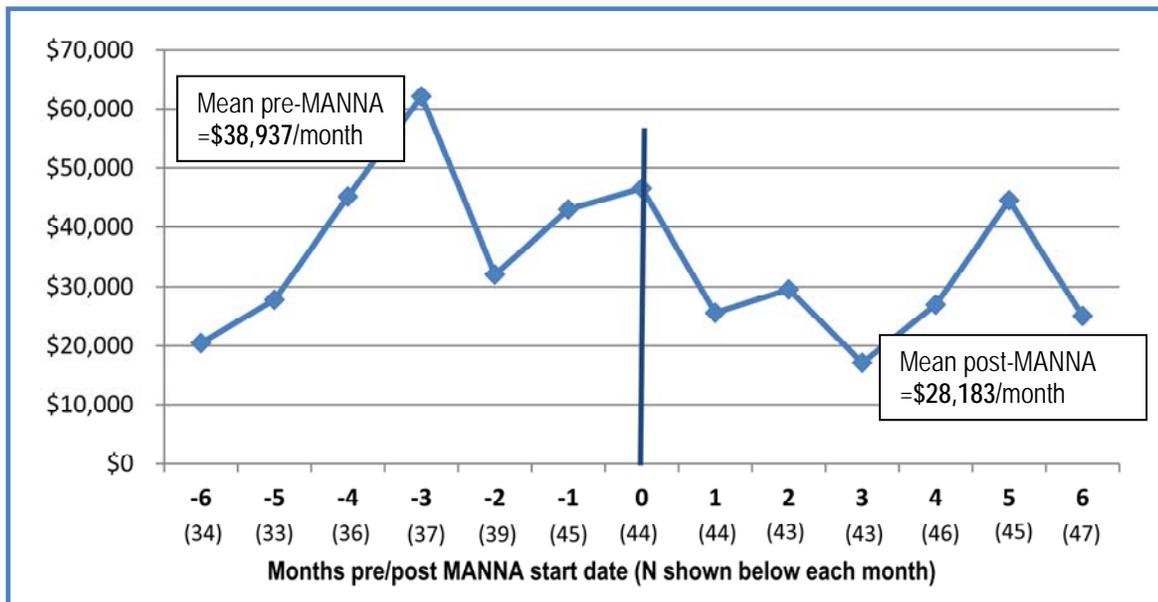
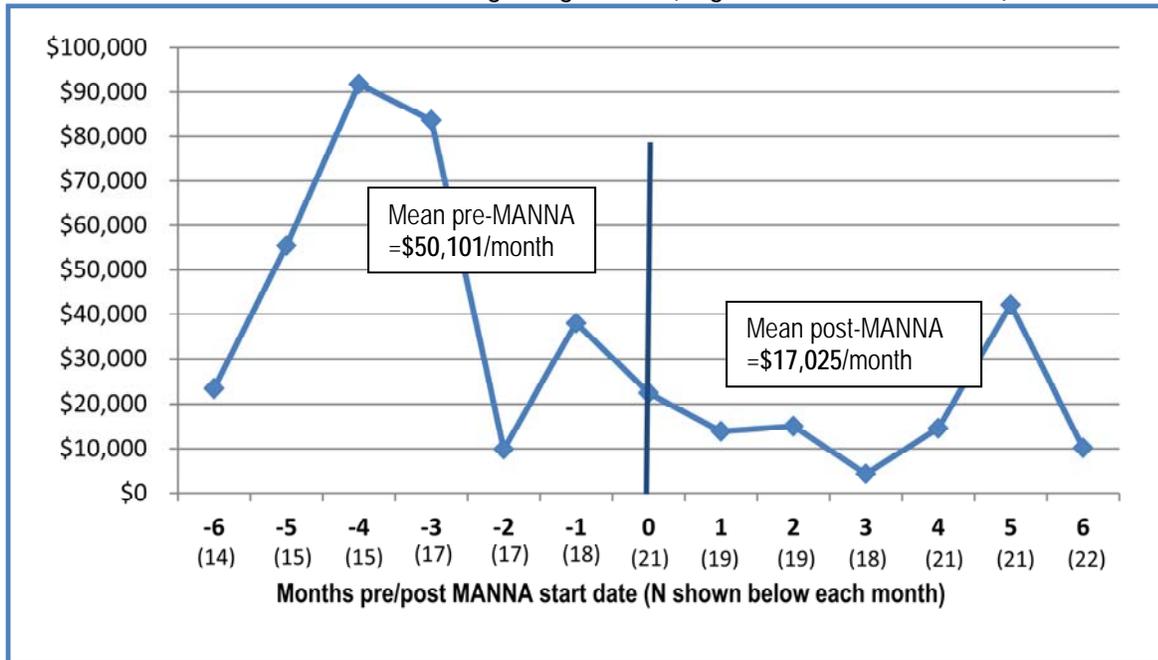


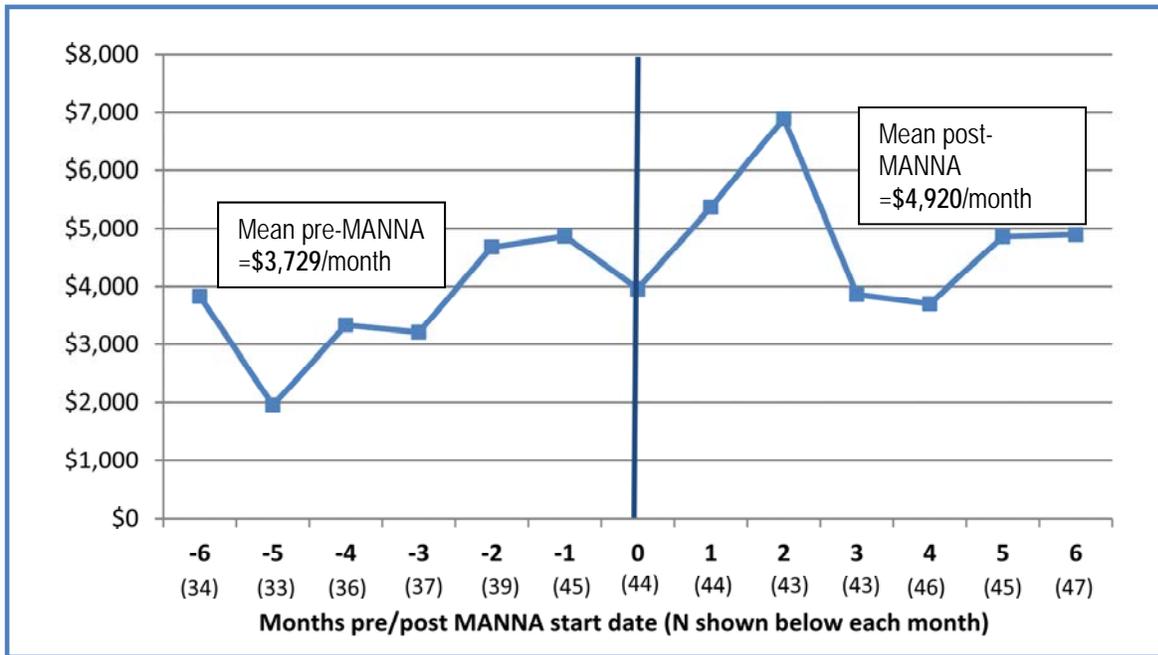
Figure 2: Average Monthly Health Care Costs of MANNA clients with HIV/AIDS six months prior to service and six months after beginning service (August 2007-December 2010)



Average Monthly Emergency Room Costs

Figure 3 illustrates the continuum of average monthly costs incurred by trips to the emergency room (ER) during the six months prior to receiving MANNA services and the six months following initiation of services. Like overall costs, the pattern is somewhat erratic; however, in this case there is a sharp increase in costs during the first two months of MANNA services, from nearly \$4,000 in month zero to nearly \$7,000 in month two, the highest during the 13-month period. However, from month two to month three, average monthly costs decrease by 44%, the largest decrease in the 13-month period. The average monthly cost over the six-month period following initiation in MANNA (almost \$5,000) was higher than during the six-month period prior to receiving MANNA services (approximately \$3,700). This mean is largely driven by the sharp increase during the first two months as MANNA clients, as noted above.

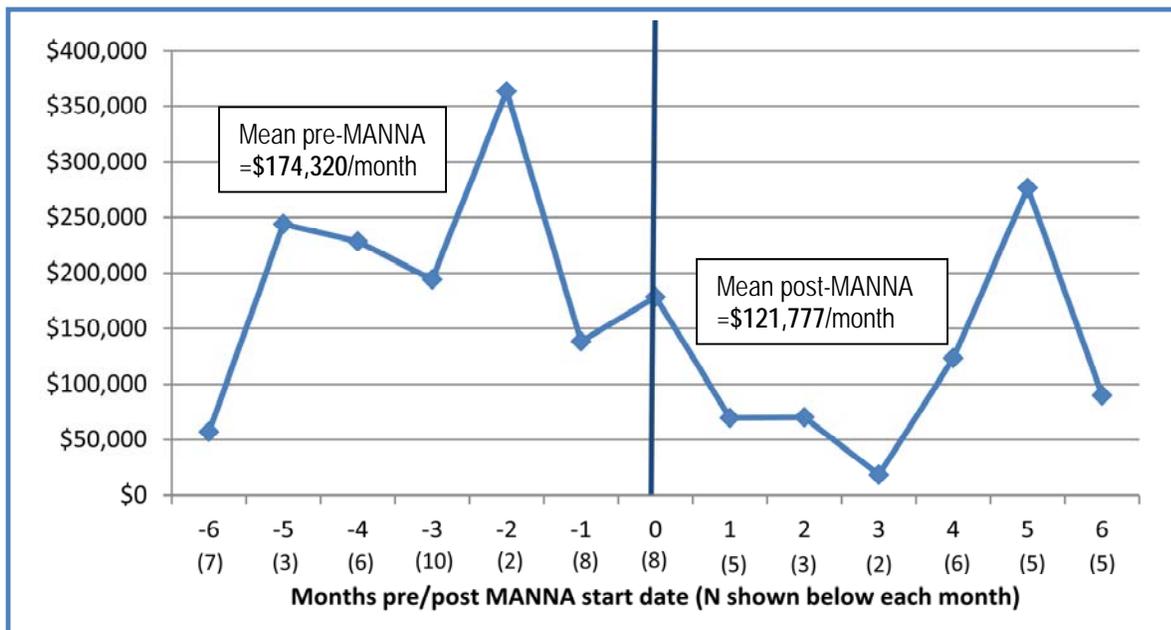
Figure 3: Average Monthly Emergency Room Costs of MANNA clients six months prior to service and six months after beginning service (August 2007-December 2010)



Average Monthly Inpatient Costs

As shown in Figure 4, the average monthly costs for inpatient hospitalizations among MANNA clients decreased from approximately \$174,000 per month over the six months prior to entry into MANNA to about \$122,000 per month over the six months following initiation of services. Average monthly costs declined sharply in the first three months of starting the program, from over \$178,000 in month zero to approximately \$18,000 in month three, a decrease of about 90%. Costs increased dramatically between months three and five, to over \$276,000, and decreased again (to approximately \$90,000) in month six.

Figure 4: Average Monthly Inpatient Hospital Costs of MANNA clients six months prior to service and six months after beginning service (August 2007-December 2010)



3.3 Between-Group Analysis: MANNA Clients vs. Comparison Group

On the whole, as shown in Table 5 below, the results of our between-group analysis indicate that individuals who received MANNA services burdened the system less in terms of costs and length of stay as compared with a similar group of individuals who did not receive MANNA services. This was true for all outcomes except those associated with emergency room visits.

Health Care Costs Overall

Mean monthly overall health care costs for MANNA clients were just over \$28,000, compared with almost \$41,000 for the non-MANNA comparison group. This difference of more than \$12,000 is statistically significant. Similar but even more pronounced results were found for those study participants with HIV/AIDS, with mean monthly costs over \$20,000 lower in the MANNA group (whose costs averaged almost \$17,000) as compared to the comparison group (whose costs averaged over \$37,000).

Emergency Room Visits

Although the difference is not statistically significant, mean monthly emergency room visit costs for MANNA clients were higher compared to those of the comparison group (almost \$5,000 versus \$3,700 respectively). There was also a difference in the mean monthly number of ER visits, with MANNA clients having a higher number of visits (0.6 on average) than the comparison group (0.3 on average). This difference is statistically significant.

Inpatient Stays

MANNA clients' inpatient stay costs, number of stays, and length of stays were significantly lower than those of their non-MANNA counterparts. In terms of costs, MANNA clients averaged

over \$132,000 per month in comparison to almost \$220,000 among the comparison group, a difference of more than \$87,000. The MANNA group’s number of inpatient visits (0.2 on average) was also lower than that of the comparison group (0.4 on average). In addition, length of inpatient stays among MANNA clients was almost 11 days, compared to over 17 days for the comparison group.

Home discharges were also more prevalent among MANNA clients who had inpatient stays. One potential indicator of cost-savings is what happens to clients once they are discharged. Some are discharged to state or federally-funded nursing homes or other inpatient facilities, while others are discharged to cancer centers or other rehabilitation centers. Patients can also be discharged to their homes. On average, in the twelve months following the start of their MANNA services, 93% of clients with inpatient hospitalizations had home discharges compared with 72% of their non-MANNA counterparts.

Table 5: Mean Monthly Visit and Costs for MANNA Clients (after starting MANNA services) and the Comparison Group

	12 months post-starting service with MANNA	Comparison Group (mean over 44 months of the study period)	T-value (degrees of freedom)
Overall Health Care Costs			
Mean monthly costs [†]	\$28,268	\$40,960	3.45 (582)
Mean monthly costs HIV/AIDS [†]	\$16,765	\$37,287	6.04 (317)
ER Visits			
Mean monthly ER visit costs	\$4,893	\$3,700	-1.67 (89)
Mean monthly number of ER visits [†]	0.6	0.3	-4.78 (557)
Inpatient Stays			
Mean monthly inpatient costs [†]	\$132,441	\$219,639	3.35 (59)
Mean monthly number of inpatient visits [†]	0.2	0.4	5.08 (561)
Mean monthly inpatient length of stay [†]	10.7	17.1	3.53 (58)
Mean percentage of individuals with discharges to home [†]	93%	72%	-6.14 (58)

[†]Difference between MANNA and Comparison Group is significant at p<.05.

3.4 Analysis of Interview Data – Experience with MANNA Services

The MANNA clients interviewed for this study had ages ranging from 31 to 62 years old, with an average age of 55. The majority were African American (58%), followed by Caucasian

Americans (33%), and Hispanic Americans (8%). Most interviewees were male (67%). The monthly income of interview participants varied widely, from \$0 to \$750 per month, with a mean of \$458. Two-thirds of the interviewees had a primary diagnosis of HIV/AIDS (67%) and the remainder had a primary diagnosis of cancer. Ten of the twelve interviewees reported comorbidities beyond their primary diagnosis.

All interviewees were referred to MANNA by a professional, usually their case manager or doctor. Additional referral sources included a nurse practitioner and a social worker. The majority of interviewees reported being referred because they were underweight. Several interviewees attributed their low weight to poor eating habits and/or not getting enough nutritious foods. One respondent indicated that in addition to being underweight, they were also referred to MANNA because their calcium levels were low. Additional reasons for referral included low muscle mass and an inability to prepare meals after having received medical treatments (such as chemotherapy, a bone marrow transplant, etc.).

The majority of interviewees reported receiving MANNA meal services for approximately six months, although some received services for as long as two years. In addition to meal services, data from the MANNA database show that nine interviewees received medical nutrition therapy (MNT), a therapeutic approach to treating medical conditions and their associated symptoms via the use of a specifically tailored diet devised and monitored by a registered dietician (15); two were followed by an HIV Registered Dietician (RD); and one was followed by a dialysis RD¹⁰. However, when asked about these additional services, the majority of interviewees did *not* report having participated in education or counseling through MANNA. This lack of recognition of the supplementary components of MANNA's program may be due to the fact that MNT does not necessarily occur at MANNA but is also delivered at other care clinics and/or over the telephone; six of the nine interviewees who received MNT received it at other locations or over the phone. It could also be that the counseling components were not recognized or perceived as "nutritional counseling", which was how the interview question was phrased. See Appendix B for the entire interview protocol¹¹.

Prior to receiving MANNA services, most interviewees reported purchasing their own food at supermarkets or grocery stores and cooking for themselves; however, some mentioned that family members purchased and/or cooked food for them. Most interviewees ate meals regularly before starting MANNA; however, a few reported only eating only one or two meals per day.

Once they were connected with MANNA, interviewees indicated that they ate "most" of the food provided, noting that the amount delivered was more than adequate, and that they were often unable to finish all of the meals. Many interviewees also indicated that their appetite was diminished due to their health condition. The majority of interviewees reported liking the taste of MANNA foods. Overall satisfaction with MANNA was consistently high across interviewees.

¹⁰ According to MANNA, a variety of topics can be covered in a counseling session including: wasting, restoring visceral proteins, dealing with taste changes, nutrition and wound healing, as well as food safety. MANNA dietitians specialize in wellness and are unique in that they will perform and analyze a BIA test (Bio-electrical Impedance Analysis) to assess the client's body composition.

¹¹ It should be noted that meal tips, in the form of printouts, are sometimes included in food deliveries and are shared with clients at that time. This form of nutritional counseling was not included in the protocol.

All interviewees reported that their health improved in the time period during which they received MANNA food deliveries. For example, many specified that their weight increased to a healthy level. For some, this weight gain also helped to diminish the symptoms of their health conditions. Interviewees generally noted that receiving food deliveries led to healthier and more consistent eating habits. For example, a few interviewees mentioned that the MANNA meals added healthy foods such as milk and vegetables to their diets.

Interviewees with food restrictions and/or special diets noted that MANNA prepared meals that met their doctor's specifications. One interviewee mentioned that after receiving chemotherapy, nausea caused them to go for several days without eating; however, they found that their body was able to tolerate the meals prepared by MANNA. Interviewees with health conditions that prevented them from cooking mentioned that receiving MANNA food deliveries eased their concerns about how they were going to be able to properly feed themselves: *"Basically I felt better and at ease, I couldn't have made it without it."* Interviewees who were referred to MANNA after undergoing medical treatments indicated that receiving meals helped them heal from their treatments. *"I've gained weight which is a plus, I am eating three meals a day, and they give me enough fruit and vegetables. I was eating a lot of sandwiches no grains, and now all those things are in my diet now."* Once these clients were no longer experiencing the negative effects of chemotherapy, for example, their weight increased to normal levels, and they were able to shop and cook for themselves. The relatively young clientele's attainment of good nutrition and weight gain during severe chronic illness supports our findings of lower health care costs overall and fewer inpatient stays.

4. Discussion

In three of the four within-group cost analyses—monthly health care costs for all MANNA clients, for HIV/AIDS clients, and inpatient hospitalization costs—average costs were lower during the six months following clients' entrance into MANNA as compared to the six months prior to their entering the program. For these three expenditures measured, the decline was particularly dramatic during the first three months of receiving MANNA services, after which costs increased. At no time during the six months following the start of MANNA services, however, did costs reach the levels they were during the six months prior to service, suggesting an impact that is most marked upon initiation of services.

Average monthly health care costs of MANNA clients overall were 28% lower in the six months following the start of MANNA services as compared to the six months before receiving services (Figure 1). In addition, when the monthly health care costs of MANNA clients were compared with those of non-MANNA clients with a similar demographic and chronic illness profile, the expenditures of patients receiving MANNA services were 31% lower. The greatest changes in outcome measures, however, occurred among clients with HIV/AIDS, whose average monthly health care costs were 66% lower in the six months following the initiation of MANNA services than they were during the six months preceding services (Figure 2). Similarly, when compared with HIV/AIDS patients in the comparison group, the expenditures of MANNA clients with HIV/AIDS were 55% lower (Table 5), indicating a significant impact of improved nutritional services. Persons who are chronically ill have the highest nutrition requirements, and those living with comorbid conditions have specific nutritional needs that may be challenging for patients or

their family members to understand or adhere to without additional support, such as that provided by MANNA.

Monthly inpatient hospital costs of MANNA clients were more than 20% lower over the six months following initiation of MANNA services as compared to the six months prior to starting MANNA (Figure 3). When compared to non-MANNA clients, the costs of inpatient hospitalizations of those receiving MANNA services were 40% lower (Table 5).

The average number of monthly hospital visits by MANNA clients was half that of the comparison group, and the length of stay for inpatient visits was 37% shorter. Number and length of inpatient hospitalizations impact inpatient expenditures, as seen in our analysis, but also represent additional burdens not shown here, such as prescriptions, transportation, and logistics associated with prolonged illness and even the risk of nosocomial infections, as well as the burden of increased workload for health care providers. Furthermore, chronically ill patients are often discharged to other inpatient facilities, such as state or federally-funded nursing homes, cancer centers or rehabilitation centers, representing a potentially large financial burden. MANNA patients were 23% more likely than non-MANNA clients to be discharged to their homes, suggesting that these patients not only represent a lower financial burden but are healthier upon discharge; having the access to nutritional food from MANNA may be contributing to less need for long-term care or sub-acute rehabilitation (Table 5).

In face-to-face interviews, MANNA clients described improvements in health and faster recovery times, which they attributed to their improved nutrition and weight gain, particularly during times in which they were most vulnerable, such as following hospitalizations and medical treatments. Clients reported a consistently high level of satisfaction with the MANNA program in terms of both the quality and quantity of food provided and the outcomes they associated with the MANNA services.

Somewhat surprising were our findings associated with emergency room (ER) visits. Mean monthly emergency room costs were 24% higher for MANNA clients over the six month period following services as compared to the six month period prior to starting MANNA (Table 3). This increase was most marked during the first two months of MANNA service, after which costs fell sharply but remained high through the six-month period examined relative to pre-MANNA service levels. MANNA clients also experienced a greater number of ER visits and trended toward higher ER-associated expenditures as compared to the non-MANNA comparison group.

There are a few factors to consider that might help to explain the higher costs and utilization associated with ER visits. Prior to entry into MANNA, clients are likely to have been at the most nutritionally vulnerable and acute point in their illness, and the ER may have been these patients' only point of contact with the medical system. The severity of their illness may have rendered a visit to the ER difficult or even insurmountable. Early on in their service, when their illnesses are still acute, but their strength begins to increase, they may be more likely to access the ER, as they still view the ER as a primary point for receiving care. Once clients start receiving MANNA services, they are required to be under the care of a physician. The increase in ER visits could actually be seen as a part of the process of acclimating to receiving regular care through more routinized medical visits. Additionally, because of the higher proportion of home discharges, the

ER would be a natural destination if clients became suddenly ill, whereas a long-term care or other facility would be equipped to handle this sort of situation.

4.1 Limitations

While we are confident in the trends suggested by our findings, there were some limitations with our study design that need to be considered. These are:

1. The MANNA client sample size;
2. Identifying an appropriate comparison group;
3. Lack of knowledge about the comparison sample; and,
4. The timeline of outcomes examined.

Small sample size

We initially envisioned including in the study at least 300 of the over 600 people who received MANNA services during our defined service dates of August 2008 to April 2010. However, identifying clients who had health coverage with the participating MCO (continuous or otherwise) proved to be challenging. While our sample is large enough to be statistically robust in our between-group analyses, it becomes very small in our within-group analyses, with fewer than 10 people represented for some months. Reporting monthly means somewhat circumvents this problem, but the addition of just a few very sick or very healthy people could skew the results. The within-group findings, therefore, should be interpreted with caution.

Challenges in identifying a comparison group

In the absence of a randomized controlled trial, which is considered to be the gold standard for understanding the impact of an intervention, propensity score matching is often used to create a comparison group that is similar to the client group but is not receiving the intervention. In this study, we created a model that balanced on client age, race/ethnicity, gender, and chronic and nutritional illness. However, since the MANNA client population was unusually sick, we had to start with a very large population to find a group of people who were similarly ill, and in doing so, we identified people who, in some cases, had a higher prevalence of chronic illness. Initially, we did not have nutritional illnesses in our propensity score model. Adding nutritional illnesses as a criteria caused a lack of balance in chronic illness diagnosis prevalence, wherein those with nutritional illnesses may have been weighted more heavily and could have also had multiple chronic illnesses. It is possible that our results may have been biased in favor of higher costs and utilization among some in the comparison group, although because the differences existed only among those who had more than four Charlson Indexed chronic illnesses, the relative percentages were small, and there were no differences in the proportion of those with nutritional illness, we believe the bias is minimal.

Additional factors are unknown about the comparison sample

Our comparison sample was matched to the MANNA client sample on the basis of health insurance status, demographic characteristics, chronic illness, and nutrition-related diagnoses. While we determined that comparison group members had not received MANNA services (by cross-referencing the entire client database with the MCO's database), we had no knowledge of whether or not they were receiving any other types of additional nutrition services. This limitation may have attenuated the differences in costs and utilization between groups. In other

words, if people in the comparison sample were receiving additional nutritional services, our study may have understated the true difference between groups; in this case MANNA may be more effective than this study could actually document. This type of bias warrants attention in future studies of this type.

Timeline of study

In this study, we examined within-group changes in health care costs over a 13-month period of time: six months prior, one month to come onto the program, and six months following initiation of MANNA services. We also examined between group differences in costs and utilization, using a 12-month period post-MANNA service to make this assessment. Longer timelines could provide additional information about the efficacy of a nutritional program such as MANNA, and suggest trends about long-term costs and utilization of the program.

5. Conclusion

This study represents a comparative analysis of the impact of a meal delivery service and counseling program on health care costs and utilization of health care services. While there is ample research and evaluation of meal delivery service programs, there are few existing evaluations of comprehensive programs providing 21 meals per week and that also have an ongoing counseling component and additional wrap-around services. The findings of this study are consistent with prior research showing that nutrition is an integral part of disease management and often enables the chronically ill to maintain a healthy body weight, withstand side effects of medications, improve the functions of the immune system, and enhance overall quality of life (1, 3). Beyond their financial implications, these results suggest an improvement in health outcomes and quality of life for recipients of MANNA services and underscore the need for adequate nutrition in managing health and the importance of programs designed to address this need, particularly for chronically ill populations.

While the associations indicated by our results are tentative (due to methodological limitations discussed), they suggest that MANNA's meal delivery services may have positive impacts for the clients served. The results present a strong claim for further research around the MANNA meal and service model in order to decrease the health care cost burden and disease management in a community setting.

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Appendix A: Complete List of Possible Nutrition-Related Diagnoses (Provided by MANNA)

Adult Failure To Thrive
Abnormal loss of weight
Abnormal weight gain
Adult Failure To Thrive
Anemia, unspecified
Anorexia
BMI <19 Adult
Cancer
Constipation
Diabetes
Diarrhea
Dysphagial
Eating disorder, unspecified
Failure To Thrive
Food allergy
Gastritis
Gastroenteritis
Heart Disease
HIV/AIDS
Hospice
History of nutritional deficiency
Hyperlipidemia
Inappropriate diet/eating habits
Insufficient weight gain during pregnancy
Lactose intolerance
Malnutrition (1st and 2nd degree)
Nutritional marasmus
Obesity
Other protein calories malnutrition
Postgastectomy syndrome
Renal Disease
Underweight
Unspecified nutritional deficiency
Unspecified protein calorie malnutrition
Vitamin deficiency

Appendix B: Interview Protocol for Sub-Group of MANNA Clients

1. When did you begin to use MANNA meal services?
2. Why were you referred (or interested) in MANNA meal services?
3. How was your health when you first started receiving MANNA services?
4. Before you started receiving MANNA, from where and how did you get most of your meals?
5. What did you have to do in order to start getting MANNA services? For ex, did you complete an application, or speak to someone at MANNA?
6. Are you currently receiving MANNA services?

If not,

- a. When did you stop receiving services?
 - b. Why did you stop (be sure to establish whether they became ineligible vs decided to stop)?
7. How did/do you like MANNA's services?
 8. Did/does receiving MANNA services help you?

If yes, What are/were some of the things it helped you with?

If no, why was it not helpful?

9. What is your overall opinion of MANNA food services?
10. Besides food services, MANNA also provides nutrition counseling (at the MANNA office and over the phone) as well as educational activities like cooking classes. Have you participated in any of these types of activities?
11. How do you think MANNA can improve its services?
12. Do you have any questions you would like to ask us?